The Concrete of NOW

_Jen Seevinck_

Introduction

In this chapter I discuss my approach to making the interactive art system _+-now_ and the insights that it generated. These are insights into the structure of interaction as well as means to effect these. The approach I use is a practice-based research approach. It is a densely interwoven fabric of practice, theory and evaluation that involves reframing the concepts behind the art work, conducting evaluation studies, engaging with theories of emergence and aesthetics and reflecting on the landscape that inspired the work. One reframed concept is that of open-ended design. As will be described, this was a design objective for _+-now_. During the process of making _+-now_ I related open-ended interaction to emergent interaction. Open interactions tend to be non-repeatable, unfixed and unbounded while in an emergent interaction something qualitatively new and surprising occurs. Both are unpredictable and creative. My practice has involved exploring these characteristics and the effect they have on interaction experience. As an artist, I found that an unpredictable interaction experience can be very worthwhile. It offers both opportunities and challenges. This is new and possibly even controversial territory for interaction designers. I discuss it and other design issues for emergent and openly structured interactions later in the chapter.

Another outcome from my practice and another facet of _+-now_ is its empathy with the Constructivist art movement. Briefly, my Constructivist approach employs a transparent, visual and formal structure to treat the plastic elements of the work concretely. This includes using colour for its own concrete properties rather than as a referent to something.

My work and this chapter relate the concept of open-ended experience to the theme of the active audience. This is described in the next section where the role of the audience in Brechtian theatre is related to openness in art; making it directly applicable to the conceptual aspects of my practice. Later in the chapter I show how my practitioner reflections on _+-now_ have informed a discussion about the nature of open interaction. This has enabled me to explore another focus area of this book, namely the structure of interaction.

The chapter begins with the context these themes provide to the discussion. I then describe my art system _+-now_. This is followed by a discussion of the practice-based research
methodology adopted and my process of iteratively reflecting-in-action. Outcomes from this process are then also discussed.

**The active audience, the structure of interaction and ++-now**

An early example of the active audience is the politically motivated reconfiguration of the audience from spectator to producer in the 1930s (Benjamin, 1931-34). Bertolt Brecht’s plays exemplify this. They aimed to dispel narrative tension to encourage critical audience engagement with the subject matter rather than passive spectatorship. The Happenings of the Situationists also advocated an active audience for the political purpose of redefining passive ‘watching’ to instead prioritise ‘active living’ (Debord, 1957). The audience is a defining characteristic of all these works. Whether critically interpreting or performing it, the role of the audience is integral because the work is not fully realised or complete until an audience acts to complete it. This reliance on the audience also characterises the work as ‘open’ (Eco, 1962). The open system is open to multiple interpretations and ambiguous. For example, the Brechtian or Situationist audience can respond in different ways and their interpretation or performance is not fixed or limited. Furthermore the open work is unfinished until it is interpreted by the participant or collaborator, thereby concluding or ‘closing’ it. In summary, an open system is ambiguous with multiple interpretations, unfinished, supporting creative action and inexhaustible (Eco, 1962, Juul, 2002, Sengers et al., 2006, Seevinck et al., 2009). The conceptual agenda behind ++-now is consistent with this position. That is, its aesthetic and philosophy aim to facilitate an active audience and a creative, interpretive experience. As will be shown, emergence is open-ended and by facilitating emergence, ++-now is also open-ended. Its creation is accompanied by research into emergence. This combined practical and research effort frames a view of interaction design as open-ended. This relates my work to the active audience theme because, as has been explained, an active audience is supported by an open system, a design objective for ++-now. My work also relates to another book theme: structuring interaction. This is because open and emergent interactions create unique interaction design opportunities and implications. These aspects of open and emergent interactions are discussed later in the chapter by using ++-now as an example.

