Theories of consciousness :

1. Global workspace of information (Newman & Baars, 1993; Baars, 1983)

2. Integration of information (Tononi,2008)

3. Neural oscillations or thalamocortical loops that may form the mechanism for the binding of information across brain areas (Engel & Singer, 2001; Crick & Koch, 1990)

Newman, J., & Baars, B. J. (1993). A neural attentional model for access to consciousness: A global workspace perspective. Concepts in Neuroscience, 4, 255–290.

Baars, B. J. (1983). Conscious contents provide the nervous system with coherent, global information. In R. J. Davidson, G. E. Schwartz, and D. Shapiro (Eds), Consciousness and Self Regulation (p. 41). New York: Plenum Press.

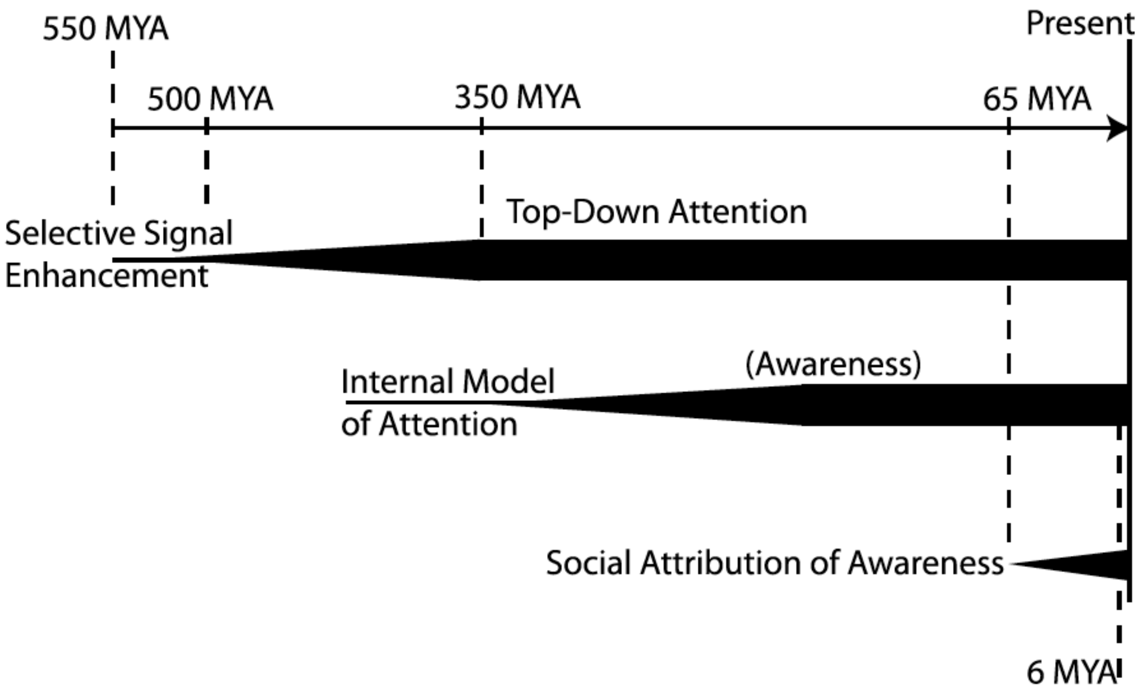
Tononi, G. (2008). Consciousness as integrated information: A provisional manifesto. Biological Bulletin, 215, 216–242

Engel, A. K., & Singer, W. (2001). Temporal binding and the neural correlates of sensory awareness. Trends in Cognitive Science, 5, 16–25.

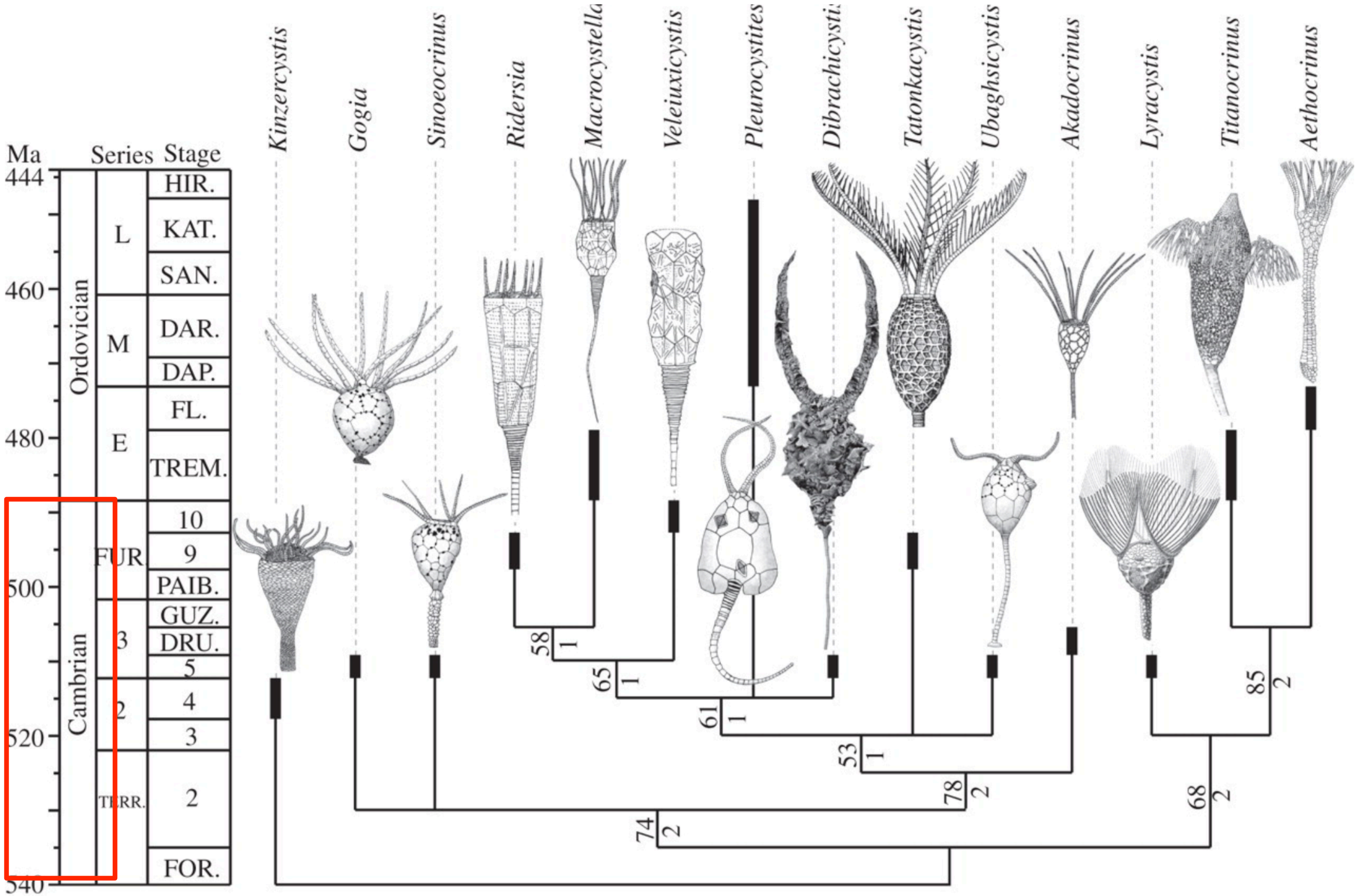
Crick, F., & Koch, C. (1990). Toward a neurobiological theory of consciousness. Seminars in the Neurosciences, 2, 263–275.

