Lara Boyle //

At first glance, Naum Gabo's *Kinetic Construction* is nothing special. A thin, motionless steel rod extends from a pit located in the base of a black square. With the push of a button, however, the rod springs to life. The rod wiggles back and forth as a motor beneath the base whirs with a soft hum. The oscillations force the rod to bend and bulge, and the resulting motion transforms a plain stick into a fundamental physical form: a standing wave.

*Kinetic Construction* is often considered the first work of the kinetic art movement, which explores sensations caused by literal or illusory motion[1]. Gabo was a Russian and Jewish artist at the turn of the 20th century, but his original training was in medicine and the natural sciences. His scientific training instilled in him an enduring interest in how art could represent space and time. Indeed, Gabo did not originally design *Kinetic Construction* as a work of art, but rather as a tool to teach the principles of kinetic energy to his students.

Can you separate an object's volume and mass? Gabo believed it was not only possible, but necessary. Of this effort, Gabo stated, "Every engineer knows that the static forces of solids, their material resistance, are not a function of their mass…but you sculptors of any trend and any nuance, you always cling to the old prejudice according to which it is impossible to free volume from mass."[2] Gabo's *Head No. 2* is a prime example of his ability to sever the seeming link between these elements. An object can be "big" without being "heavy."

After his initial studies of space, Gabo moved toward capturing time in his art via pieces that created a sense of motion. In his Realistic Manifesto, Gabo admonished artists that worked solely in two-dimensional space. He wrote, "We renounce the thousand-year-old delusion in art that held the static rhythms as the only elements of the plastic and pictorial arts. We affirm in these arts a new element, the kinetic rhythms as the basic forms of our perception of real time[2]." Gabo similarly criticized other contemporary abstract art movements like Cubism and Futurism for not going further in their abstraction.

Far before the time of Gabo, individuals explored how moving structures could enchant audiences. Automata, self-moving machines that follow a predetermined series of commands, existed as far back as 150-100 B.C[3]. Likewise, cuckoo clocks with predictable motion have mesmerized since the 17th century[4]. These creatures and machines, however, are chained by the orders of their circuitry. Most modern kinetic artists prefer to allow external forces, from wind to gravity to the viewers themselves, to generate the motion. These forces grant kinetic art a level of spontaneity and flexibility not seen in the automata.

Silver swan (an 18th century automaton). Photo by Glen Bowman via Flickr, CC BY-SA 2.0.

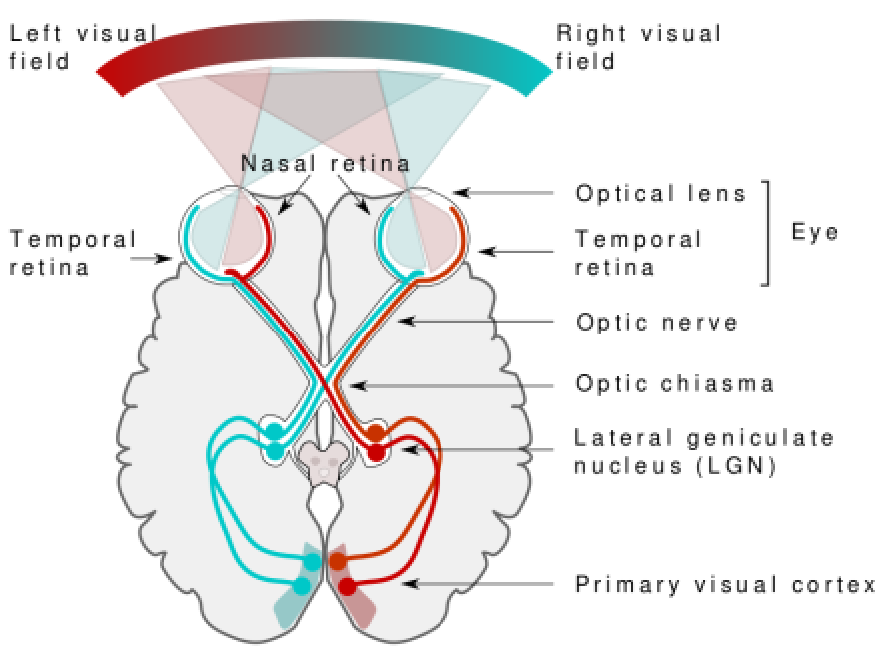
Take modern kinetic artist Anthony Howe, who is best known for his dazzling sculpture at the 2016 Rio Olympic games. Howe uses interconnected repeating structural elements to generate otherworldly and elegant sculptures, which flow and change over time. The speed of the wind shapes the experience of the viewer. His sculptures must both move with little wind and withstand huge gales, and thereby also present immense technical challenges along with artistic ones.

Why does kinetic art mesmerize? In 1994, two neurologists by the name of Dr. Zeki and Dr. Lamb argued that kinetic artists unwittingly built pieces that specifically and maximally “turned on” regions of the brain important for processing visual motion[5]. Because the ability to watch or track objects as they move through space is one of the most useful skills that humans possess, it requires a surprising amount of brain power.