**Description of ++-now**

++-now is an interactive art system installed in Beta_Space at the Sydney Powerhouse Museum in 2008. It uses sand as an interface to interact with two images. One image is monochromatic and projected on a wall screen while the other is colourful and projected
directly onto fine, white sand. Gestures in the sand result in imagery projected on the sand and the rear-projected screen (Figure 1). The wall imagery behaves like visual echoes by mimicking the shape, direction and speed of a mark in the sand with repeated renderings. In the installation statement I described it as “layering and moving across time”. Visual echoes of gestures on the large screen add up in opacity to create areas of increased brightness and this enables the participant to interpret new shapes. At the same time the image persists and they can interact with a history of their gestures. The work addresses these aspects while encouraging the participant to be present in the moment, in the now.

Figure 1 + --now installation at Beta_Space 2008

**Methodology**

The practice-based research process that I use integrates the creative, practical aspect of building interactive art systems with the research aspect of conducting its evaluation. It also
includes theoretical components such as classifying emergence and investigating aesthetics and interaction design. Thus it incorporates practice, evaluation and theory. An analysis of my research process is given in Edmonds and Candy (2010) and described as starting with practice while being very much driven by theory.

The creation of +-now utilises reflection-in-action, iterative design and evaluation methods. The reflection-in-action methodology can be broadly understood as describing methods whereby the knowledge embodied in professional practice is exercised and developed (Schön, 2003, see also Muller in this book). Reflection-in-action methods include framing and reframing problems, exercising knowledge during practice and reflecting on the results of any practical decisions made. This latter method is also known as listening to ‘situation talk-back’ (Schön, 2003).

The design method used here is similar to iterative prototyping for software design. It draws on Barry Boehm’s software design spiral (1986) to repeatedly assess the design objective, alternatives and constraints by iteratively developing and evaluating prototypes. Edmonds’ Absolute_4.5 and Absolute_5 exemplify the use of iterative methods to create art systems (Edmonds, 2006). He shows a high quality ‘draft’ version of his art system and evaluates it before final completion. Earlier works and evaluation studies have also informed +-now. Glass Pond is an earlier art work sharing the same conceptual origin as +-now and was evaluated in an exploratory study (Seevinck et al., 2006). An informal evaluation of +-now was also conducted in 2007 (Seevinck et al., 2008). The influence of these studies on the creation of +-now is discussed in the following section.

Evaluation is inherent to the design method. It also relates to the reflection-in-action methodology because it generates situation talk-back. The evaluation methods used in this practice-based research approach draw on ethnography. The empirical data collection methods used include field studies, observation and soliciting opinions. Data analysis is framed by the Grounded Theory methodology. Grounded Theory methods were proposed by sociologists Glaser and Strauss in their book The Discovery of Grounded Theory Strategies for Qualitative Research (1967). They advocate a ‘bottom up’ approach to research where theories are distilled from the data as opposed to the data being tested against an hypothesis. It involves framing a view of the data in accordance with the research area under investigation while minimising preconceptions about outcomes.

The integration of these methods of practice and evaluation is through a process of iteratively reflecting-in-action. This is shown in Figure 2. Here the reflection-in-action methods of problem framing, knowing-in-action and listening to situation talk-back are related to each other and to the iterative design methods. Evaluation is also shown as it relates to reframing the situation and providing situation talk-back.
Personal process

The creation of ++now was through a process of iteratively reflecting-in-action (Figure 2) and its methods are now discussed. I will then review the concept behind the work and the evaluation studies. Key theoretical investigations that guided the creative design are described at the end.

It should be noted at this point that because I draw on a Constructivist aesthetic, the discussion of how ++now was created necessitates describing what it is, in order for that discussion to be meaningful. The Constructivist art movement entails integrating the form of the work with its methods of construction and is detailed in the forthcoming theoretical discussion. This integration means a discussion of the creative process needs to reference the form of the work and consequently a discussion of process entails a description of the work.

Iterative reflection-in-action

Iterative reflection-in-action has been used as follows. Firstly the creative problem is framed (see quadrant 1, Figure 2). This is the concept behind the work. This initial problem is then investigated through the practical construction of an artefact or prototype (quadrants 2 and 3). Artefact construction draws on my prior experience and creative repertoire. That is, it employs the tacit knowledge and skill of a practitioner. The artefacts are subsequently evaluated and reflected upon (quadrant 3). Reflecting on the evaluation outcomes is listening to situation talk-back (also quadrant 3). It results in a new
understanding of the situation which informs the planning of the next iteration of the spiral (quadrant 4). This leads to refining the objective for the next iteration, that is returning to quadrant 1 and repeating the cycle. I continue to iterate this process until I am satisfied with the artefact.