About half a billion years ago, neuronal nets evolved a fundamental new ability that allowed salient signals to win a competition and become enhanced at the expense of other signals.

Attention is something the brain does. It is a data handling method in which selected signals are enhanced at the expense of other signals.



Graziano, M. (2014). Speculations on the Evolution of Awareness. Journal of Cognitive Neuroscience, 26(6), 1300–1304.



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Kinzercystis
Gogia
Sinoeocrinus
Ridersia
Macrocystella
Veleuxicystis
Pleurocystites
Tatonkacystis
Ubaghsicystis
Akadocrinus
Lyracystis
Titanocrinus
Aethocrinus
58
1
65
1
61
1
53
1
78
2
74
2
68
2
85
2

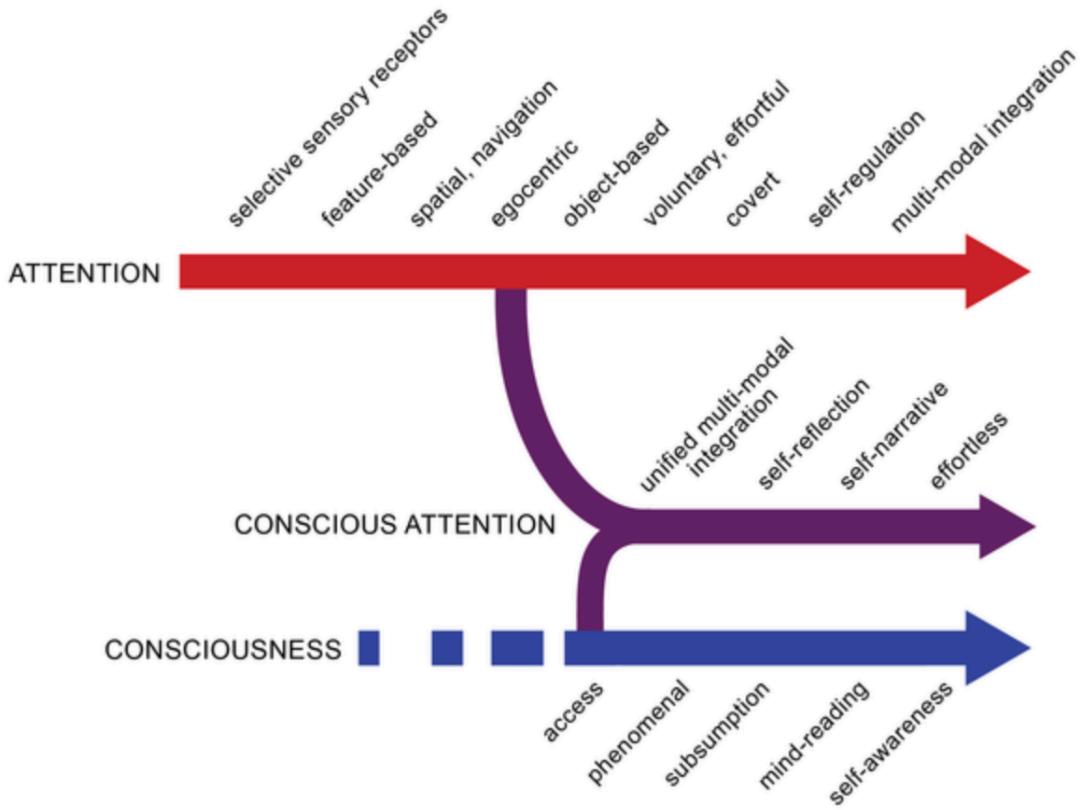
Hydras evolved approximately 550 MYA with no selective signal enhancement. *Animals that do show selective signal enhancement diverged from each other between approximately 550 and 500 MYA*.

Animals such as birds and mammals that show sophisticated top–down control of attention diverged from each other approximately 350 MYA.

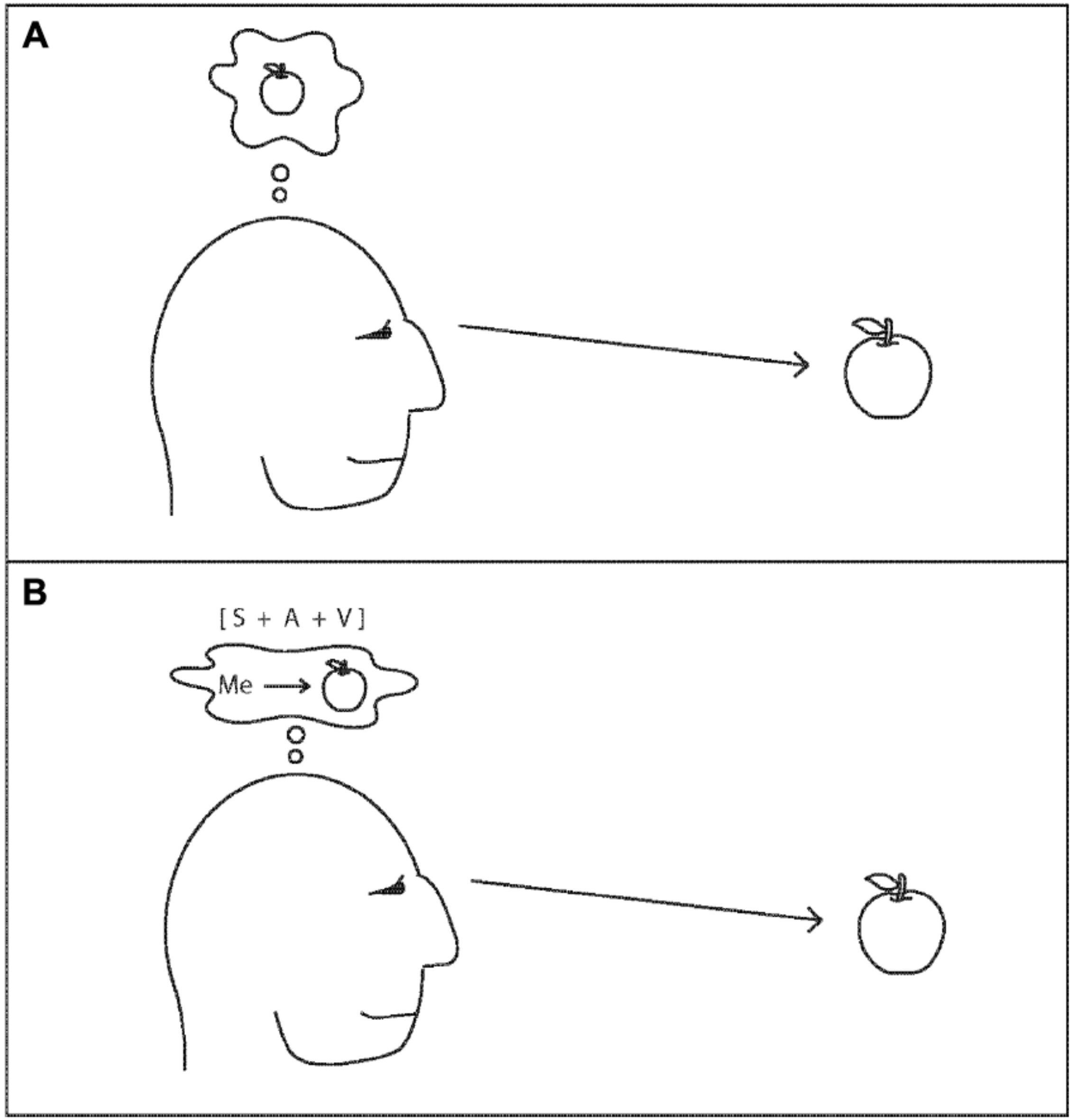
Primates first appeared approximately 50-55 MYA. Hominins appeared approximately 6 MYA.

