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# Differentiating Interaction

**Jennifer Seevinck**

I am an artist and researcher working with the concept of emergence to create digital, interactive art systems. My interest in the electronic arts began in the 1990's when I was working with procedural computer graphics and architectural metaphors for creating virtual space. From 2000 I was building virtual reality (VR) environments for immersive and augmented reality systems for a range of applications, but in 2007 I began practice-based PhD studies in order to focus on interactive art. This led to my interest in emergence and participant experiences during interactive art. It has continued to inform my work including the artworks discussed here, a recent monograph on *Emergence and Interactive Art* (Seevinck, 2017), and my approach to teaching. In summary, my creative practice is largely driven by (1) emergence theory, (2) the conceptual framework or initial problem of a creative work, and (3) the research I do into people's experience of interactive art. This approach has meant that I'm also exploring interaction in concrete, formal ways. In the first section of this chapter I discuss these three aspects alongside creative work. In the latter half of this chapter I discuss some of the expressive potential of interaction.

## Emergence

Emergence occurs when something new that is not immediately obvious or expected comes about. This is a new 'whole' that is more than a simple sum of parts. It is a Gestalt that is heterogeneously different to its constituting parts. And, by virtue of this heterogeneous novelty, it is also creative. It may also, at first or to our best understanding, be unexplainable. A comprehensive discussion of emergence and how it relates to interactive art has recently been published (Seevinck, 2017). As is elaborated there, emergence can be understood as either *physical* or *perceptual*.

Physical emergence occurs in the natural, physical world. For example, a flock of geese is more than simply a collection of birds. Rather, this flock constitutes the specific interaction of the individuals to travel in each other's slip stream, resulting in reduced wind resistance for individuals and an ability for the flock to travel further together, than individuals would alone. The 'interaction between the parts' or individual birds, means that the flock is more than a simple sum of the birds and rather an emergent whole.

Perceptual emergence is the emergence of new shapes, behaviours and experiences in people. It draws on design research efforts in emergent shapes; new forms that 'emerge' perceptually when viewing drawings of multiple shapes that interact with each other (such as through overlapping or adjacency) to suggest new

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understandings. By drawing overlapping squares, one can, for example, perceive an emergent triangle shape. Similarly, one's ability to perceive the characteristic 'V' shape in a flock of snow geese is an example of perceptual emergence. Observation or more specifically, perception, characterises this type of emergence. It occurs within an observer, audience or participant and is, unlike physical emergence, reliant on an observer to exist. It is the experience of something qualitatively new, surprising and different to what was there before. It also involves some sort of creative interpretation or understanding in that observer, audience member or interaction participant.

### Concept

In my work a concept drives the creative outcome, and the concept comes from an initial situation. The situation can be social such as a conversation or it can be a physical site such as a landscape. The situation functions as an early 'problem space' that, through the iterative processes of sketching, making and reflecting, informs a framework for the creative decision making. These processes work hand-in-hand with emergence theory.

For example, in 2012 a project with artists with Cerebral Palsy involved conversations that led me to questions around creative agency and creative experience. This drove my interactive art work, *Of me With me* (2015), where participant interaction is through a drawing gesture that generates echoing and divergent line drawings. These dynamic compositions facilitate a creative experience that is new, unpredictable and familiar to the participant because it stems from their initial drawing line. The system utilises a generative algorithm, coinciding with my work in *physical emergence* theory. The visuals that are created also enable the participant to experience creative, *perceptually emergent* compositions.

In later works *Light Currents* (2015) and *Dichroic Wade* (2016, Figure 1) the concept stems from a place. Specifically, the physical landscape of the Brisbane river and light on the water informed early aesthetic investigations. The work involves bright colours and highlights from illuminated, dichroic glass pieces that move in response to people inside, as well as changes in the wind conditions outside, via real-time data feeds from online weather reporting agencies. The data feeds and concept around wind on the river relate the work to the site beyond the white gallery cube. It also gives form to the *hybrid*, real-networked place that we inhabit; one which crosses both spaces and where we increasingly exist across both, as a matter of course and, arguably, new ways of being in the world. Explicitly facilitating interaction in this hybrid type of space is discussed more later in the chapter. More discussion of the art systems can be found in Seevinck (2017).

