

MO COSTANDI

Neuroscience writer

IMPLIED MOTION IN HOKUSAI MANGA

Posted on [Tuesday, March 23, 2010](#) by [Mo Costandi](#) under [Art](#), [fMRI](#), [Neuroscience](#), [Vision](#)

ARTISTS EMPLOY A NUMBER OF DIFFERENT TECHNIQUES TO REPRESENT IMPLIED MOTION IN two-dimensional works. One of these, commonly used in posters, comics and animation, is the affine shear effect, whereby a moving object is depicted as leaning into the direction of movement. Cartoonists also use action lines to depict movement and speed, with straight lines conveying fast movements and wavy lines conveying slower ones. Motion can also be conveyed by superimposing several images showing the successive positions of a movement, or by a blurred image showing the different positions simultaneously.

The Japanese artist and printmaker Katsushika Hokusai (1760-1849) used a different and innovative technique to convey motion. The simple line drawings in his Manga strips lack all of the commonly-used motion effects, yet give a strong impression of movement by depicting the human body in highly unstable postures. As [a new study](#) just published in the journal *NeuroReport* shows, the figures in the sketches are

perceived to be moving because their gravity-defying postures activate regions of the visual cortex that are sensitive to motion.



Dancing figures

Hokusai Manga is a collection of over 3,000 small, woodblock-printed sketches that was published in 15 volumes between 1815 and 1878. The drawings depict various aspects of everyday Japanese life as well as animals, objects and mythological characters. Hokusai was inspired by, among other things, European scientific illustrations, and his sketches are based on keen observation. His ability to gracefully depict the human body in motion is exemplified in the sketch *Suzume Odori-zu* ('Dancing Sparrows', top) from volume 3 of the Manga, and in many of the sketches contained in volume 6, which is devoted to the martial arts (above).



Performances

It is well established that static images with implied motion activate a subregion of the extrastriate cortex referred to as area V5 or area MT. This is a part of the visual cortex located in the inferior temporal gyrus, which contains neurons that are sensitive to motion. (V5 has even been shown to be activated by verbs such as “walking”, or mimic words that imply the same action.) Research into this phenomenon often uses paintings and photographs as visual stimuli. Abstracted drawings such as those contained in the Hokusai Manga have been used seldomly, however, so Naoyuki Osaka of Kyoto University and his colleagues set out to establish whether or not they have the same effect.

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The researchers recruited 14 university students and showed them Hokusai Manga illustrations while scanning their brains by functional magnetic resonance imaging (fMRI). Three different types of illustrations were used: one set depicted people in positions that strongly imply motion, another showed people without implied motion (such as the sketches of the priests above), and a third showed inanimate objects. Sixty of each type were presented in a randomised order, for 2 seconds each and separated by an interval of half a second. The participants were required to indicate which of the illustrations gave the impression of motion, and how strong or weak that impression was, by pressing a button.



As would be expected, all of the sketches activated the primary visual cortex, which contains neurons that are responsive to specific properties of visual stimuli, such as contrast and the orientation of edges. The sketches with implied motion, but not those without, strongly activated the motion-sensitive visual cortical areas on both side of the brain, and also elicited weak activity in the cerebellum. Classically, the cerebellum is said to be involved in balance and coordination of movement, but it is also known to play a role in the perception of motion, and several studies have shown that patients with cerebellar lesions have motion perception deficits.

The authors suggest that the unstable postures in the Hokusai Manga figures act as visual cues that induce the effect of implied motion. Their research could be extended to investigate whether the sketches of animals also activate motion-sensitive brain regions. Hokusai was also fond of depicting water in motion, as is evident from his best-known work, *The Great Wave Off Kanagawa*. We know that the brain is particularly sensitive to biological motion, so it would also be interesting to investigate if this print, and others that feature moving water, also produce the implied motion effect.

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Osaka, N., et al. (2010). Implied motion because of instability in Hokusai Manga activates the human motion-sensitive extrastriate visual cortex: an fMRI study of the impact of visual art. *NeuroReport* 21, 264-267. DOI: [10.1097/WNR.0b013e328335b371](https://doi.org/10.1097/WNR.0b013e328335b371).

Kourtzi, Z. & Kanwisher, N. (2000). Activation in Human MT/MST by Static Images with Implied Motion. *J. Cog. Neurosci.* **12**: 48-55. [[PDF](#)]

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4 thoughts on “Implied motion in Hokusai Manga”

frog

Tuesday, March 23, 2010 at 6:32 pm

As a new study just published in the journal NeuroReport shows, the figures in the sketches are perceived to be moving because their gravity-defying postures activate regions of the visual cortex that are sensitive to motion.

This seems to have it upside down, analytically. Of course, the only way for an image to be “perceived as moving” requires, is equivalent to, “activating regions of the visual cortex that are sensitive motion”. If they didn’t, one would have to question whether we’ve properly identified the regions of the visual cortex that are sensitive to motion!

Perception of visual motion IS activation of regions that are sensitive to visual motion.

The question is how do such complex abstraction as “unstable postures” lead to that activation. You can’t expect that there are “unstable posture neurons” like contrast structures — it takes pretty sophisticated processing to identify entities that can have postures, much less that the posture in that context is unstable. Perception in this case must be highly influence from what is traditionally thought of as downstream of raw “visual cortex” processing — which is hidden by glib statements about “activation of the visual cortex”.

Briana

Wednesday, March 24, 2010 at 5:45 pm

I agree with frog, the expectation of moment would obviously activate the areas that perceive movement. A more interesting question is why lines and forms can trick the brain into perceiving movement based on rules of gravity which clearly do not apply to an image.

I suppose this study does show that viewing an image implying motion activates the same place as seeing real movement does, showing the brain as a space-saving device and also naive.

It would be interesting to see what process is going to work making sure the viewer doesn't think the image is ACTUALLY moving, perhaps by comparing results with the perception of photographs, animation, video, and physical movement.

Love Hokusai's work. 😊 Thanks for the post!

Erwin Keustermans

Wednesday, March 24, 2010 at 7:27 pm

what a load of gobbledygook. It gives my cortex the creeps.

Bob

Thursday, April 29, 2010 at 9:18 pm

As a cartoonist and commercial illustrator I don't buy most of this.

I believe that the images listed are not innately understood to represent movement, but that we learn to "read" such images in much the same way that we learn written

characters. Some (art) schools are particularly slavish to simple techniques that emphasize 'lines of motion' simply because they are the most commonly understood.

It is no wonder that these images get mixed up with language centers of the brain. The process of abstraction of ideas is similar...

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