Graziano, M. (2014). Speculations on the Evolution of Awareness. Journal of Cognitive Neuroscience, 26(6), 1300–1304.

Mammals appeared on the earth long before the extinction of the dinosaurs; in fact, dinosaurs and mammals originated within 10 million years of each other, in the late Triassic **about 200 million years ago**.



Gradually, this signal enhancement came under top–down control and became selective attention. To effectively predict and deploy its own attentional focus, the brain may have evolved a constantly updated simulation of attention or attention schema

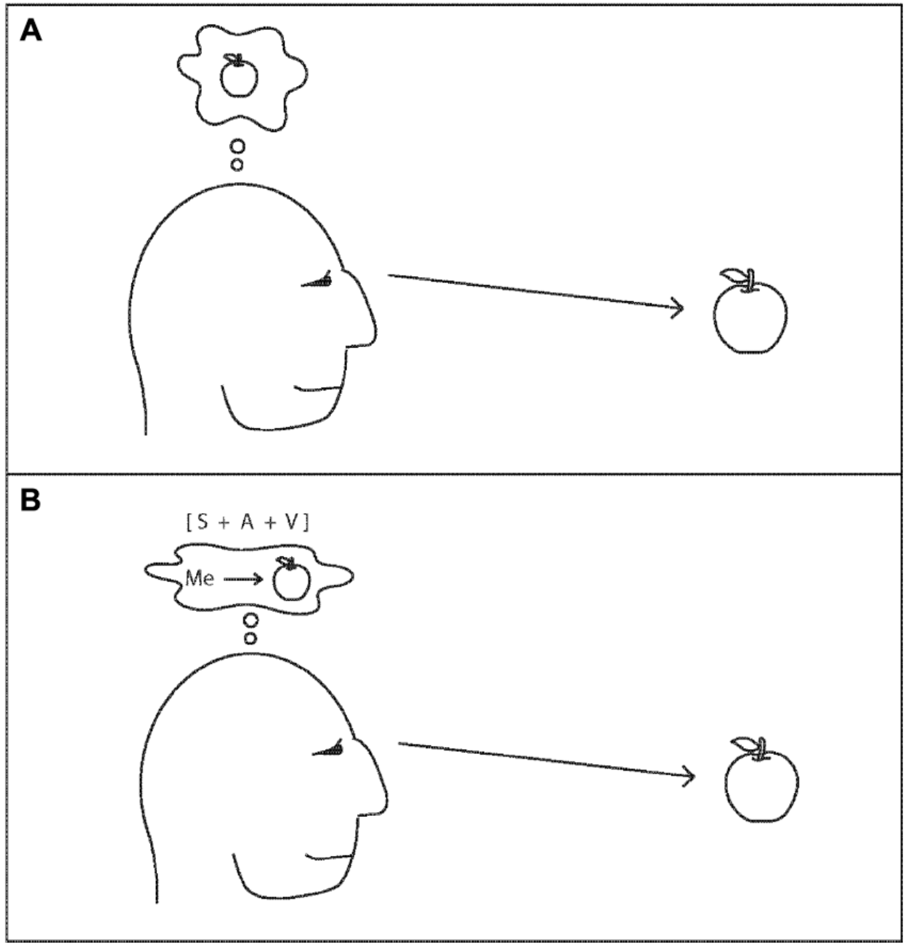


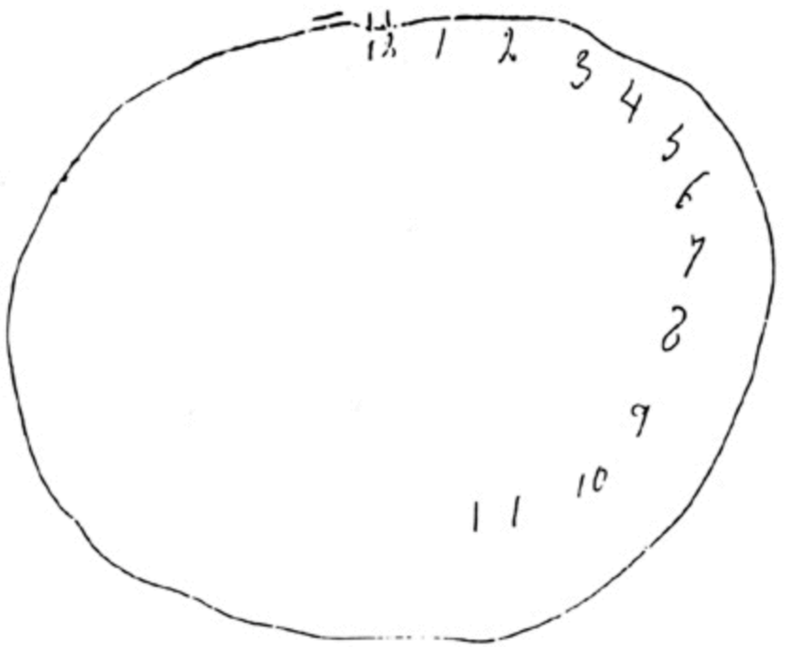
The attention schema theory.

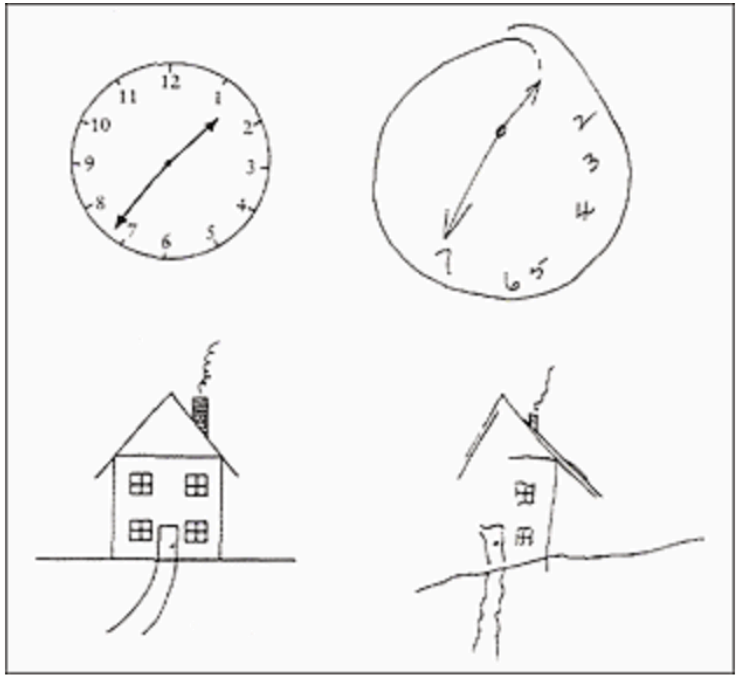
(A) Visual attention is captured by the image of an apple. On its own, this process results in the ability to accurately process the stimulus features – shape, color, motion, etc. – of the apple, but it does not provide any basis for the brain to conclude that it possesses subjective awareness of the apple.