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**Figure 1** Dichroic Wade Seevinck 2016. Photo A. Hearsey. Image courtesy the artist.

### **Research and Making**

My approach to creating artwork draws on both research and practice to inform one another. The practice sets the research agenda and the understandings gleaned through research inform the practice. It is a type of Practice-Based Research approach (e.g. see Edmonds and Candy, 2010) and for me, the creation of the interactive artworks involves methods from Reflective Practice (Schön, 1983), iterative design and interaction technologies. Evaluation of participant experience of the interaction also informs the ongoing thinking and making. Evaluations are conducted at various stages and include observing participant interactions with the art systems and conducting interviews. As well as influencing my practice and research, evaluation findings can contribute to more general understanding of people's experience of interactive art (e.g. see Seevinck 2017).

### **Towards a Differentiated Understanding of Interaction**

Digital technologies have undergone rapid and significant changes. We have seen a shift from digital revolution in the 1990's through to the social media era (Paul, 2015). Computation itself has shifted from the procedural execution of steps as in the processing of an algorithm to an emphasis on interaction (Dourish, 2001). The domain of Human-Computer Interaction (HCI) has similarly changed, moving from an understanding of the user that focused on human factors through to understanding them as actors, and to considering broader contexts for computing beyond the workplace and participation (e.g. see Bannon, 1992; Bødker, 2006).

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Digital art has also grown, changed and diversified. We see themes from artificial life to telepresence in the work and a variety of ways in which artists relate to technology or experience (e.g. Shanken, 2008; Lieser, 2010; Candy and Edmonds, 2011; Paul, 2015). With the increased capacity and influence of technology, we are expanding our understanding of the aesthetics around computing and digital technology. I also think that we have an increased capacity and opportunity to pursue a more nuanced understanding of interaction. This interest in the subtleties and variations of interaction has, for me, come about through practice and research. In making and writing about interactive experience I have started to think about the different aspects, or dimensions of interaction. What, for example, might be its essential or ‘concrete’ elements?

The idea of essential elements in art was core to the Concrete Art movement of last century. They are the material elements of work, such as the brush strokes or pigment. Importantly, they are also of greater concern than what the painting might depict. As artist Max Bill said, the work is about “*the fundamental elements of painting, the colour and form of the surface*” rather than naturalistic representation (Max Bill in Chilvers, 2009).

In my practice I have been thinking in terms of concrete elements of interaction. *Light, response* and *gesture* have become focal points and I’ve investigated them as a part of the process of making interactive artworks. They are discussed next, alongside artworks that helped me understand and explore them.

## Light

Light is a primary concern for *Light Currents* (2015) and *Dichroic Wade* (2016). I have worked to manipulate it directly, using pieces of suspended dichroic glass to reflect, filter and transmit, and effect shapes of colour on surrounding surfaces of wall, floor, ceiling or people. The colours are the product of layered materials and direction of materials. In this way, this direct manipulation of light as a material is articulating colour, movement and shape. Light is treated as a material that can be varied to create various effects along these dimensions. This is a different approach to that of modulating imagery for a projector. Rather, in these works, light is used in a painterly way and as expressive in its own right: it is the focus of the work. The manipulation of this element (light) is a primary concern for the work.

*Light Currents* is the first in this series of interactive artworks. Its technical implementation draws on the technologies and techniques of Physical Computing including sensors, actuators and a microcontroller (O’Sullivan and Igoe, 2004). It consists of light, dichroic glass, wire and internet. The glass tiles are suspended horizontally on tautly spun steel wire. They are agitated by servo motors via vibrations sent along the wire, causing ‘shimmers’ of reflection to occur as they move. When a participant moves in the space, one of the servo motors moves and vibrates the glass tiles. The other motor also drives movement but this is informed by changes in the wind outside, as communicated by weather stations online, in real-time.

