

Lines and Lacunae: The Deep History of Drawing in Thought

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Geometrical abstraction does not happen in thought alone. It is as much afforded by the human culture as a massive complex system with interconnected webs and distinct scales of activities as it is facilitated by the problems of embodiment and restricting or enabling constraints which come with it. But how embodiment at the dawn of evolution has anything to with geometrical abstraction and drawing in thought as a spatio-temporal simulation par excellence? Surely, such a claim appears as far-fetched to those who might still hold onto some hard distinctions between the abstract and the concrete, the ideal and the real. The problem of embodiment in relation to geometrical abstraction has been recently studied systematically by a group of mathematicians, philosophers, and neuroscientists named Geo-Co, short for ‘Geometry and Cognition (A Two Way Relation)’. Among the members of this group are logician Giuseppe Longo, mathematician Bernard Teissier, philosophers Jean Petitot and Jean-Luc Petit, and neuroscientist Alain Berthoz who was employed by NASA in the 1980s to study the perceptual anomalies in a zero vertical gravity gradient.

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What does it mean to have a body? The question is as murky as the question of what does it take to have a mind. Reductively speaking, the problem of having a body in evolutionary terms is the very problem of navigating and being vigilant about the surrounding space. To achieve this goal, the organism cannot be merely a blob of organic stuff. It must have inbuilt tools or organs—sufficient causal structures—that at once provide the organism with a sense of bodily integrity (a sense which is fundamentally a neuro-computational simulation) and sensitivity to dominant parameters and variables through which the organism can differentiate itself from itself and the environment. Such differentiation is what can be called the constitution of a frame of reference for the organism. In its rudimentary form the frame of reference can be egocentric meaning ‘X senses the environment from a central stable point of view’). In a more advanced form, it can be an allocentric frame of reference in which the central perspective is temporarily destabilized, and in a mobile fashion, the organism locates itself in space in accordance with the elementary (i.e., non-conceptual) relations between detected items in the environment itself. This is what Henri Poincaré has dubbed ‘weak ontologism’. Roughly speaking, the strong ontologism pertains to the question of what is there or what is in the world. As Poincaré has suggested these sorts of concerns or questions carry with themselves a loaded baggage of unexamined assumptions rooted in the egocentric point of view, a perspective or frame of reference that is stationary. Whereas when we ask, ‘what is there?’ by drawing the relations between things or items which might as well be mobile or changing, we are in an entirely different territory. This is what Poincaré calls the germ of geometrical abstraction which is a species of hypothesization or simulation in the sense of a building a model similar to a phenomenon

and then studying its behaviors over time and an extended domain.¹ To abstract something like a line is to hypothesize about how we can draw—as in connecting the dots puzzles made for children—various mobile and impermanent relations between things or items in the world, with the hypothetical assumption that none of these items might actually be stationary or even real. In this sense, the allocentric view is but the primordial form of a hypothetical modeling and simulation of the world.

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Imagine an aquatic predator who is adept at chasing a prey even though the prey moves chaotically (have you seen a fox pursuing a rabbit that avoids a straight line of escape?). The prey does not escape in a straight line but makes twists and turns. How can this prey be captured by a predator? This is the problem of embodiment, having a sufficient structure equipped with adequate mechanisms capable of detecting the relations between the prey, a rock, and other things at the bottom of an ocean. As in the beginning of the evolutionary complexification, we can imagine a predator equipped with two fearsome capacities: eyes (sensitivity to light) and the vestibular system in the inner ear (sensitivity to inertia and the gravitational pull). These two upgrades are by no means arbitrary. Evolution of species on this planet have always responded to the pressures exerted by the presiding factors existing on this planet, namely, light and vertical gravitation. The predator's eye is a weapon of pure simulation. The moment the signals are registered on the predator's retina, we get a saccadic jerk, the pupils move in milliseconds from left to right and vice versa, so as to calculate the possible orientation of the prey as it escapes. The vestibular system of the inner ear is an organ that registers the gravity of earth and inertia. The inputs made by these organs are synthesized in the predator's nervous system. For the predator, its internal model of the prey's flight can effectively simulate the possible variations of how the prey escapes. The predator makes a move. It moves its body as if it were a mobile frame of reference. The combination of all these three effectors and sensors—the saccadic jerk of the eye, the gravitational signals registered by the vestibular system and the motion of body—generate a *gesture* of mobility (a model) that can most likely capture the prey even though the movement of the prey is unpredictable and chaotic. Here we are, a dynamic gesture of the predator that can simulate and capture the most chaotic escape line of a prey. This gesture is generated by action on perception via a series of feedbacks between locomotory sensors and effectors of the organism and the global attentional system of the organism. The chase line of the predator is not exactly a line but a gesture that simulates the very perceptual dynamic qualities of a continuous line. The problem of embodiment has always been the problem of dynamically coordinating perception and action. This is what can be called the germline of abstracting a line, no matter whether the line is straight or a geodesic connection between mobile points.