(B) In order for the brain to conclude that it possesses subjective awareness of the apple, the brain requires more than just information about the visual stimulus [V]. It requires that the brain also have information about the self [S], and about the process that links the two together, attention [A], such that the larger, overarching relationship between self, attention, and stimulus [S+A+V] can be represented. According to the theory, the A component of this larger representation would not include any of the physical, mechanistic details of the real process of attention, and so it would appear to depict a physically impossible entity, a process that can accomplish the same things as attention without the mechanistic basis for doing so. This brain would conclude that it possesses a fundamentally mysterious property: a mental possession of something, a subjective awareness. In this account, the brain's conclusion that it has subjective awareness reflects the information contained in a simplified but useful model of attention, an attention schema.

(C) Graziano, M., & Webb, T. (2015). The attention schema theory: a mechanistic account of subjective awareness. Frontiers in Psychology, 06, 500. frontiers. doi:10.3389/fpsyg.2015.00500


A
B
[S + A + V]
Me

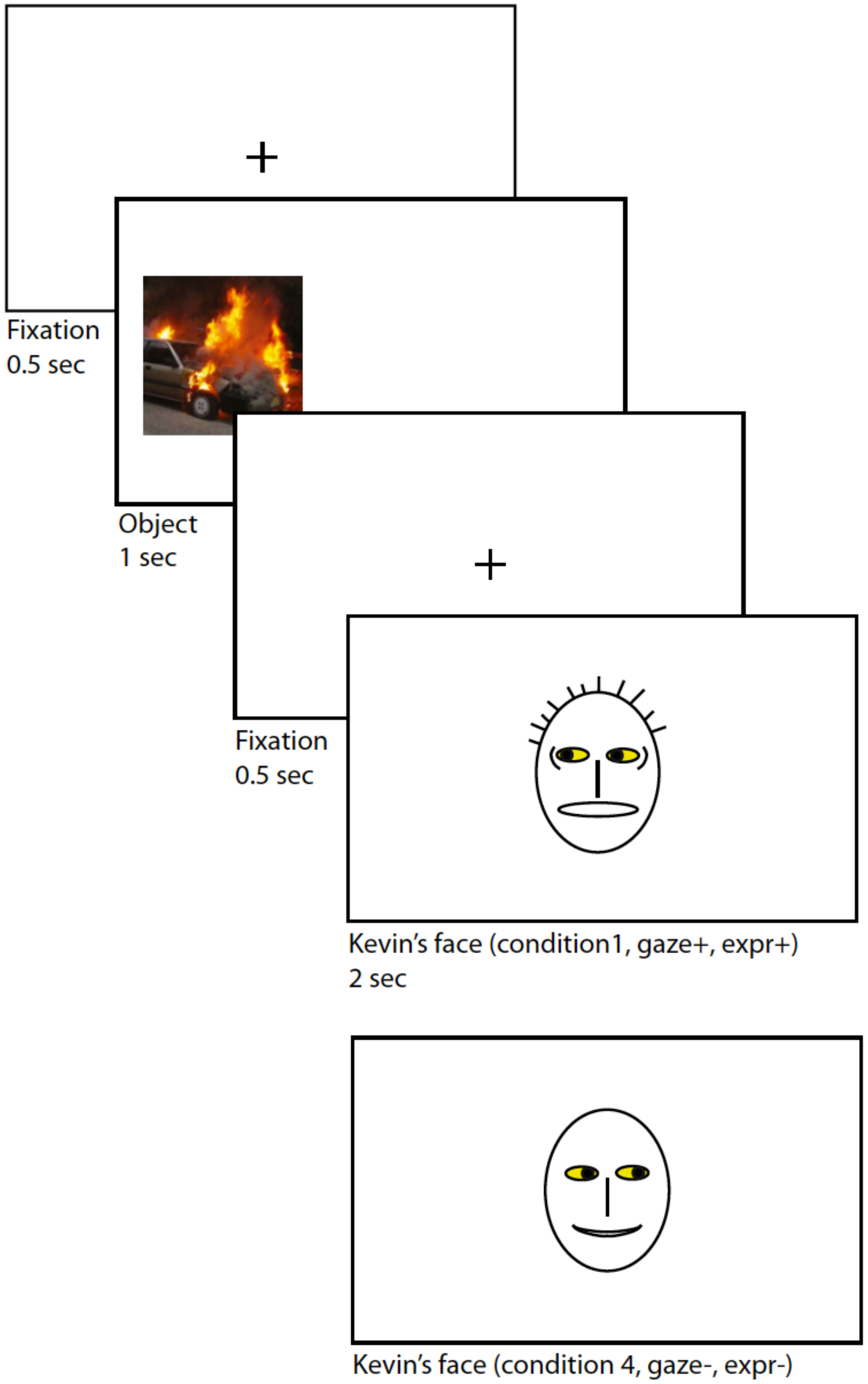




Neglect Syndrome (a.k.a Hemi-neglect)

- Fails to respond to meaningful stimuli presented to side opposite brain lesion (contralateral space)
- Ignores people on one side of room; eats from only one side of plate; draws half of an object, grooms half their body.
  - But can adapt by learning to turn plate; to turn head; to move objects across visual field.
- Not due to motor defects
- **Occurs in**
  - 30-90% Right hemisphere damaged patients (RHD), depending on type of patient (tumor, injury, etc) and type of test
  - 2-15% Left hemisphere damage (LHD)

- Right Parietal Stroke – recovery at 2 months, 4 months, 6 months, 9 months

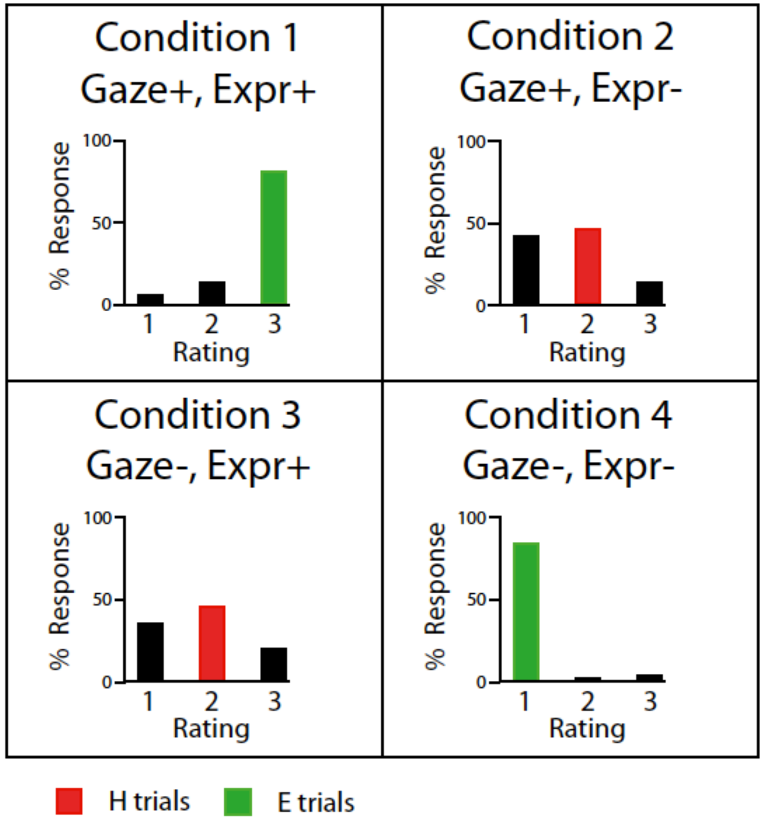


Social attribution task.