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*Dichroic Wade* is a different system that is part of the same body of work. Here the glass pieces are suspended vertically as pendulums which move using three servo motors. Weather is accessed through internet servers and in real-time. Participant presence is also monitored though with the addition of facilitating proximity through an ultrasound sensor, to give a sense of people's approach. Where no participants were sensed in the gallery space, wind data from outside agitates the pendulums of glass pieces. An approaching participant can, however, interrupt the display to further agitate the same servos and suspended glass pieces. *Dichroic Wade* facilitates a variety of different reflections and has more opportunity for turbulence as well as cascading rhythms than I found with *Light Currents*. In making these works I became interested in exploring the different system behaviours and the types of response that could be generated.

### **Response, Gesture**

*Dichroic Wade* utilised different types of responsive system behaviour. As mentioned, the proximity of a participant to the work was sensed in this work. It was coded so that when one approaches the work the agitation of the pendulums and the reflections would increase. This is a fairly common and easily understood type of responsive feedback because we already have mental models associated with, for example, going closer to a fire which will feel hotter.

Another more *solitary* mode of response was also implemented in this work. This was a 'crescendo' of movement followed by a period of stillness that would be triggered when a visitor was very close to the work, at the height of the sensors sensitivity. It is solitary in the sense that it is a self-contained composition, playing out without waiting for any more input from the audience to the art system.

*Dichroic Wade* and *Light Currents* also facilitate a *layered responsiveness* to the participant. I think of this as a combined response that blends participant presence / proximity *and* the changes in the weather outside. Both influence the behaviour of the servos which, in turn, agitate the suspended glass tiles. The combined layered response model visualises different places at the same time: the physical place inside where the participant and the work are as well as the physical place outside where the wind is blowing. And then there is also the virtual, internet data space that is augmenting the interior place.

Different types of responses provide different opportunities for meaning making. The immediate action of moving in front of this work causes it to change, agitate, and give a predictable feedback response. Or it can cause a crescendo of movement and a more solitary response. There is also the potential for types of distended meaning-making to occur, when the interaction is stretched out across space and place, as in the response that results from behaviour or input from the weather outside or other distant or seemingly separate elements.

The interactive artwork that uses drawing gesture as an input, *Of me With me* (2015) also explores aspects of response, though in a different way. Interaction involves a drawing gesture which is soon followed by 'echoes' of that gesture on

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the screen. Here the speed, direction and tempo of the participant's gesture affects the imagery and it echoes dynamically with slow, fast, staccato, fluid etc. gestures. This occurs across multiple scales and levels of detail, all in real-time, and an overall composition and movement arises that is new and unexpected yet also retains a pattern of self-similarity. It can be described as an *unfolding, echoing response*, where a participant's incoming, real-time gesture is both source and echo for the amplified, generated drawing. During evaluation of the work, highly variable and differentiated participant gestures were observed, ranging from making points, fluid contour drawing through to zig-zag gestures. Gesture and response are the focus of this work; they drive the echoing system behaviour and emergent imagery. The manipulation of these concrete elements of gesture and response were a primary concern.

Common to *light, response* and *gesture* are *space* and *time*. These can provide further insight into interaction and its expressive potential, and are discussed next.

### **Time, Space**

*Light, response* and *gesture* all occur in *time* and *space*. And *time* and *space* are variable qualities, as has been explored by artists, architects, scientists and so on. Thinking about their nature in the context of interaction is useful because it can provide us further insight into the nature of interaction.

Firstly, thinking about *response* in terms of *time* reveals a range of possibilities. Response can be immediate like a key press or it can be delayed. The *influencing* behaviour of Ernest Edmonds *Shaping Forms* works (2007, 2011), for example, facilitates a system response to a participant action that is delayed: it occurs a day or two after the person acted. Tempo and rhythm, as explored in music and film, can also help thinking and exploring responsiveness in interaction. Response can also be thought of as an 'event', a type of temporal moment as in the 'crescendo' described above. Or it can be considered alongside gesture, in terms of relating to the participant's speed of interaction, as in *Of me With me* where the incoming speed of a participant's gesture directly affects the system speed.

