

# Activation in sensory brain areas reflecting creator's visual intention

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## Abstract

Visual creations such as paintings and designs portray what creators had in mind and wished to express. Such “visual intention” of the creators is explicit and ready to be seen in some cases but is implicitly embodied and obscured in others. Considering that experiencing those creations are fundamentally a perceptual act that emerges from neuronal events, success of a creator can be evaluated by testing whether the creator's intention resonates with viewers' sensory systems and is reflected by neurosensory events. In this talk, I'm going to discuss a couple of studies of mine to address this point using functional Magnetic Resonance Imaging (fMRI). One study exploited a specific kind of abstract paintings in which artists intended to portray motion. Whether the impression of motion in those paintings is associated with activation of motion-sensitive area MT+ was investigated. The other study utilized images of products of which design included visual features inducing perceptual impression in another sensory modality. Whether the neural machinery that ordinarily engaged during perception of real sensory stimuli is activated when people view this kind of products was explored.

**Key words:** *painting, design, visual intention, sensory system, fMRI*

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## Study1. Brain activity accompanying perception of implied motion in abstract paintings (Kim & Blake, 2007)

Early 20th century artists including Duchamp and Balla tried to portray moving objects on a static canvas by superimposing objects in successive portrayals of an action (Cutting, 2002). This study investigated whether implied motion in those paintings is associated with activation of motion-sensitive area MT +.

### Methods

Motion Rating: 12 abstract paintings with implied motion and 12 abstract paintings that were not intended to portray motion were selected. Observers used a 5-point scale to rate the extent to which those paintings portray motion, with the scale values ranging from 1 ('no sense of motion') to 5 ('very strong sense of motion'). Each image was presented for 1 s and observers rated the

image by pressing one of five buttons on a keyboard.

fMRI: fMRI was used to measure brain activity of observers while viewing abstract paintings receiving the highest and the lowest motion rating scores in Motion Rating. Five individuals (2 male, 3 female) with prior experience of abstract paintings exploiting multiple stroboscopic images and five individuals (3 male, 2 female) without prior experience participated in this study. All participants were naïve about the purpose of the experiment and none of them participated in Motion Rating. Visual area V1 and visual motion-sensitive area MT+ were functionally localized using conventional rotating wedge stimuli with counter-phase flickering checkerboard patterns (Sereno *et al.*, 1994) and optic flow stimuli respectively. In the main experimental session, Each 4 s trial began with 1 s presentation of a stimulus (abstract painting), then a 2 s response period followed by 1 s fixation period. The fixation cross remained visible throughout the scan, and the observer

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was instructed to maintain fixation while attending to the entire stimulus. The observer performed a 1-back task to maintain attention. Image preprocessing and analysis of the localizer runs was conducted in Brain Voyager 4.9 and QX v.1.2 (Brain Innovations, Inc.). Raw BOLD signal of each main experimental run in the voxels defined as ROIs (V1 and MT+) was averaged. The time series from each event onset to 16 s thereafter was extracted from each ROI to compute respective percentage signal changes, with the no-event time series as baseline.

## Results

**Motion Rating:** We found that observers rated abstract paintings with implied motion higher in portraying motion than they did other abstract paintings in which motion is not intended. We also found that observers who had previously experienced abstract paintings with implied motion tended to give higher motion ratings to that class of paintings.

**fMRI:** BOLD responses within MT + were larger in response to abstract paintings that convey a strong sense of motion, compared to abstract paintings rated weak in implied motion. However, these differences in MT + activation were seen only in observers with prior experience viewing these kinds of art. Within V1, however, 'motion' and 'static' paintings evoked equivalent responses in both groups of observers.

## Discussion

Results from this study suggest that subtle expression of motion implicitly embodied in abstract paintings can evoke activity in a human brain area generally regarded as an essential component in motion perception. Our results represent a step beyond those found in previous, related studies revealing MT+ activation does accompany perception of illusory motion (apparent motion: Kaneoke *et al.*, 1997; illusory motion: Conway *et al.*, 2005; the motion aftereffect: Culham *et al.*, 1999; motion scintillation associated with op-art: Zeki *et al.*,

1993). The sense of motion associated with viewing paintings by Duchamp and by Balla can be differentiated from perception of illusory motion. The paintings require active interpretation and an understanding of a given visual stimulus, and even then the viewer does not perceive actual movement within the painting. Our findings also extend previous studies showing MT+ activation produced by viewing photos with implied motion (Kourtzi and Kanwisher, 2000). Our results suggest that those paintings and, therefore, the artists who created them, were truly successful in stimulating brain mechanisms that create perception of motion.

## Study2. Brain activity reflecting experience of implied sense in visual product designs

Designers are faced with a challenge to create captivating products that can be enjoyed and chosen by people. Appealing to the multiple aspects of an individual's senses is one good strategy for product designers. The present study investigates whether designers' intention to introduce perceptual experience in another sensory modality to the product designs are reflected by neural response within the relevant brain areas.

## Methods

23 right-handed female participants mean age=21.4, SD=±1.8) were scanned with 3T MRI machine (ISOL Tech, Oxford OR63), while they were viewing sequentially presented visual product designs; In one session, 20 visual product designs with implied gustatory experience (VG) and 20 control product designs (VGc) were presented in a randomized order. VGc were created by modifying VG so that the visual features responsible for implied gustatory experience were removed. In another, separate session, 20 visual product designs with implied kinesthetic experience (VK) and 20

corresponding control designs (VKc) were presented.

Participants viewed passively the presented stimuli during scanning. Each trial started with a fixation cross (2-4s) followed by a presentation of the product design (1s). The fMRI data were acquired by 3T MRI machine (ISOL Tech, Oxford OR63) and analyzed with SPM5.

Following standard preprocessing steps, time series data were convolved with a hemodynamic response function to create regressors for gustatory (VG), kinesthetic (VK), and “multi-sensory” (VG+VK) designs.

## Results

Results showed that visual product designs with implied gustatory experience (VG), in particular, showed greater activation than the matching control designs (VGc) in the insula region. It's been shown that this area is associated with actual gustatory perception (Small *et al.*, 1999) and gustatory imagination (Porubska, 2006). In contrast, visual product designs with implied kinesthetic experience (VK) elicited greater activation in the occipito-temporal junction near the visual motion sensitive area MT+ and the supplementary motor area (SMA) than did VKc. Both of these areas are shown to be involved in motor simulation such as imagination of tool use (Ruby & Decety, 2001).

## Discussion

The present study showed that visual features in product designs inducing perceptual impression in another sensory modality indeed left neural signatures in the relevant brain regions. We have a reason to assume that the brain responses reflecting the implied sense in the VG and VK are linked to people's preference for those products (see the poster by Sung et al. in this workshop). Our results suggest that those products with additional sensory experience implied and, therefore, the designers who created them, were truly successful in stimulating brain mechanisms that process perception and imagination of those senses.

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