My process of iterative reflection-in-action involved two aspects: the development of the concept and evaluation studies which are now discussed.

**Concept**

+-now originates from my personal response to a landscape. This, in turn, informed the initial concept of the work. For me, the concept gives meaning to the artwork. It is the ‘backbone’ that ties all the elements together, it embodies the aesthetic intent of the work and it guides creative decisions. The concept therefore includes the design problem while concept development includes problem reframing.

I developed the concept along three trajectories. All three trajectories led to open-ended design (Figure 3). The development of the concept draws on earlier work (Seevinck, 2010) and began with landscape studies at an artist residency at I-Park in the USA in 2003. During an initial site analysis I studied the landscape. This interpretation guided the creation of the interactive art system Glass Pond (2005). Glass Pond was subsequently evaluated in an exploratory study. This study’s outcomes and my practitioner reflections resulted in developing the concept further and this evolved concept subsequently informed the creation of +-now.

The initial site analysis involved studying the land and water features. I found these to encourage a dreamy, reflective experience. This interpretation was reframed several times. Two significant evolved concepts are the experience of being ‘lost’ and the perception of illusions. They are now described.

**Lost experience to Open-ended experience**

The concept of a reflective and dreamy experience was developed further to evoke a sense of being ‘lost’. This was achieved through philosophical thinking about what the lost experience means to me. The resulting characterisation differentiated this experience as a way of ‘being in the world’ that is similar to ‘being in love’ and different to the type of being such as ‘being in a vessel’ like a room or a car (Heidegger, 1978). This interpretation aimed to facilitate a participant ‘losing’ themselves in their interaction i.e. being highly involved in what they are doing.

The creation of an interaction where one can ‘lose’ oneself in one’s surroundings was guided by site studies. I had observed the landscape to possess an infinite abundance of visual forms, textures and experiential depth. I then reasoned that this infinite ‘richness’ is a characteristic of all natural landscapes: nature is continually changing, unpredictable and it
supports multiple interpretations. For example a lake can be dark, light, wet, dry, frozen or a mirror depending on the weather. It can also be a place for swimming, skating, quiet reflection, water storage or wildlife. In short, the natural world is ‘open’. Further reflection led me to consider that a rich (open) environment can support exploration to the point of losing yourself in what you are doing.

This consideration of the lost experience led me towards open interaction design, as shown in Figure 3 below.

Two other concepts also evolved towards open interaction. These are the concept of perceptual ambiguity and investigations of sand as an interface material. They are now discussed.

**Figure 3 Concepts that led me towards designing for an open-ended experience**

Perceptual Ambiguity to emergence to open-ended experience

Another interpretation of the reflective and dreamy experience revolved around perception. During my reflective and dreamy experiences at the site I noticed that my vision could ‘soften’ or become blurry. This shifting or oscillating of my focus enabled me to perceive new and unexpected things. This was particularly noticeable at the water’s edge where the imagery of reflections and shadows on the water surface could combine seamlessly with objects such as floating leaves and silt on the base of the pond (Figure 4). I reasoned that when the eye oscillates between reflections on the water’s surface and views under the water, these views can combine to create the illusion that they are one single, real object. This concept of ‘perceptual ambiguity’ resulted from concept reframing and involved the creation of artefacts (Seevinck, 2010).
The newly reframed concept of perceptual ambiguities was itself reframed into an investigation of emergence. Emergence became of primary importance to the creation of +-now and other practice-based research and this is discussed later in this chapter. The reframing process that led to emergence was facilitated by further landscape studies and evaluations. These additional landscape studies revealed visual illusions of figures and shapes. I observed such an illusion in the coastal swamps of Virginia Beach, USA. This is the habitat of the Bald Cypress tree which uses an aerial root system to collect oxygen during high tide. These aerial roots (‘knees’) protrude through the surface of the water and can combine with their reflections to create illusory objects or emergent shapes. One example of this is a ‘diamond’ shape. This shape is the product of a shadowed aerial root (triangle shape) and its reflection on the bright, still water (another dark triangle). These two shapes merged into one diamond-shaped illusory object (see the Cypress knee photographs on the book’s website). Perceiving this diamond shape is similar to the process of perceiving a triangle shape in a drawing of two overlapping squares (Figure 5). Furthermore, both are instances of emergent shapes.