Let’s say that you and your friends decide to play a game of catch. As soon as your friend tosses the ball, your eyes are drawn to the movement. Not only can you find the ball, you can also track that ball through space with relative ease. Even if you are not expecting the throw, you can orient yourself and, if you are graced with good hand-eye coordination, catch the ball. Perhaps most impressively, you can predict where the ball will be in the future. You don't need any knowledge of the ball's velocity or mass to predict where it will go; your brain does all the work for you, instantaneously and outside your conscious awareness.

The catcher not only tracks the ball, but predicts where it will go and unconsciously moves towards it. Graham Richter, CC BY-SA 3.0, via Wikimedia Commons

In *World We See, Part 4*, I covered how ganglion brain cells at the back of the eye began to process color and brightness information of our visual world. These cells send this information towards the brain via axons, the brain cell equivalent of telephone cords. These axons travel in tight bundles from the back of the eye until they reach the optic chiasm. There, the cords cross so that information from the right visual field will be processed by the left brain, and vice versa. See the below diagram to understand how information is shuttled to the left and the right brain.




Ganglion cells cross over at the optic chiasm and send information to the LGN. Miquel Perello Nieto, CC BY-SA 4.0, via Wikimedia Commons

The axons finally reach their targets – cells in an area of the brain called the lateral geniculate nucleus (LGN) of the thalamus. The name isn't important; but the thalamus is known as the first processing area of all sorts of sensory information in the brain (the odd and notable exception being smell). Two main cell types abound in the LGN: the petite parvocellular cells (P-cells) and the relatively massive magnocellular cells (M-cells).

As we have seen in *Part 3* and *Part 4*, the brain prefers to separate different features of the environment from one another, so they can be processed in parallel as opposed to sequentially. P-cells will receive most of the eye's color information; that is, all the information from the cones discussed in *Part 3* and the single-opponent cells discussed in *Part 4*. M-cells, on the other hand, mostly receive information from the color-blind rods in the eye. The relationship between P- and M-cells is like that of the tortoise and the hare. P-cells send out information slowly but surely. Color information is important, but rapid changes are rare – so what's the rush? M-cells like to send out quick bursts of information before quieting down. Fast communication is a must for detecting movement. The major limit in the brain for identifying motion comes from how fast these chubby cells can fire.

The LGN is layered like a cake, with M- and P-cells processing motion/depth and color information, respectivelyP- and M-cells communicate with cells in the far end of the brain, in an area called the primary visual cortex. By combining information from multiple LGN cells, the occipital lobe starts to construct a complex picture of the world where objects do not exist as separate pixels but as cohesive objects with traits like color, shape, and motion. As an example, some cells in the primary visual cortex are only turned on when a part of an object moves in a certain direction or orientation.

In their paper on kinetic art and neurology, Drs. Zeki and Lamb asserted, "In its development, kinetic art underemphasized or even eschewed form and colour in its efforts to promote motion… by deemphasizing colour, kinetic artists then tailored their art to stimulate optimally the two M-dominated areas [of the occipital lobe][6]." When Naum Gabo created *Kinetic Construction*, there was no scientific understanding that motion might be processed by the brain in any unique way. Drs. Zeki and Lamb argued that the creation of kinetic art was an instinctual process governed by trial and error, through which artists found a way to specifically target the piece of the visual system that processes movement.

I imagine Gabo, a scientist in his own right, would be pleased to learn that his emphasis on motion mirrors how the brain functions. After all, Gabo believed that art had a special place in the discovery and creation process: "What we cannot express by the art of thinking, by the art of science or philosophy or logic, we can and should express by the poetic, visual, or some other arts. It is for that reason that I consider morals and aesthetics one and the same; for they cover only one impulse, one drive inherent in our consciousness – to bring our life and all our actions into a satisfactory relationship with the events of the world, as our consciousness want it to be, in harmony with our life and according to the laws of consciousness itself[6]."

At this point we've covered how objects in space get their color and motion. But how does the brain define an object? How do artists distinguish between objects and background in space? Stay tuned to learn more.

Citations:


1. "'Kinetic Construction (Standing Wave)', Naum Gabo, 1919-20, Replica 1985." *Tate Museum*, http://www.tate.org.uk/art/artworks/gabo-kinetic-construction-standing-wave-t00827.
2. Gabo, Naum, and Nikolaus Pevsner. *Realističeskij Manifest = The Realistic Manifesto*. 1920.
3. Jones, Alexander. "Antikythera Mechanism." *Oxford Research Encyclopedia of Classics*, 2017, doi:10.1093/acrefore/9780199381135.013.8157.
4. Johannes Graf, The Black Forest Cuckoo Clock. A Success Story. NAWCC Bulletin, December 2006; p. 646.
5. Zeki, S., and M. Lamb. "The Neurology of Kinetic Art." *Brain*, vol. 117, no. 3, 1994, pp. 607–636., doi:10.1093/brain/117.3.607.
6. Hadden, Peggy. "*The Quotable Artist*". Allworth Press, 2007.