Visuality and the haptic qualities of the line in generative art

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Abstract

The line has an important and particular relationship with the generative artwork distinct from other elements such as the 'pixel', 'voxel' or the 'points' that make up point clouds. The line has a dual nature as both continuous and discrete which makes it perhaps uniquely placed to straddle the analog and digital worlds. It has a haptic or felt quality as well as an inherent ambiguity that promotes a relatively active interpretive role for the audience.

There is an extensive history of the line in generative systems and artworks, taking both analog and digital forms. That it continues to play an important role, alongside other more photographically inspired 'perceptual schemas', may be a testament to its enduring usefulness and unique character.

This paper considers the particular affordances and the 'visuality' of the line in relation to generative artworks. This includes asking how we might account for the felt quality of lines and the socially and culturally constructed aspects that shape our relationship with them. It asks whether, in what has been described as a 'post digital' or even 'post post digital' world, the line may offer a way to re-emphasise a more human scale and a materiality that can push back, gently, against other more dominant perceptual schemas. It also asks what generative art can learn from drawing theory, many of the concerns of which parallel and intersect with those of generative art.

1. Introduction

The line is particularly interesting to consider in relation to computationally created generative artworks because they appear to share key characteristics of both the digital and the analog. Individual lines are self contained and 'discrete', a quality associated with the digital [1]. Yet they are also 'continuous' and can express an ambiguous and 'felt' quality in their reception. This observation invites a closer investigation of the line in generative artworks and how we perceive them. This paper aims to examine the particular visual affordances of the line and how these might shape the reception of the generative artworks that employ them. This includes certain socially and culturally constructed 'ways of seeing' that might be described as their 'visuality'.

This paper will consider lines in a broad sense. Rather than debating which marks should be considered lines and which not, it will be focusing on what are perceived as lines or having the qualities that lines can exhibit. This recognises that lines can be employed in myriad ways that often blur the distinction between line, surface, shape, tone etc. They can also be used in conjunction with other marks such as points, blobs and to form polygons.

While not all lines are made by what might be seen as a 'drawing process', it aims to show how theories of drawing practice may usefully inform how lines are perceived in the context of generative art. It is not the intention of this paper to define drawing, which Deanna Petherbridge, in the classic tome 'The

Primacy of Drawing', describes as a 'futile task' [2]. But it will look at different definitions and understandings of drawing in order to try and unpick the key characteristics, including their tactile qualities and their relationship with process and action.

2. Drawing, lines and generative art

Lines and drawing both have a long association with generative art practice. Well known early experiments with generating lines include the drawings produced by Harold Cohen's AARON [3] and the work of Charles and Colette Bangert using graphic plotters in the 1960s and 70s [4]. Reas and McWilliams outline a history of drawing with computers from the pioneering 'Sketchpad' interface of Ivan Sutherland through to computer-aided design systems and scripting languages such as PostScript [5]. Although we might trace the relationship between the line and generative art back far further as Laura Marks does in identifying a genealogy for new media art in Islamic art that reaches back several centuries [6]. An expanded definition of the line might even look at early mechanical forebearers of computing in the Jacquard Loom [7] or the conceptual work of Sol Le Witt, often cited as a predecessor of generative approaches to art production [7, 5]. However, the focus here will be on the contemporary reception and use of lines in generative artworks.

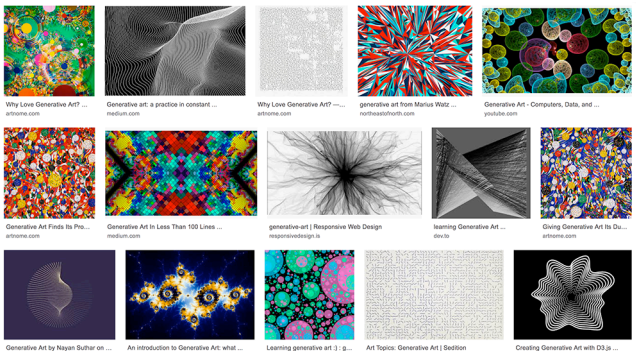

Figure 1. Image search results for 'generative art'