**Figure 5 Overlapping two squares affords the perception of an emergent triangle shape.**

Emergence can be loosely defined as occurring when a new form or concept appears that was not directly implied by the context from which it arose. The art system +-now facilitates the emergence of new shapes. As has been described, gestures in the sand generate echoing shapes. The persistence of the imagery means that the images of several gestures can overlap. Since the imagery is transparent, overlapping areas accumulate opacity and have greater brightness. Like the diamond-shaped areas of the cypress and the triangle shape in
Figure 5, these brighter areas can also be interpreted as emergent shapes. This is shown in Figure 6. This excerpt from +now shows a series of gestures in the sand and the corresponding monochrome images. It illustrates how emergent square shapes can be interpreted from two overlapping rectangles.

Figure 6 Emergent square shapes (frame 5) result from overlapping gestures in the sand (frames 1 and 3)

**Sand to open-ended experience**

Early landscape studies included the collection of sand from the site. Sand was thought to evoke a sense of that place and the experience of it. Through its use as an interface to the work other properties became apparent. For example, associations with the beach afford playfulness and its familiarity to people means that it is accessible and predictable. These qualities of sand confirmed later theoretical research into the affordances of materials. The
affordances of materials are a perceptual activity originally put forward by Gibson (1979). In +--now the affordances of sand make it an intuitive interface.

Sand play is used in psychotherapy and its origin there is accredited to a story by H.G. Wells (1911). While Wells’ story does not mention sand it does describe a quality that sand possesses – openness. Floor Games was written for his sons and about their games. It describes their collective disdain for certain toys “...we despise those foolish, expensive, made-up wooden and pasteboard castles that are sold in shops – playing with them is like playing with somebody else’s dead game in a state of rigor mortis.” Simple blocks of timber are preferred given they afford “...an infinitude of imaginative games.” Like the simple blocks in Wells' games, sand is a versatile material that can be used in many ways.

In +--now, sand records traces of events past, like footprints on the beach. This aspect of the interface has been tightly integrated with the imagery which also ‘persists’, or retains a memory of events past. Sand supports a highly involved interaction through its playful, intuitive and imaginative qualities and in the way a participant leaves traces of their interaction – themselves – behind.

**Evaluation studies reframe the concept, directing me towards emergence**

An exploratory study of participant interaction with +--now found that the participant perceived dynamic emergent shapes such as a pulsing, beating heart (see the heartbeat figure from +--now on this book’s accompanying website). This study was conducted in 2008 with one participant. Her interaction with the work was observed and she was then interviewed about her thoughts and experience (Seevinck et al., 2008). Her interpretation of the emergent shapes as figures or compositions signalled the potential for further investigation into the concept of emergent interaction.

An earlier exploratory study of the preceding art system Glass Pond also directed concept reframing towards emergence. This first study was conducted in 2005. Seven participants were observed to interact with Glass Pond and interviewed about their experience (Seevinck et al., 2006). The insight into participant behaviour and experience that was gained in this study includes the formation of new intentions or goals during interaction; the creation of compositions with the system; and the ability to predict only a part of the system’s behaviour. This unpredictable system behaviour frustrated some participants. My reflection on these outcomes – the formation of goals, creativity and unpredictability – revealed that they all relate to emergence. Theoretical investigation into emergence was subsequently conducted.
Theory and Practice

As described earlier and in Edmonds and Candy (2010) the creation of ++now relied on theoretical investigations as well as on the iterative application of reflection-in-action. I will now describe three key theoretical investigations that accompanied this practice. They are emergence, aesthetics and unpredictability.

