

Scanpaths as Drawing

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1. Introduction

Drawing, as a tool and method of expression, possesses an almost unique quality of comprehensibility. From a very young age we are able to grasp the conventions of drawing and typically actively engage in the interpretation and production of drawings. Drawing is an area for creative exploration and artists have experimented with both conventional commercially available materials for drawings (pencils, pens, computers etc.) and with tools destined for a different use.

2. History of Drawing

Historically drawing was often considered to be a preparatory stage of artistic production or as a by-product of the process of making. However since the mid 1990's drawing has emerged as an autonomous subject within the creative disciplines. This was followed by the establishment of many undergraduate and postgraduate courses in drawing within both the UK and beyond. As a result the topic has received greater theoretical consideration and in turn this has provided a platform for artists to

explore new approaches to the discipline. Many still work within the conventions of drawing as even the so-called ‘simple’ pencil has an enormous range and can respond in sophisticated ways to the intentions of the maker. Drawings’ history “as an under-regarded and under-theorized backwater that gave artists freedom, allowing the field to be open for artists to make of it what they chose” Dexter (2005) enabled the discipline to be interrogated through wide ranging research contexts, as artists reinvent the subject using new technologies and methodologies.

3. Exploring what constitutes drawing

Long before this renewed interest in drawing, artworks that were to become significant to the future for drawing were being made and became the subject of debate as artists sought to establish new concerns for the discipline of drawing beyond the traditional. For example, the exploration of an operational engagement between world, mind and body was explored in Richard Long’s 1967 piece, *A Line Made by Walking*. The idea was simply to “walk back and forth until the grass is trodden into an evident line”, Dexter writes, “A Line Made by Walking suggests we are all artists when we are walking, and from this point, there is only a short step to understanding body movement as the drawing of invisible lines in space”. This work and indeed Dexter’s comments open the possibility of exploring physical movements as drawing. There is no requirement for a drawing tool here as the body itself is used as tool. Using his weight, Long is able to compress the grass until it is unable to maintain its structure, thus the drawing is made directly without a drawing instrument. The resulting drawing is of course ephemeral: it would not be long before the grass would be able to regain its composition and the evidence of the act would be lost. There are parallels here with the more traditional use of drawings as preparatory work –

preparatory studies are often lost, destroyed or inaccessible as the originator may never make them available for public or private viewing. In Tom Marioni's *One Second Sculpture*, action photograph 1969, a handful of sticks are launched into the air and captured on photographic film sequentially as they rise and fall. At times making contact with each other the sticks make shifting line compositions in the air using the force of the artists throw to create a collection of endings in space. The physical aspect of these works is again highly apparent with confirmation of the artists presence secured by the camera footage. Our interest on eye movements and drawing grows out of these ideas that a physical act, such as walking or moving the eyes, can be the drawing of lines in space.

3. Eye movements

Although the visual world appears to be stable the sensory system we use to detect the visual world – the eye – is constantly moving (see Findlay & Gilchrist, 2003). These movements are achieved by a set of six muscles that are attached to the eye ball. In humans, the eye generates a limited set of types of movements which all have distinct functions. These types of movements can be distinguished by the nature of the movement generated and the properties of the visual world that lead them to occur. The types of eye movements can be broadly classed into movements that keep the eye stable in relation to the world and movements that point the eye in a new direction towards something of interest (Walls, 1962). The vestibular-ocular reflex counter rotates the eye in response to a movement of the head and so keeps the eye pointing in the same direction, this simple reflex is very effective. The ability to continue to read on a moving train or bus is a testimony to this systems ability to correct for every jolt and pothole. Smooth pursuit movements allow a moving object to be tracked by

matching the movement of the eye to the movement of the object and as a result keep the object at a fixed location on the retina. Optokinetic nystagmus occurs when the whole visual world moves, under these circumstances the eyes move in a saw-tooth pattern to track the world. Vergence movements move the two eyes together, but in opposite directions to maintain both eyes pointing at an object of interest as the object moves towards or away from the eyes. And finally when the world is stationary, saccadic eye movements move the eyes to point at regions of interest in the environment. Saccadic eye-movements are fast ballistic movements and are followed by a period of time when the eye is stationary called a fixation. Vision isn't possible during the saccade so it is during these periods of fixation that information is gathered by the visual system. Fixation can vary considerably in their duration, from as little as 1/10 second to over a second. Saccades are required because toward the central part of vision, or the fovea, visual ability and particularly the ability to resolve fine detail improved dramatically (see Anstis, 1974). As a result of this drop off of visual ability away from the central visual axis we simply can't see very much away from the current point of fixation. The illusion of being able to see everything with fine detail at once is just that – an illusion.

4. Scanpaths

When scanning a static scene the eyes make a sequence of saccades and fixations. An example of such a sequence is illustrated in Figure I. The term *Scanpath* was used by Norton and Stark (1971) to describe this chain of fixations and saccades. What is clear, even from Figure I, is that the eyes are not moving completely randomly around the scene; instead the eyes tend to land on important and meaningful parts of the

picture. As a result the sequence location and durations of the fixations carry something of the structure of the picture.