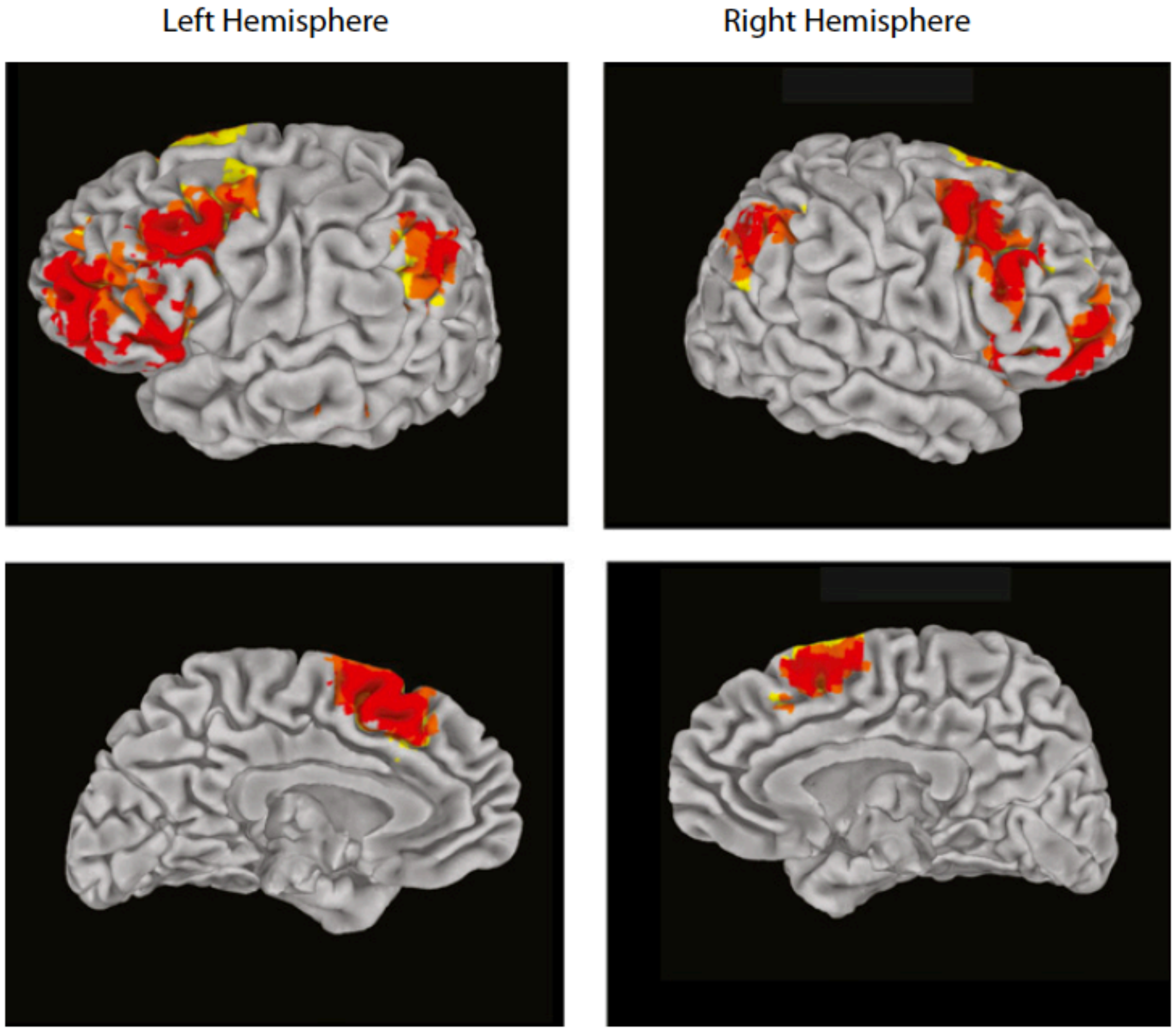
Subjects pressed buttons to rate Kevin's awareness of the object on a scale of 1 (not aware), 2 (somewhat aware), or 3 (very aware). Two versions of the face stimulus are shown corresponding to trial condition 1 (gaze and expression both aligned to the object: gaze+, expr+) and condition 4 (gaze and expression both misaligned with the object: gaze–, expr–). Other conditions included condition 2 (gaze+, expr–) and condition 3 (gaze–, expr+).

Kelly, Y., Webb, T., Meier, J., Arcaro, M., & Graziano, M. (2014). Attributing awareness to oneself and to others. Proceedings of the National Academy of Sciences, 111(13), 5012–5017.

Behavioral results for the social attribution task. Bars show percentages of the three different ratings among all trials by all subjects. Two trials types were defined: “easy integration” (E trials, green bars) and “hard integration” (H trials, red bars). In E trials, behavioral responses suggested that the subjects interpreted the two cues as consistent with each other, both indicating a high degree of awareness or both indicating a low degree of awareness. In H trials, behavioral responses suggested that the subjects had interpreted the two cues as discordant with each other, one cue indicating a high degree and one cue indicating a low degree of awareness, resulting in a judgment that compromised between the two cues.