Emergence

The concept of emergence is a design problem that came out of the iterative reflection-in-action process; that is, it is a reframed understanding of the landscape. I conducted research into emergence to find a common understanding bridging the various disciplines. That is, I followed the design research discipline to understand emergence as something that occurs when a new form or concept appears that was not directly implied by the context from which it arose (e.g. Gero, 1996). I have also followed Gestalt theorists and computer scientists to understand the emergent whole as something that is greater than the sum of its parts (e.g. Wertheimer, 1938, Holland, 1998). I then tried to resolve these different approaches to emergence by creating a taxonomy of emergence. Finally I contextualised the taxonomy within aesthetics by drawing on Constructivist art theory. This taxonomy is shown in Figure 7.

The first level of the taxonomy distinguishes between emergence that relies on an observer to exist or which can exist independently of an observer. This distinction mirrors a primary divisor in emergence literature from various domains (see also Cariani, 1990, Seevinck et al., 2008). Thus the emergent ‘whole’ which relies on an observer to exist is Perceptual emergence; while the emergent ‘whole’ which may exist independently of an observer is Physical emergence. The next level of classification differentiates the different types of emergence in terms of feedback. This separates instances where the emergent whole ‘feeds back’ into the parts and alters them; from instances where there is no feed back from the whole to the parts. Where there is feedback, the emergent quality is intrinsic to the structure and where there is no feedback it is extrinsic to it (Crutchfield, 1994). Finally, the taxonomy differentiates between types of emergence that can relate to art in one of two ways. This is a differentiation based on referencing. Thus emergence that references something else in the world such as through modelling or interpreting something familiar is called Referenced emergence. Conversely emergence that does not reference anything and is completely original and instantiates something completely novel and concrete is called Concrete emergence. This last level of the taxonomy draws on aesthetic research and practice. The emergent composition of a heartbeat that was previously described is an example of Referenced Intrinsic Perceptual emergence (4D in Figure 7). It is a Perceived object which relies on the participant to interpret it in order to exist as the ‘heart beat’ composition. The heartbeat interpretation also sustains the composition itself because the
participant creates gestures in the sand to ‘keep the heart beating’. Each of these gestures is a pulse, sharing the meaning of the whole heartbeat. The emergent whole therefore informs the parts, feeding back into them. As such it is Intrinsic to the whole. Finally, the interpretation References a heart.

Figure 7 Taxonomy of emergence in interactive art

Aesthetics
Theoretical investigation into aesthetics ran parallel with practice and informed the creation of ++now. For example, a Constructivist aesthetic helped to resolve the evaluation study outcome of unpredictability. It also informed other aspects of the work such as the construction of the pedestal and the use of colour. As will be described, the Constructivist aesthetic is also consistent with open interaction design.

Constructivism is an art form that came about with the abstract geometric constructions of Vladimir Tatlin in 1913. Known as Russian Constructivism, it prioritised the use of modern materials and transparency in the construction of a work as honouring progress and transparency within social structures. The celebration of the construction of the work became significant to a number of other artists including Naom Gabo and Bertolt Brecht. As mentioned earlier and in the editorial, Brecht and Benjamin advocated social transparency by dispelling narrative tension and emotional engagement to instead promote a critical audience engagement with the subject matter. Constructivist Gabo literally interpreted the call for transparency in his use of modern materials with transparency of structure in reliefs. However unlike Brecht he but did not believe that art needed to have an overt social purpose (Chilvers, 2004). He considered the elements of construction such as line, colour, and shape as valuable in their own right and that there was no need to imitate nature or reference anything else for the work to have value (Gabo, 1937). This emphasis on the concrete, plastic elements of the art work became the essence of the Concrete art movement. As summarised by Theo van Doesburg “a pictorial element has no other
meaning than what it represents, consequently the painting possesses no other meaning than what it is by itself” (van Doesburg in Baljeu, 1974).