An image search for 'generative art' [figure 1] returns a high percentage of images composed of lines, implying a stereotype of 'computationally drawn' images almost as a visual shorthand for the 'generative'. While generative art practice is far more diverse than such a stereotype, it is interesting to note a certain association in the wider public consciousness. Lines and drawing practices are still regularly employed in the creation of work in the fields of generative art and wider new media and digital practice. One reason that the line continues to be widely used in generative art practice could be the particular affordances of the line not just in production but in their reception. While the pixel, voxel or polygon will all have their own visual qualities and associations, this paper focuses on the line and what factors may affect our reception of them; both in terms of different types of line and how our reception may be socially and culturally constructed.

3. Visuality and scopic regimes

Hal Foster defines 'visuality' as the difference "between the mechanism of sight and its historical techniques, between the datum of vision and its discursive determinations" [8]. This acknowledges that not only do we see differently from each other but that there are factors that affect "how we are able, allowed, or made to see" [8]. The concerns of visuality go beyond purely those of 'analytic' aesthetics and the formal qualities inherent to the artwork. It is far closer to the 'pragmatic aesthetics' of Shusterman [9] since it acknowledges the contexts brought to the experience by the audience. While affected by the individual contexts of the viewer, the rhetoric and factors shaping how we see can form conventions and mechanisms sometimes termed 'scopic regimes' [10] or 'perceptual schemas' [11]. Perspective is perhaps the most well known and critiqued example of such 'scopic regimes'. Panofsky's analysis of perspective demonstrated its constructed and culturally situated nature and that, far from being a single regime, there are several variations [11].

Perspective remains a dominant schema that it has been suggested underpins the photographic image [12]. It also has a key role in computation. Lev Manovich, in describing the 'automation of sight' and 'computer vision', refers to the 'perspectival machines' and 'geometry engines' of computational media [13]. This can be seen in the lines of the grid typically found in 3D software such as Unity or Blender [figure 2]. This is what Damjan Jovanovic terms the 'ground grid', marking out a uniform grid space, homogenising the space and suggesting a certain 'total visual empowerment' [14]. The straight lines used here are not neutral but suggest of a way of thinking about the depiction of space and the technologies that underpin them. A perceptual and conceptual framework not dissimilar to the way perspective was associated with 'subjective rationality' and symbolic of the harmony between optics, mathematics and God's will [10].

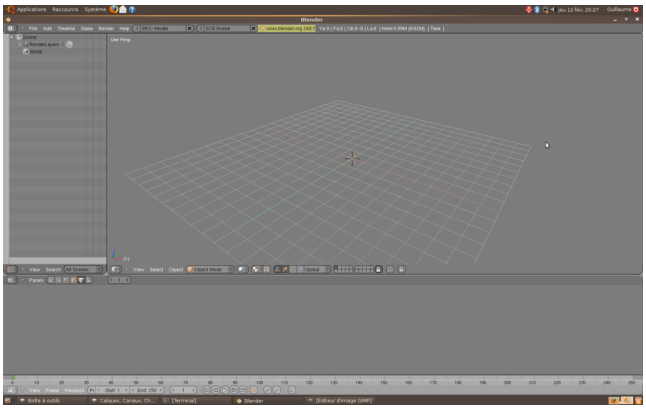

Figure 2. Screenshot of Blender showing 'ground grid'

Here we might consider the visuality of straight lines. Tim Ingold argues that straight lines are suggestive of modernity and artificiality, pointing to the mantra of romanticism: 'nature abhors a straight line' [15]. The straight line is ubiquitous today, Ingold argues "even where they don't really exist" [15]. Such is the ubiquity of the devices of perspective that we are predisposed to detecting their presence. Showing this was the motivation for my making the work *Expressions of Ideal Relations* (2019) [figure 3]. This looped animation shows a rotating photosphere drawing composed of what may appear to be scribbled lines but which reveal the ghostly traces of the underlying equirectilinear grid that contains them. The lines of the equirectilinear grid are implied by the more erratic lines in the spaces between them. What we can also see is that lines can operate simultaneously at the surface and to suggest space. The hand drawn lines have a different quality to the straight lines they imply. These more erratic lines, as we shall see, bring their own visuality.