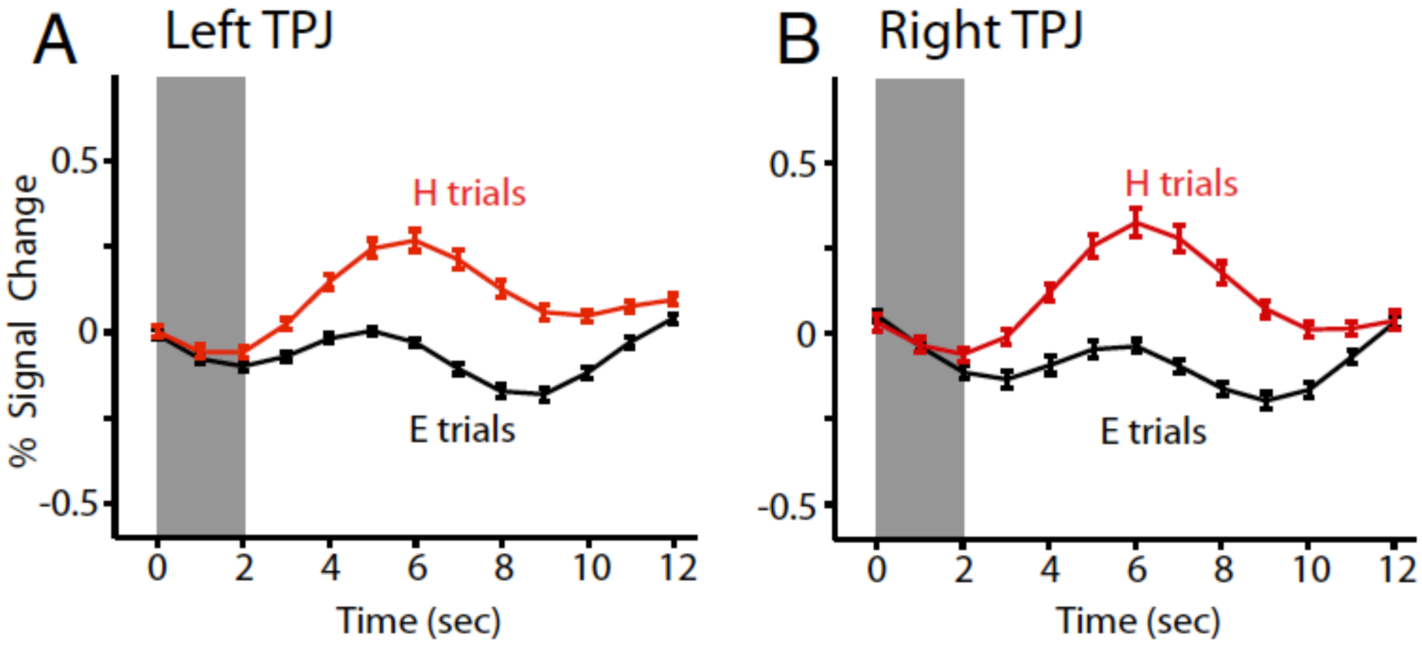


Kelly, Y., Webb, T., Meier, J., Arcaro, M., & Graziano, M. (2014). Attributing awareness to oneself and to others. Proceedings of the National Academy of Sciences, 111(13), 5012–5017



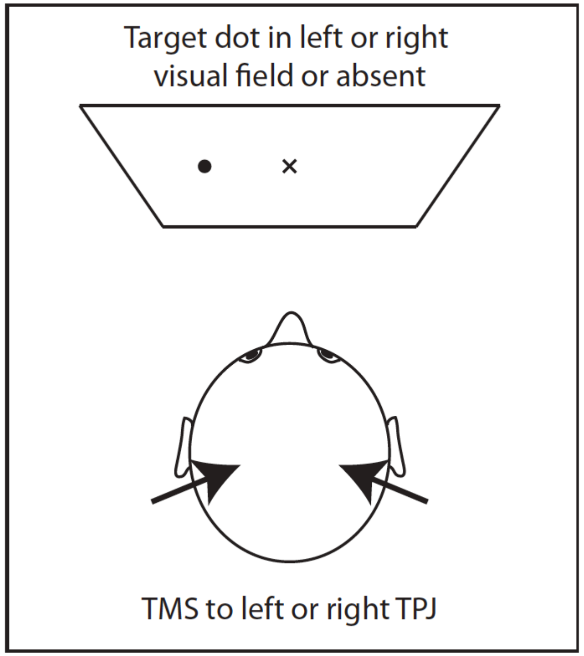
Group fMRI data from 50 subjects. Data were aligned to Talairach coordinates and projected onto a standard pial surface. The contrast performed was H trials – E trials. Thresholded at $P < 0.05$, corrected for multiple comparisons adjusted for a 15-voxel minimum cluster size.

Kelly, Y., Webb, T., Meier, J., Arcaro, M., & Graziano, M. (2014). Attributing awareness to oneself and to others. Proceedings of the National Academy of Sciences, 111(13), 5012–5017

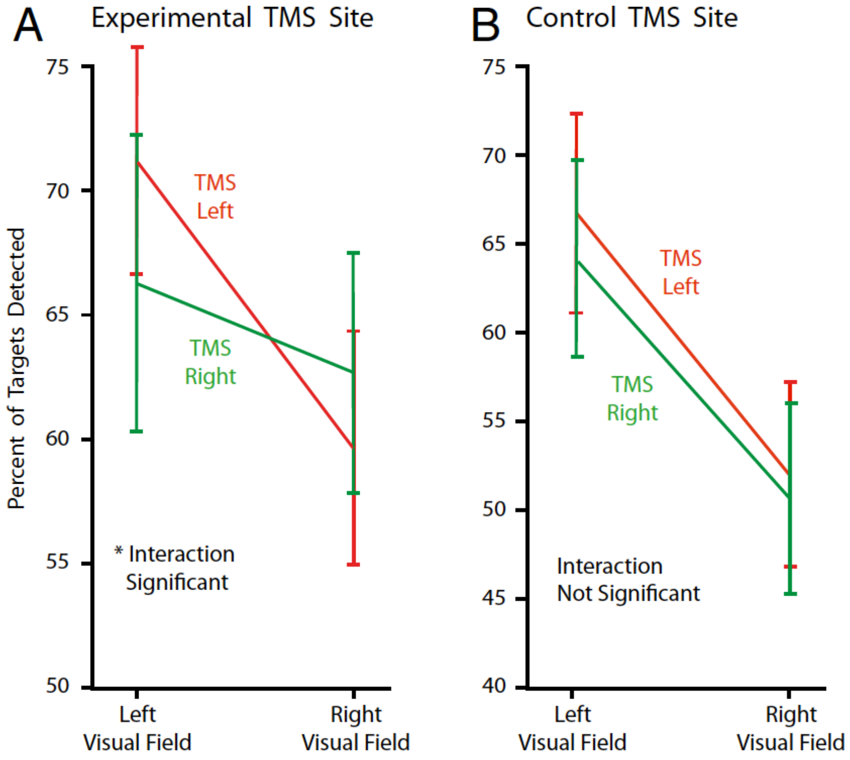


Time series data for the left (A) and right (B) TPJ. For each brain area, mean fMRI activity is shown as a function of time through the trial. The activity is averaged over eight adjacent voxels per subject and averaged over all subjects (error bars show SE among subjects). The gray bar shows time of face presentation. The TPJ showed significant activity during the social attribution task and was significantly more active in H trials than in E trials.