The concrete and Constructivist aesthetic resonates with +now. This interactive art system treats the plastic elements of interactive art and the process of its construction as concrete elements without referent and transparently combined. For example the timber pedestal that holds the sand clearly shows the construction methods used. Similarly the construction of emergent shapes is transparent and self-evident: the layering of the areas of light opacity dynamically illustrates the construction of brighter, new shapes. Transparency in the construction of emergent shapes provides understanding of the emergent shapes to the participant. Significantly, this transparency and understanding address the frustration that participants felt when confronted with unpredictable system behaviour. That is, by understanding how the emergent shapes are constructed the need for control and predictability is alleviated ( - more on this later!)

The use of colour in the augmented sand is also informed by Constructivist principles. During landscape studies at the site the sparkling reflection of sun light on the surface of the water was found both beautiful and relevant to the work (see (b) and (c) of the colour figure on the accompanying website). Rendering this ‘sparkling’ behaviour became an objective. The imagery therefore concentrated on high value and saturated primaries, and in particular red and green. This selection of colours is based on my experience with projected digital colour, where I have found that blue will be the least bright whereas green will come forward and appear to persist. Green and red also support bright, vibrant areas like those of the sparkling light on the water currents because, as complementary colours, they appear vibrant to the human eye when adjacent to one another. As additive primaries of the emissive colour wheel ((a) in the Colour figure, online), they add together to make white. Since the imagery renders ‘visual echoes’ of gestures one on top of the other, layers of colour ensue. Thus the layering of bright red and bright green results in them being added together and creating bright areas. A noise algorithm is also used to dynamically disturb and roughen the image’s behaviour.

Colour is used in this work in a Constructivist manner. That is, colours were chosen based on how they behave and on their intrinsic nature. Specifically, their selection depended on how well they could support the sparkling behaviour of light rather than on what they might refer to or symbolise.

This chapter has described a practice-based research approach that integrates the process of construction with the art system itself. This Constructivist art system is inspired by a landscape and as such, the response to this landscape is the concept behind the work which, in turn, is the design problem. The reframing of this problem has therefore been synonymous with the evolution of the works’ concept and form. This creative process
involved iterative reflection-in-action, evaluation and theoretical research. It has been accompanied by reflections on the structure of interaction. The reflections have afforded insight into interaction, open design, emergence, Constructivism and creativity. This insight is now aggregated into a model of interaction that revolves around openness.

**Structuring interaction**

The practice-based research process surrounding the creation of +now has led me to view interaction as something that can be emergent and open. Thus, in addition to the iterations of concept and form that was involved in creating +now, my understanding of interaction design has also been reframed. This reframed view is now described. The discussion structures interaction in terms of the qualities of emergent and open-ended systems. The implications and significance of designing for these qualities and for open systems are also described.

**Open interactions**

As has been discussed, open interactions are creative, unpredictable, ambiguous, without a clear goal and unlimited. By contrast, ‘closed’ interactions are repeatable, finite, predetermined and sustaining clear intentions. The navigation of an intranet website or virtual world; or the progression through a series of challenges or levels in level games are typically closed interactions; differing from the more open interaction where one is able to express oneself such as starting a SIMS family (Wright, 1999) or composing with +now (Seevinck et al., 2009). The ambiguity and room for expression that is integral to an open art work means that it is possible for the audience to assume a more active role than in a closed work. The active audience has been discussed earlier in this chapter and by Candy in this book.

While creating +now I reflected that it was possible to organise many qualities of interaction along a continuum. This is shown in Figure 8. Here a range of interaction design qualities (such as unpredictability, creativity, repeatability) are organised according to their degree of openness.
Design issues for emergent and open interactions

The creation of emergent systems has its own set of opportunities and challenges. Ensuring that the desired participant experience is achieved necessitates the use of evaluation. The creation of +-now has been influenced by evaluation study outcomes. These evaluation studies have been described earlier and in Seevinck and Edmonds (2009). Their outcomes include participant behaviour that is creative as well as frustration with unpredictable system behaviour. Creativity and unpredictability are characteristic of open or emergent interactions. They apply to the design of any open or emergent interaction, as is discussed in the next section.

Creativity

Creative behaviour characterises both open and emergent systems. Firstly, the open work necessitates creative behaviour in order to close or complete it. This creative behaviour could be via conversational interaction between system and participant as in interaction with +-now; or improvisations as in the performance of Stockhausen’s score, Klavierstück.