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¹ The concept of similarity as understood technically in modelling does not mean correspondence. The model does not correspond with the target phenomenon, nor does the simulation of the model's behavior. The criteria of similarity are varied, some are based in representational fidelity, some based in dynamic, abstract and/or real properties of a phenomenon and some can be entirely based on the subjective decisions of the modeler to single out some aspect of a phenomenon rather than others.

From the evolutionary gesture of a predator to an artist's or a mathematician's abstraction of a line, there lies a gap of million years. To have a concept of the line is not the same as having an evolutionary gesture of a predatory chase line. To confuse between these two is to relapse on some form of naïve naturalism which people like Adolf Grünbaum have effectively debunked. If all abstractions were coming from nature or the problems of embodiment, then why it took us so long to come up with a non-Euclidean form of geometry, or even more starkly geometrical frameworks such as Cartanian geometry in which the perspective or the frame of reference is itself mobile and deracinated. What does the world look like once we apply such a geometrical framework to the furniture of the world? The world appears to be scattering, the perennial opposition between the ego and the world, inside and outside collapses. The inside infiltrates the outside and vice versa via a series of convolutions or twists. The classical phenomenalist encounter with a world that faces us like a distorted perspectival mirror image of ourselves in an abyssal lake is supplanted by various tidal movements that uproot both the observer and the observed. The analogy of the distinction between the embodied gesture can equally be posed in terms of the history of art in which new abstractions of lines and gaps (*lacunae*) are put forward not because they are given to us by nature but because such abstractions are acts of world-building and world-simulation. In a nutshell, saying that an abstraction is *afforded* by a natural gesture—the enactivist duality of action on perception—is not the same as saying the abstraction has been *constituted* by natural factors. Y being enabled by X does not mean it is constituted by X. To construct a new abstraction of a line, to draw a line is to simulate a new world by perceptual and embodied ingredients, gestures of mobility and halt, gaps and continuities. But the mere existence of such ingredients is not sufficient to make a line. One has to have a *recipe* of how to draw and redraw a line in thought. That is the act of worldmaking or simulation in the broadest possible sense.

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Kant has famously claimed that all mathematical cognitions are synthetic. A judgement such as ‘ $2+3=5$ ’ is synthetic. We often think of 5 as the unification of 2 and 3, but not in terms what this number (5) is. The cognition of 5 is not already given in the mere unification of 2 and 3. Hence, ‘ $2+3=5$ ’ is a synthetic—rather than analytic—act of cognition (*erkenntnis*). The concept of a straight line, however, is not a quantity, but a quality. It is the geometrical judgement about how to find the shortest path between two points. But even this geometrical judgement is also synthetic in so far as the concept of a straight line is not already given by two points. Instead, it is a synthetic judgement with regard to a cognitive recipe for finding or making the shortest path between two points. The same can be said about the concept of discreteness and continuity, connections and *lacunae*. Yet more interestingly, for geometrical cognitions such as a point, line or a plane, the synthetic judgements pertaining to such geometrical objects all have as their implicit assumption a *systematic concept* of space. This concept, however, is not empirical, but rather it is systematically cognitive. One cannot simply derive the concept of space by stacking spatial characteristics derived from our senses upon one another. For a point or a line to be located in thought or on a paper, it should be in one place rather than another. This very simple assumption ‘here or there, in one place rather than another’ already presupposes the whole of space, the systematicity of space in

cognition. But here a problem arises, what if we could reframe or reconstruct the systematicity of space, the concept of the whole of space? Does it mean by virtue of this reconstruction we can draw new lines, make new punctures in thought and in paper? The answer is resolutely ‘Yes’. This reconstruction can be made not only in geometry but also in art. The term for this act of reconstruction of the very concept of space as a whole and correspondingly, the synthetic acts of cognition (as in drawing a line) is *worldmaking*: what it means to simulate new world-versions.