*Space* is arguably also a variable quality despite our is a tendency to think of it as even: as a homogenous void between objects. Instead, space is informed by a myriad of factors from the quality of the light entering a room, the temperature or materials we encounter, through to personal context and meaning. The axial progression to the altar of a Gothic church will take us through different spaces informed by not only the increased ceiling height but also the quality of coloured light coming from the windows either side and our sense of getting closer to the altar and God. An encounter with Richard Serra's *Between the Torus and the Sphere* (2003-8), similarly illustrates the changing experience from tight to expansive, from being with others, to being surrounded by others, to being aware of them, or alone. Here there is an experience of tension in the space that makes one place feel different to another. These spaces are not all the same.

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## Hybrid Space for Art

Modern networking technology has meant that time and space are different in other ways as well. Not only do we have the metaphorical real-world space of VR, but we also have the pervasive presence of that digital data space in our everyday. Developments in Ubiquitous Computing mean that wireless networks and connected devices follow us and our audiences everywhere (Weiser, 1991). Satellites and wireless internet servers have increased in both quantity and reach, and our smart phones are not only facilitating one-to-one communication but are also streaming announcements of this ongoing, other virtual world – from social media status updates to proximity alerts based on our current location. The ubiquity of networks and smart devices that prompt and interrupt us mean we are continually immersed in data and inhabiting this other virtual world in parallel to the real physical world. The virtual, networked layer overlays our understanding and the meaning of being in traditional, real world places and contexts. Everyday spaces have changed as we inhabit hybrid digital-physical space (e.g. see de Waal and de Lange, 2008). This change also affects the art gallery. The white cube is now similarly hybrid, including virtual space in addition to the physical. Our understanding and experience of artwork in the gallery changes along with this change in context. Conventional or interactive, whatever the art form, its audience and space are mediated by the pervasive data networks and the space for the artwork more complex, multiplicitous and ambiguous. Artists can explicitly engage with this hybrid space to effect response this way. My artworks *Light Currents* and *Dichroic Wade* make the digital network explicit and accessible to gallery participants who are able to see the changes in the outside landscape evidenced here, as well as interact to change that representation of the landscape through their own movement in the space. Moreover, interacting with the weather data through local movement makes it possible for people to reconsider their relation to the immediate space and natural landscape outside.

## Reflecting on Interaction, Emergence and Differentiation

My practice, research and engagement with emergence theory have led me to think about interaction in terms of openness, unpredictability and variation. They describe the rich space of potential interaction we have with one another in conversation, as well as in the physical world more broadly. They can be explored through models of emergence, ranging from simulating it within the digital domain, through to positioning a participant relative to the digital domain in rich and creative ways. In an emergent interactive art system, a participant could, for example, perceive new patterns such as a flock of birds moving as one, or an emergent butterfly shape from intersecting, moving glass reflections as in the *Dichroic Wade* evaluation. Or, as one participant with *Of me With me* was found to do, they may unexpectedly play a ‘chasing’ game with the drawing system (see also Seevinck 2017).

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Participant interactions that are surprising or creative are important to me. They move beyond the dominant, HCI paradigm that prioritises efficiency, control and predictability; and away from an understanding of interaction as a procedure with ‘action-reaction’ implementations. Emergence can facilitate this move. The theories of emergence can explore depth and nuance in interaction.

I’ve come to think of interaction as a differentiated quality. In creating interactive art systems, I’ve worked with fundamental, or concrete, aspects of interaction such as the *light*, *response* and *gesture* described here. I’ve also looked for their internal subtleties and ‘textures’. Light, for example, was explored in terms of reflection and transmission, informed largely by the materiality of the dichroic glass; while unfolding gestures were revealed through the lens of emergence theory.

Engaging with interaction in poetic and granular ways can provide interactive artists and designers with new, creative understandings. It can also inform more articulated experiences of digital art interaction in our increasingly hybrid everyday.

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