5. Scanpaths and drawings

There have been a number of studies of the scanpaths that are generated when drawing (Tchalenko, 2007; Miall & Tchalenko, 2001). However, the focus of our work has been to investigate the extent to which scanpaths themselves are a way of drawings. Admittedly a rather direct and unconventional way of drawing but one that has a resonance with the work of Long and others discussed above. In our work we have investigated if the eye movements themselves can become the metaphorical mark.

6. The work

Catherine Bakers work as an artist is motivated by art as a kind of research with drawing becoming the mode of enquiry. Her art education involved teachers who often spoke of seeing and looking when instructing their students in the art of observational drawing, drawing was described as being as much about looking as the making of marks on a surface. The difficulty here is how we define the act of seeing. As the description of the active processes of seeing above illustrated, it is far more complex than it may initially appear, after all it is a question which has provoked the thoughts of artists, scientists, psychologists and philosophers for centuries. Mel Gooding writes in relation to the drawings of Claude Heath “As time goes by, the very way we look at the world is subject to continuous modification, sometimes subtle and imperceptible, at certain moments drastic and surprising: we are constantly seeing things differently.” In the same way that a child may use the process of

drawing to learn something about the world we use our sight to make sense of our complex and visually demanding world.

The importance of scientific data is paramount in the work, it is significant to Baker that this work is accurate and will withstand scientific scrutiny, whilst simultaneously providing scientists with an opportunity to understand vision from a new perspective.

Second Sight 2007, is one piece of work that grew out of this inquiry into scanpaths (see Figure II). It is an installation that consists of 170 solid resin orbs, which range from 22 -150mm diameters. The orbs were hung to reflect a one-minute scanpath, they show the relationship between objects in a space and the very nature of their existence creates a new scanpath from the viewer and how they might 'see' the piece. The conception of this piece was developed from a five-minute scanpath and was an attempt at a three-dimensional representation of how we might be 'reading' our environment. Each orb signifies a single fixation, the size dictating the duration of the fixation. Each orb casts shadows over the environment in which it is housed and thus hundreds of overlapping circular or oval shadows, each a different intensity smothers the surfaces, in the same way our vision might. In addition, each orb acts like a lens, reflecting its surroundings and each of the other orbs in its surface, making a clear relationship apparent with each of the other fixations, accumulating to make a cohesive visual experience.

One Second Line 2007, is a three-minute video projection and opposing eye footage projection that was developed as an animated drawing, which quite simply mapped pupil activity. This was recorded when looking at a rural landscape scene using mobile eye tracking equipment. The initial split screen video footage (see Figure III) shows the eye on the left and the scene being tracked on the right. The scene was then removed to allow the eye movements to be seen independent of the original

location with each sequence mapping the movements that took place over one second. Approximately five to seven movements took place each second and thus this generated a substantial amount of 'plotted' movements, which were part of the process of Baker making sense of the visual environment. The corresponding eye footage is projected on an opposing wall so that the invisible dialogue between the moving eye and moving lines can be visualised, with the pupil actions creating the drawing thus the final outcome consists of two parts.

7. Conclusion

The relations between perception and drawing is one that has attracted a great deal of interest in the last 30 years. The two authors, one an artist and one a scientist, have been working at the interface between science and art to explore how the relationship between these two areas of enquiry and the interface between the incessantly moving eye and drawing.

8. Notes

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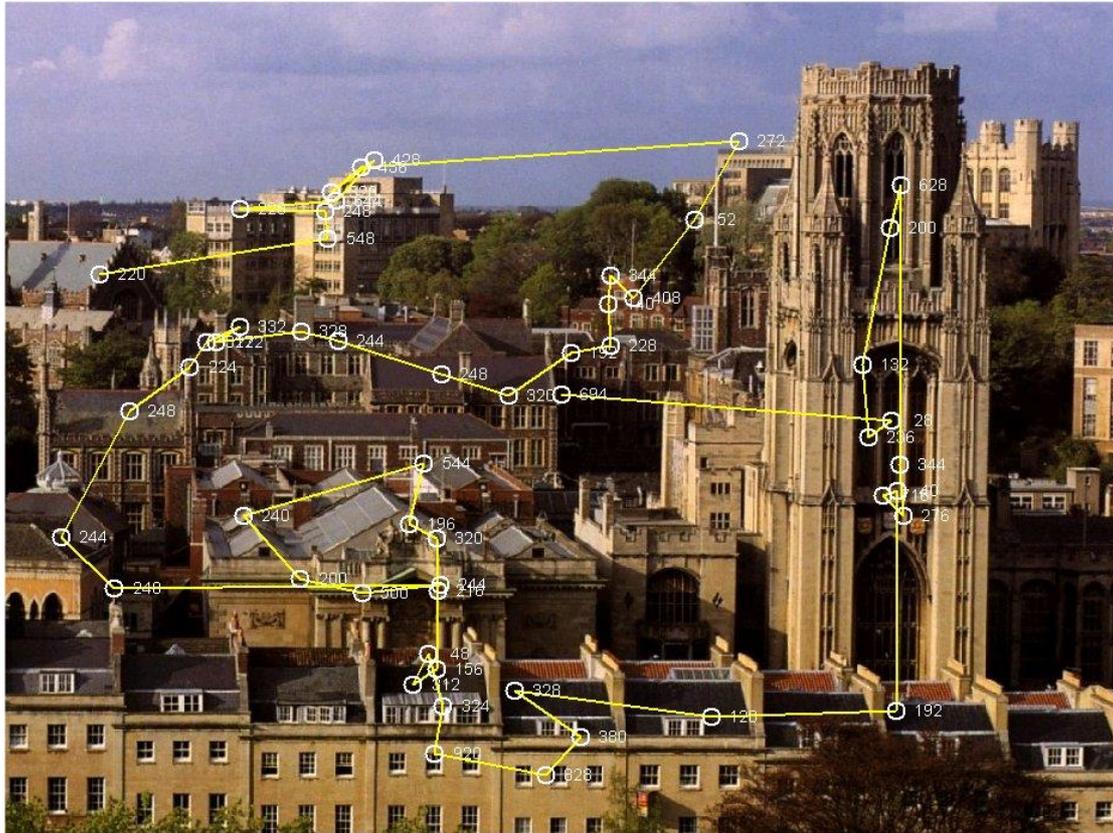