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To make a world is to make a new model of the world and correspondingly, a new simulation of the world’s behavior—one that affords us with different if not more abstraction of things, both things in the new world and those which inhabit the old world. When it comes to worldbuilding, every act of cognition can be seen as an act of re-cognition. To make a new world, one has to re-cognize the old world. To make a new line, one has to re-cognize what it means to draw a line in thought. In his book *Ways of Worldmaking*, Nelson Goodman provides us with a tentative list of operations through which we can make new worlds, or world-versions, each of which is an act of knowing, re-cognizing the old world anew. Not only to re-conceive the old world but also to conceive hidden possibilities which might or might not have been given to us by the old world. In every simulation of X, we find ourselves confronted with hypothetical scenarios as how X behaves if we had changed this or that parameter, constrain or variable. We can apply the same operations to what it means to draw a line, what it means to have new acts of drawing itself:

- 1) *Composition and Decomposition*, which are operations by which things are taken apart and put together to make ever more new part-whole relationships, taxonomies, classes and subclasses of entities and their features whose combination results in the construction of complexes and the specific connections they afford. For example, think of how haptic predicates can be applied to the predicates of color in a painting to create synesthetic predicates, or metaphorical transfers which integrate the boundaries of different kinds of gestures, models, pictures, ideas, etc. A drawing made with monadic points as its ingredients is not exactly the same world as one made by points as intersections of lines, or a world in lines as boundaries of holes or lacunae. A world in which lines are boundaries of holes might look mysterious and unnerving to the inhabitants of a world made by intersecting lines and curves. Artaud’s punctured drawings look delirious to a classical painter. Each world-version is also a world-vision. Composition and decomposition, thus, provide bases for identification of entities and their features according to the overall organizational scheme of a world-system (i.e. how taking apart and putting together in thus-and-so ways generates patterns and classes).
- 2) *Weighting* which allows worlds to partition relevant and irrelevant classes of entities and features such that what is a relevant class for one world might be an irrelevant class for another. The question of ‘how long does it take for the earth to revolve around the sun?’ is a relevant class of problem in the Copernican system but not in the Ptolemaic one. Likewise, the question of ‘how long does it take for the sun to revolve around the earth?’ is relevant in the Ptolemaic system but not in the Copernican framework. Categorical schemata which portray the body of Christ—even the lines, folds and shades—can become

fundamentally different as the result of different kinds of emphasis in paintings made by, for example, Grünewald and Raphael. To thicken a line or to make a gesture of thickless line by a blurring effect or by giving a point the impression of being mobile or being a projectile are all emphases which not only belong to different worlds, they also make different worlds of drawing.

- 3) *Ordering* is an operation that mainly concerns with the order of derivation within a constructional framework. The order of derivation of points with respect to the Euclidean and non-Euclidean systems are different. In the Euclidean paradigm, point can be either given elements (intuitive axioms) or the result of an elementary construction over other axiomatic data (lines intersecting). But in the non-Euclidean worlds, the order of derivation can be fundamentally different and therefore, the cognitive apparatuses specific to that ranking or the order of derivability in the system can also differ. Worlds possess hierarchies of construction or the order of derivation. Such hierarchies *demarcate*, *limit* or *enable* transition from one perceptual or cognitive ability / machinery to another. For example, think of deriving a line by a series of discrete blots of ink on a piece of paper and how you can drive a line as the abutment between two gematrical figures.
- 4) *Deletion and Supplementation*: every worldmaking in one way or another requires a procedure of erasure or weeding out and filling the gaps with new materials. Lacunae and holes are not just eccentric geometrical objects, but also operative concepts of re-cognizing and re-visioning the world. The worlds made by deletion and supplementation are worlds which increasingly supply our cognitive armamentarium with new methods of construction, new anticipations, and ways out of our established order. Think about how cubism erases the elements of the classical figurative painting. But to the extent that in the way of worldmaking, erasure is not enough—what is erased should be often replaced by new supplements—every figure loses something but also is supplemented with new lines, lacunae and diagrammatic configurations.
- 5) *Deformation* or reshaping can involve either corrections or distortions, or both. For example, think of a painter who looks at her painting subject through a handmade lens or a roughly edged shard of glass. The anamorphic effect is literally a re-shaping of the perspective. The world made by this painter is far removed from one made by a draughtsman who uses a perspective machine. Imagine if Spinoza and Huygens were both draughtsmen. Given the fact that one used hand to make lenses and the other used machinery to create optical lenses, their world-versions and visions could be fundamentally different.

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The list of such worldmaking operations on how to draw and re-draw is not exhaustive or even compulsory. But through specification, diversification and employment of such operations, different kinds of drawings qua simulations can be devised. Not only familiar abstract drawings, but also increasingly alien drawings where at once our existing perceptual, cognitive and acting abilities are challenged and we are equipped with new modes of perception, cognition and action. This is how Rob Halverson's drawings should be engaged with, as ways of reformatting and reimagining the idea of how to draw a line in thought and on paper.