Secondly, because emergence entails the occurrence of something new, it is therefore creative. The exploratory study of +-now found the participant created a ‘heartbeat’ composition in collaboration with the system. This was a new form that was neither anticipated by the artist nor planned by the participant but rather came out during interaction with it. It is an example of the creativity that emergent interaction facilitates.

The predictability balance

Unpredictability can be problematic for design. For example, many participants found the Glass Pond system unsatisfying in its unpredictability (Seevinck et al., 2006). Unpredictability is also an ingredient of open and emergent interactions. Furthermore, creativity implies unpredictability. This issue was reconciled through an iterative process of constructing and evaluating the work. The final design solution was to enable participant

<table>
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<th>OPEN</th>
<th>CLOSED</th>
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<td>More active and responsible 'participant'</td>
<td>More passive 'viewer'</td>
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<td>Unpredictable, without a goal and where the participant can express themselves such as by creating something. Open interactions possess a large field of possibilities for interaction</td>
<td>Repeatable and finite. E.g. games constituting a branching narrative structure and which can be completed</td>
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understanding of the emergent process which, in turn, enabled them to predict its behaviour in the short-term. In +now short term predictability was accompanied by long-term unpredictability. The solution mirrors the chaotic quality of the weather. The weather is a complex system that has short term predictability but long term unpredictability. For example, I can look out of the window and see a storm on the horizon and predict that it will rain in the next couple of hours. However, next month’s weather remains unpredictable. Enabling short-term predictability means that the interactive system is understandable to the participant while retaining long-term unpredictability means that the system remains open and emergent enough to surprise the participant and for something new to occur. In +now the predictability balance has been achieved in two ways. Firstly, by drawing on an emergent complex systems understanding of the weather, I was able to reframe my understanding of predictability. Secondly, I was able to implement short-term predictability because my work resonated with the Constructivist aesthetic. For instance, my work is consistent with Constructivism because its structure is transparent. That is, the new or emergent compositions and shapes are clearly shown to result from overlapping shapes. Thus transparency of construction conveys understanding of the origin of the emergence to the participant and this, in turn, leads to a sense of short-term predictability.

This section has shown that emergence is open and that both emergent and open systems are characteristically creative and unpredictable. The application of emergence theory to resolve design issues relating to unpredictability has also been described. The body of emergence research is large and ranges across disciplines such as design research, complexity theory and biology. A variety of mechanisms for the creation of emergent or open-ended interaction are therefore available. For example shape grammars or the simulation of evolution to create new forms.

Creating emergent or open-ended interactions is potentially very valuable. As I discussed earlier, the natural and real world is open and this implies that our interactions in this world are also open. Since these interactions make up most of our existence and lives they are significant. Understanding and modelling open interactions is therefore a valuable endeavour. For instance, the prevalence of open interactions might mean it feels very natural and familiar, thus the creation of such open interactions could similarly afford natural and familiar experiences for participants.

**Conclusion**

The chapter has traced the creative evolution of the interactive art system +now from poetic site analysis and conceptual development, through the use of evaluation studies and theory. The result is the tangible, intuitive and open-ended art system +now. This work facilitates the experience of emergence. Its aesthetic ‘whole’ lets a participant leave traces of
themselves behind in material and image; and these traces of past actions accumulate to create new images, encouraging the participant to dream and reflect in the ‘now’. The formal aesthetic of +-now is consistent with a Constructivist tradition in art because the concrete elements and method of construction are a meaningful part of the work. The way in which the emergent shapes are created is transparently rendered. This enables participant understanding and short-term predictability of any emergence, while retaining the capacity for surprise and collaborative creative interaction. The creation of +-now was accompanied by reflections on the characteristics of open and emergent interactions, namely creativity and unpredictability. These qualities also characterise nature and the real world. As I have shown they are also both open. Given the prevalence of open interaction in our everyday lives, I believe it is critical to an enquiry into the structure of interaction. I have found open and emergent interaction to be very relevant to my own creative practice and I believe it is highly relevant to others working in interaction practice and research. I expect my own practice-based research will continue to centre on understanding and creating open and emergent interactions.