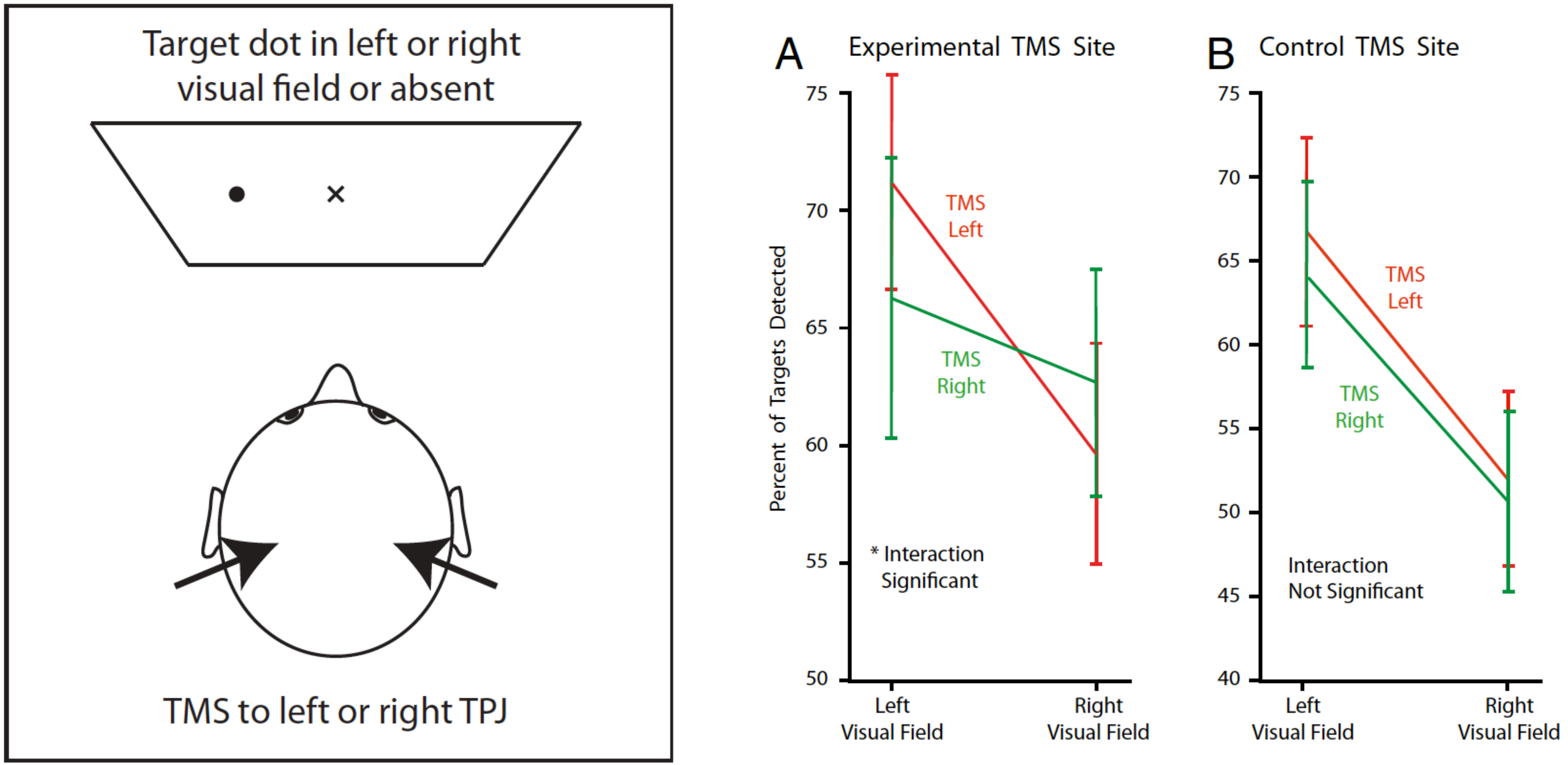
Kelly, Y., Webb, T., Meier, J., Arcaro, M., & Graziano, M. (2014). Attributing awareness to oneself and to others. Proceedings of the National Academy of Sciences, 111(13), 5012–5017



For the experimental site, for each subject, the TMS was targeted at the site of peak significant activity that had been found within the TPJ in the social attribution task in the same subject. In a separate block of trials, as a control site, the TMS was shifted 2 cm anterior. (The range of effect of TMS is ~1 cm.) In that way, it was again targeted to the TPJ but at a cortical site where no significant activity had been obtained in the social attribution task in that subject.

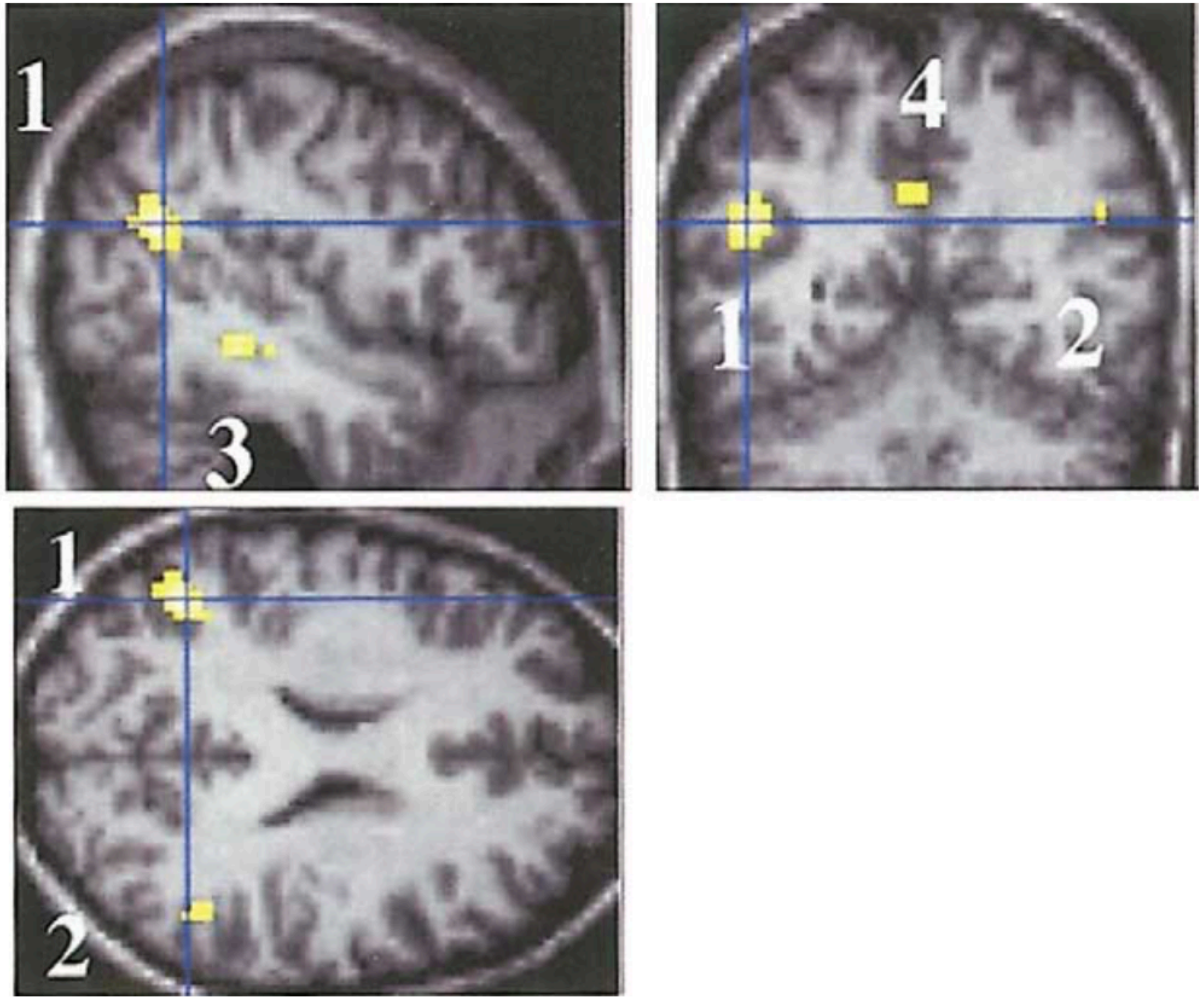


Awareness can be attributed to oneself or to others, to model one's own or someone else's attention. The TPJ may be a part of the system that attributes awareness to others and to oneself. The present experiment lends support to this theory by showing that specific regions of the TPJ are active during the attribution of awareness to someone else and that disruption of those specific sites can disrupt a subject's reported visual awareness