Figure I (pg4). Example scanpath. During viewing the eyes switch between periods when the eyes are still and pointing at a region of interest (white circles; *fixations*) and fast movements to point at a new region of interest (yellow lines; *saccades*). A continuous sequence of these movements is called a *scanpath*. The white number to the left of each white circle indicates the duration of each fixation in milliseconds. *Data recorded in the Eye Movement Laboratory, University of Bristol*

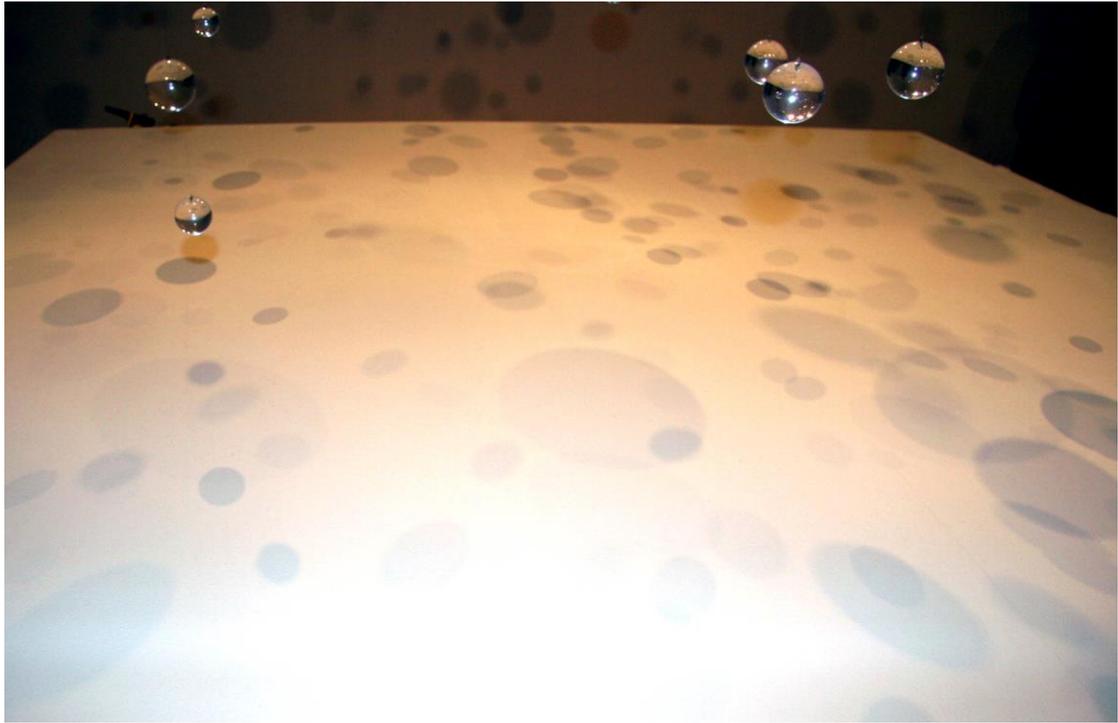


Figure II: *Second Sight 2007* (pg6). © Catherine Baker. Commissioned and by the Space 4 Gallery, Priestgate, Peterborough one the occasion of the solo exhibition *SCANPATH*, March –June 2007.



Figure III: *Working Split Screen study 2007* (pg6), © Catherine Baker. Part of a two day mobile eye tracking event in Dundee, February 2006, supported by Dr. Ben Tatler, University of Dundee. Eye on the left is tracking the landscape scene on the right whilst walking. Calibrated pupil movements are then plotted over the scene footage.