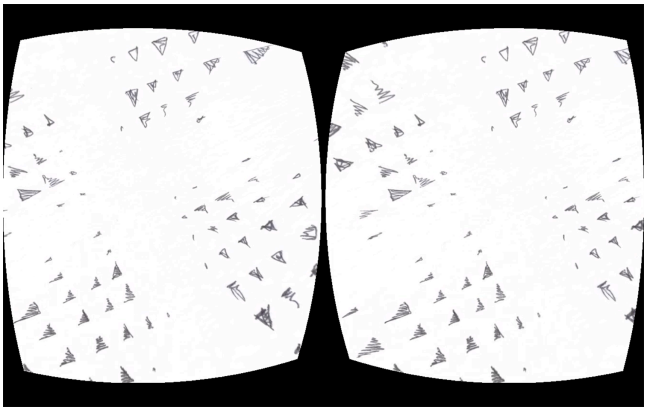

Figure 3. Screenshot of 'Expressions of Ideal Relations' (2019)

This is not to suggest that straight lines need be static since they can also suggest action and movement. This can be seen in the example of the early computer screen, which created an image using a line of light traced continually across its surface [16]. These lines, or more accurately 'vectors', are significant in that they contain a key characteristic of the line, namely a 'liveness' that is connected to the process of their creation. The vectors drawn with light are a dynamic process and an unfolding activity. This form of display has given way to the pixel based screens to which we are now accustomed. Screen displays, whose resolutions have passed the point where we can detect individual pixels, tend to recede in favour of the images they host [17]. They are presented as a transparent window onto the

world of the computer [18] facilitating a photographic realism in particular, which itself operates under its own perceptual logic. Nicholas Mirzoeff describes how the notion of 'correct focus' stems from certain forms of painting via photography [19]. It is interesting that Mirzoeff also notes an alternative 'way of seeing' found in the 'papillotage' or 'blinking' effect found in the paintings of artists such as Boucher and later the Impressionists [19]. This 'blinking' flickering effect, it as been suggested, may be closer to how we actually see, acknowledging the movement of the eye and the eyelid [19].

The decline of the vector based display in favour of the pixel display has been lamented by some who see the dynamic line giving way to "tired old naturalistic illusionism" [6]. For Cubitt, in displays based on arrays of pixels, the movement stops and the resulting image is not 'a living act', connections having become hidden and the surface opaque [6].

Alternatives to more dominant ways of seeing and to the pixel screen clearly exist, including what Whitelaw terms 'post-screen' practice, pointing to the example of Daniel Rozin's *Trash Mirror* [17]. Finding alternatives to dominant modes is even seen as a key aim for much of digital art practice [17]. Ultimately, it is not a case of which perceptual scheme is correct, but as Jay argues we benefit from being aware of the possibilities at our disposal [10]. While lines can be employed in different scopic regimes, exploiting different aspects of their visuality, it is the dynamic, live quality to their visuality that is worth closer inspection.

4. The Haptic quality of lines

By focusing on lines it would be possible to become overly concerned with the visual. Laura Marks has argued that vision is not purely visual but an embodied and multisensory experience [20]. Similarly, it has been suggested that there are no visual media only 'hybrid' and 'mixed media', such is the entanglement of senses involved in perception [21]. It can be easy to forget when thinking about digitally produced images that our experience of them is analog. After all, most of what we think of as digital media are actually digital to analog converters [22]. Vaike Fors describes a 'digital visuality' that involves an embodied and tactile relationship with media through the taps and gestures made on touchscreens [23]. Whether or not we are more tactile in the way we see, there is an argument that seeing drawn lines in particular involves a tactile sensibility.