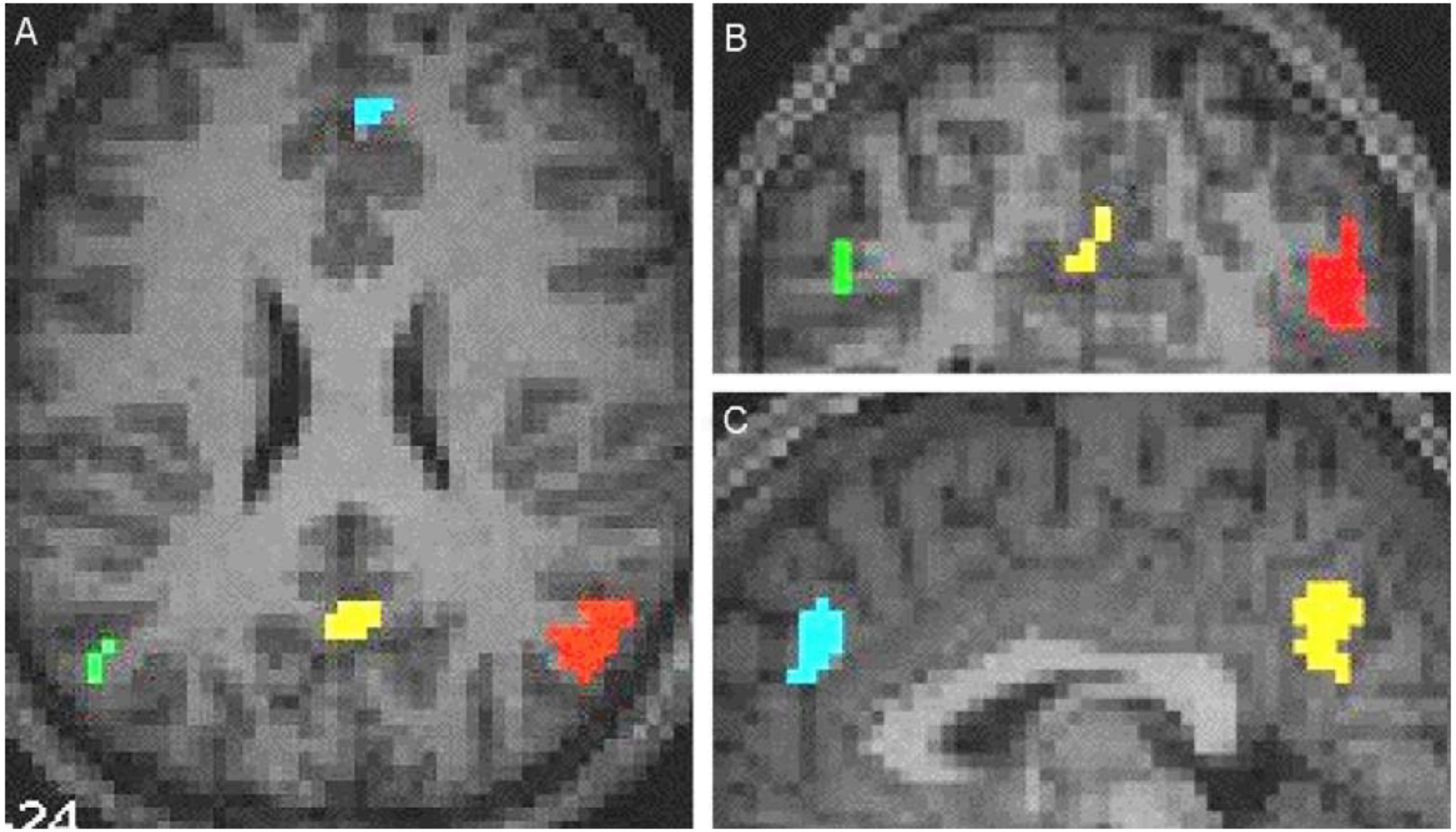
Target dot in left or right visual field or absent
TMS to left or right TPJ
A
Experimental TMS Site
Percent of Targets Detected
75
70
65
60
55
50
TMS Left
TMS Right
* Interaction Significant
Left Visual Field
Right Visual Field
B
Control TMS Site
75
70
65
60
55
50
45
40
TMS Left
TMS Right
Interaction Not Significant
Left Visual Field
Right Visual Field

Saxe, R., & Kanwisher, N. (2003). People thinking about thinking people The role of the temporo-parietal junction in "theory of mind." NeuroImage,19(4), 1835–1842



1

The results of Experiment 1 established that bilateral regions near the TPJ show a greater increase in BOLD signal when subjects reason about others' mental states, than when they reason about nonhuman objects.



Four 'Theory of Mind' regions of interest (ROIs) in a single representative subject. ROIs were defined as contiguous voxels in which the response was higher when subjects read stories about beliefs than when subjects read logically similar stories about photographs ($p < 0.0001$, uncorrected). Red = right temporo-parietal junction (RTPJ). Green = left TPJ. Cyan = medial prefrontal cortex (MPFC). Yellow= posterior cingulate (PC).

Saxe, R., & Wexler, A. (2005). Making sense of another mind: The role of the right temporo-parietal junction. Neuropsychologia, 43, 1391–1399.

When participants are asked to consider what is currently in someone else' s mind, answering that question reliably activates the TPJ.

There is no fundamental difference between my perception of someone else’s mind and my perception of my own mind. I do not directly experience my own mind. I perceive it through the same intermediary, the machinery for social perception, that I use to perceive anyone else’s consciousness. That neuronal machinery is able to collect more data on my own brain and therefore construct a better quality of model for it, but fundamentally my perception of my own mind is in the same class of phenomenon as my perception of someone else’s mind. They are both models.

I do not actually know my own mind, any more than I know anyone else’s mind—I know only the model that my social machinery has constructed of it.

Graziano, Michael S. A.. God Soul Mind Brain: A Neuroscientist's Reflections on the Spirit World (LeapSci) (pp. 52-53). Leapfrog Press. Kindle Edition.

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A basic principle of control theory is this: to control something, the system needs an internal model of it. To monitor and control its own attention, the brain builds an attention schema.
This is like a map of attention. It contains simplified, slightly distorted information about what attention is and what it is doing at any particular moment.

In this sense consciousness—a soul on a trajectory through waking life—is a perceptual illusion. It is a perceptual model that is at best a simplification and sometimes plain wrong.

Awareness is the brain’s schematic description of attention.

Graziano, Michael S. A.. God Soul Mind Brain: A Neuroscientist's Reflections on the Spirit World (LeapSci) (Leapfrog Press. Kindle Edition)

In this sense consciousness—a soul on a trajectory through waking life—is a perceptual illusion. It is a perceptual model that is at best a simplification and sometimes plain wrong.