Just as the dynamic vectors of early displays suggest movement, so hand drawn, irregular or imperfect lines can also bring with them a 'liveness' [15]. This is not dissimilar to Paul Klee's well known description of the line 'going for a walk' [16]. The free line that is suggestive of action and movement. We might also consider Hogarth's 'serpentine line' which brings with it the suggestion that seeing lines can be as much a felt experience as it is a visual one. Hogarth describes seeing the lines of a drawing as like a pursuit as the eye retraces the form and can be both "animating and animated" [16]. This animating effect implies that we can imagine ourselves drawing the lines.

The idea of our 'touching' lines as we see them relates to the dualism that Wölfflin describes between 'linear' and 'painterly', and between 'tactile' and 'optical' perception [24]. With 'tactile perception', the eye acts as a hand, as opposed to 'optical perception' where vision acts as the eye does, receiving the image. However, to suggest that line based images relate only to the tactile would be to misunderstand the nature of tactile vision. Rather than place these modes in opposition Delueze suggests an interplay between them. Deleuze uses the term 'haptic' rather than 'tactile' specifically to suggest that there is no opposition and that the haptic is simply the tactile function of sight [24]. As we have seen, lines can be used to mark space in a way that supports optical perception, but they can also appeal to haptic perception and even both modes simultaneously.

While haptic space is not unique to lines, we may have a particular relationship with their haptic quality due to our individual experiences of drawing. From the earliest images made "outlines have been used to describe and delineate representations of objects" [12], while Flusser argues drawing is a unique human activity [25]. Not only is drawing among the very first image making practices, it is also one that continues to play a key role in our visual literacy. We are exposed to line drawings from a very early age and so learn how to interpret them [12]. We learn about the particular haptic space of the line, that can create both tactile and optical experiences and which is, importantly, connected to our own experiences of making them.

Not only do we learn about images by drawing but there continues to be a relationship between thinking and drawing. Angela Anning argues that drawing is visible thinking and a demonstration of problem solving [26]. This can be seen in children's drawings as they draw what they know [26]. Only over time do we become more concerned with drawing what we can see. The connection between thinking and drawing is most clearly seen in what Terry Rosenberg describes as 'ideational drawing' - "types of drawing and … processes where one thinks with and through drawing" [27]. In this way drawing can be understood as 'thinking in action', a process where by meaning emerges and is produced through the activity [27].

Where lines do have an animating haptic quality this may also be suggestive of thinking and the underlying processes. If this is the case, then generative practice may be well placed to use these qualities to address issues of authorship, intention and skill.

5. Intention, error and skill

As Dorin et al note, understanding the process involved in generative artworks is an important influence on their reception [28]. Understanding the process can shape the way we view an artwork. For example, I have written previously about the role that understanding code plays in the reception of generative artworks [29]. Meanwhile, it has been suggested that there is a close link between understanding of process and perceptions of skill [3]. One of the key challenges facing generative art is a scepticism surrounding the level of human skill and creativity involved [3]. Here drawing theory may point to a way in which lines, especially drawn lines, are suggestive of intention, process and skill.

Benjamin's definitions of painting and drawing, while ostensibly concerned with formal aspects, are interesting for their reference to intention. For Benjamin, drawing involves marks, specifically referred to as 'signs', intentionally made on a ground [30], where as painting sees images 'emerge' from coloured surfaces. The lines made by drawing are seen as the deliberate result of action. Straightaway we can see exceptions from generative art practice which would not fit this definition, such as the automatically produced drawings of Tim Knowles *Tree Drawings* (2005) [28], or the 'found drawing' shown in figure 4 in which we can see the lines made by the zipper of a bag and guided by the movement of a train. While fitting the formal description of marks on a ground, the issue of intention is debateable and distinct from cause. However, this distinction raises an interesting question about how drawings are perceived. Is Benjamin describing a way of *seeing* drawn lines as much as the way they are created? Perhaps due to the association between drawing and thinking and the way in which we might imagine the actions that led to the marks, might this lead to the audience assuming or looking for the underlying logic of the process that created it? Do lines appear more intentional in purpose than other images which come to us as though they have simply emerged?

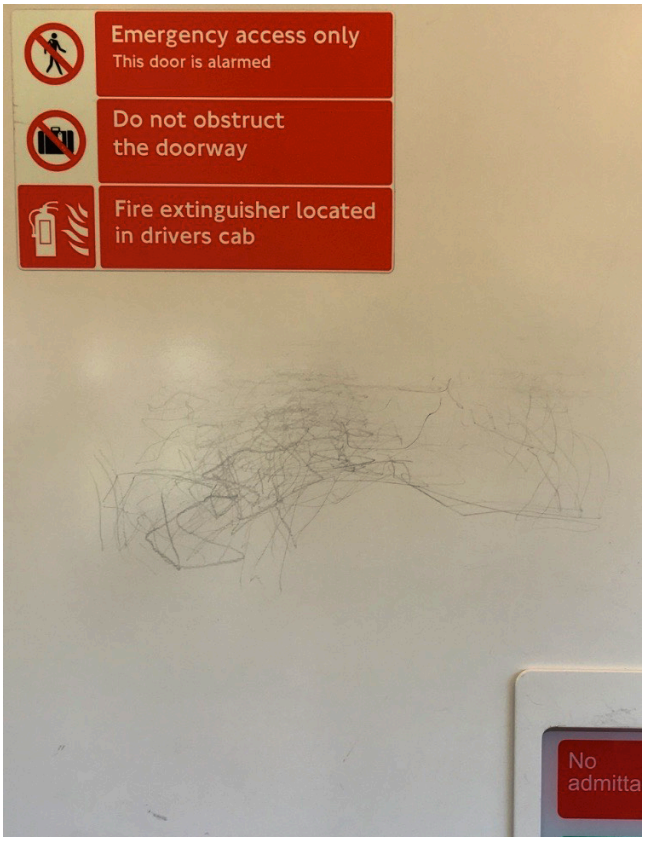

Figure 4. Found zipper drawing (2019)

One way this might be the case is where drawings are considered as records of process or activity. Derrida describes how to see a drawing is to see an activity [30]. While Lucas takes this even further to suggest that drawings should not be considered as images but as records of gesture [31]. This offers an interesting way to consider generatively produced drawings. How might the process of their creation be implied within the image? With the plotter drawings of Carl Lostritto [4] it is hard not to follow the lines and imagine the pen moving across the surface of the paper; identifying where darker points suggest an overlapping or overdrawing of lines. It is as though by seeing the component parts of the image in the lines we are invited to consider their creation, possibly informed by a certain tactile perception and association with thinking.

By comparison, the pixel itself is usually seen but unnoticed, the resolution of displays high enough to present only an image and not its component parts [17]. Vito Campinelli has described how noticeably low resolutions and pixelated images can be synonymous with poor quality [24]. Pixelated images can also have a retro aesthetic that similarly foregrounds the technology. Where the pixel or the pixel block does reveal itself, it can become a significant event and represent a break in the illusionism or the technology itself. In 'glitch aesthetics', revealing the pixel is suggestive of rupture, one which for some artists is way of challenging the hegemony of media production [32]. On the other hand, the line has its own relationship with error and noise.

When learning to code generative art systems, drawing a straight line or circle is often one of the first exercises. Although this is usually followed quickly by adding noise and variation as though attempting to making it in some way more human. Or perhaps, as Matt Pearson suggests in his chapter 'The Wrong Way to Draw a Line', just more interesting. As he notes "the 'right' way to draw a line, according to the machine, is always the most efficient and accurate way of getting from point A to point B. But from an artistic standpoint, it's the 'wrong' way that is often the most interesting." [33]. Boden and Edmonds argue that such errors appeal to the 'disturbed imagination' of the human audience [3]. Interestingly, many early computer generated drawings specifically aspired to produce believably hand drawn lines [3].

Some drawing practices may emphasise the role of the hand while others are concerned with the removal of error and any evidence of the maker. Traditionally the draughtsman would aspire to what Ingold describes as the 'workmanship of certainty', facilitated by tools and devices to aid particularly with the drawing of straight lines. This is as opposed to 'workmanship of uncertainty' [15] where instead the pen might be allowed to set off on an intended path, without the aid of guides, and which seems to resonate with the aims of generative art practices. It is as though when working with generative processes, we set

out to undertake workmanship of uncertainty. The concern is not how to remove the uncertainty associated with error, but to reintroduce it. Since with a simple line of code, we can render a perfect circle, the challenge is to find more interesting and informative ways to proceed.

For the draughtsmen of Albrecht Dürer's time, being able to draw a perfect circle was proof of the divine power of the artist and demonstrated the complete control of the mind over the hand [30]. This power was also described as 'ingenium' or for Dürer, 'Gwalt', and it was in drawing that Dürer believed Gwalt presented itself most clearly. Unlike technical skill, or 'Ars', Gwalt can not be learnt [30]. However, Dürer's drawing transformed Gwalt by connecting it to human ability rather than divine gift [30]. Rather than perfect lines, he "made the most of the effects of mistakes", allowing both "the successful and the unsuccessful [marks] to breathe life into the drawing" [30]. The Gwalt becomes the unique character of the artist expressed in the artwork and involves the way in which deviation and uncertainty are managed and used to form a harmonious whole.

Lines have the ability to accommodate the unexpected and to bring together, in the words of Ruskin, the "glittering confusion in the interstices" and the "lines without special intention […] to produce all together a well-shaped effect of intricacy" [34]. Inherent to drawing is an element of unpredictability and chance. 'Speculative lines' without immediate purpose that might later be accommodated or incorporated. Alfred Gell describes drawing as a 'ballistic' process since the marks are made by actions that cannot be fully controlled and so the outcome never fully known [35]. This seems to be a quality shared by generative processes where the outcome of the algorithm, whatever the intentions and plans, are never fully known. It could be that lines are sympathetic to marks that are unexpected since they are seen not as an error but simply the characteristic of ambiguity and invite interpretation rather than create a rupture. While generative drawings may not appear more skilful, they may be able to see the computational recede as the interpretive activity comes to the fore.

6. Conclusion – Ambiguity and the dialectic of the line

Whether employed for aesthetic, functional or technical reasons, using lines brings with it a set of pre-existing factors that affect their reception. Lines, despite or perhaps because of their versatility, are not neutral. Their reception is also shaped by our knowledge and experience of producing lines ourselves. Just as we have learnt to understand the perspectival and the photographic image, so we have also learnt from a very young age, how to see and interpret lines. This is a way of seeing that is haptic, interpretive and active. Some images such as those produced by the AI programme *Deep Dream* may seem to simply emerge and come to us like a dream. The images formed with lines have the ability to 'unfold' before us. To adopt the terms of Laura Marks, the potential 'enfolded' into the image is 'unfolded' by the viewer [36].

It has not been the intention here to privilege the line or elevate it above other ways of making images. Pixels, voxels, point clouds and polygons, or combinations of these, will all have their own visuality. For example, point clouds have their own enigmatic ambiguity and ephemerality. There have also been significant omissions to the discussion here, including consideration of the calligraphic line and other practices that blur the distinction between line and text. Nor has the animated line been considered here in order to focus on the animating qualities of the line itself. However, study of these would clearly add to our understanding of the available 'scopic regimes'.

The line can be found in many different perceptual and scopic regimes each of which can exploit different aspects of their visuality. They are capable of suggesting both stability and ambiguity. Sean Cubitt suggest the line

offers a dialectic of “discipline and autonomy”, the line being an “instrument of order” but also “capable of great freedom and invention” [16]. However, the quality which is arguably of most use to generative art is the way lines can balance ambiguity with intention and to invite the audience to interpret and reach for understanding. As Lostretto points out the “human reader is called upon to interpret, to close an open ambiguity, between process and product” [4]. In a world that has been described as ‘post-digital’ as we reappraise our relationship with the digital [22, 2], it could be that reconsidering practices such as drawing offer unique possibilities for exploring and reconciling the meeting of the computational and the human.

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