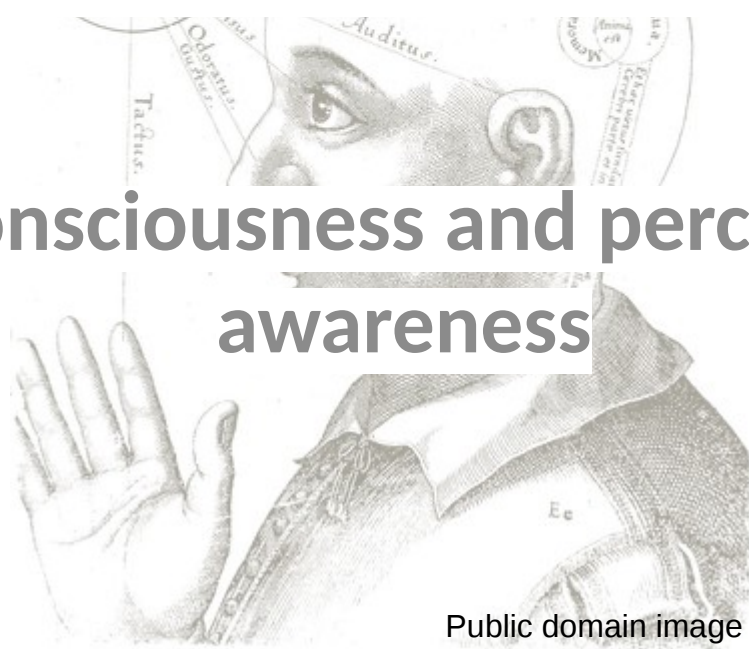




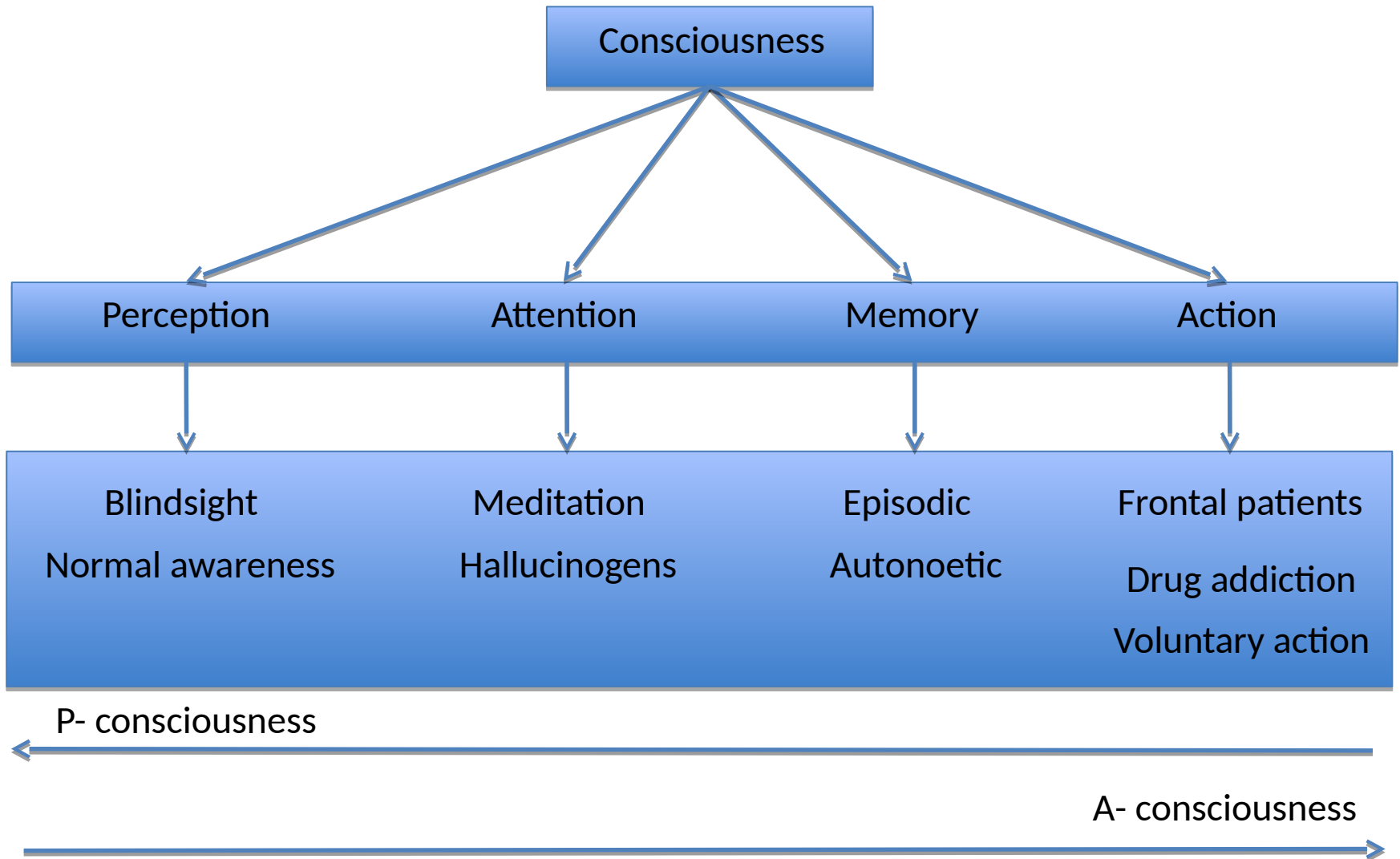
Aspects of consciousness



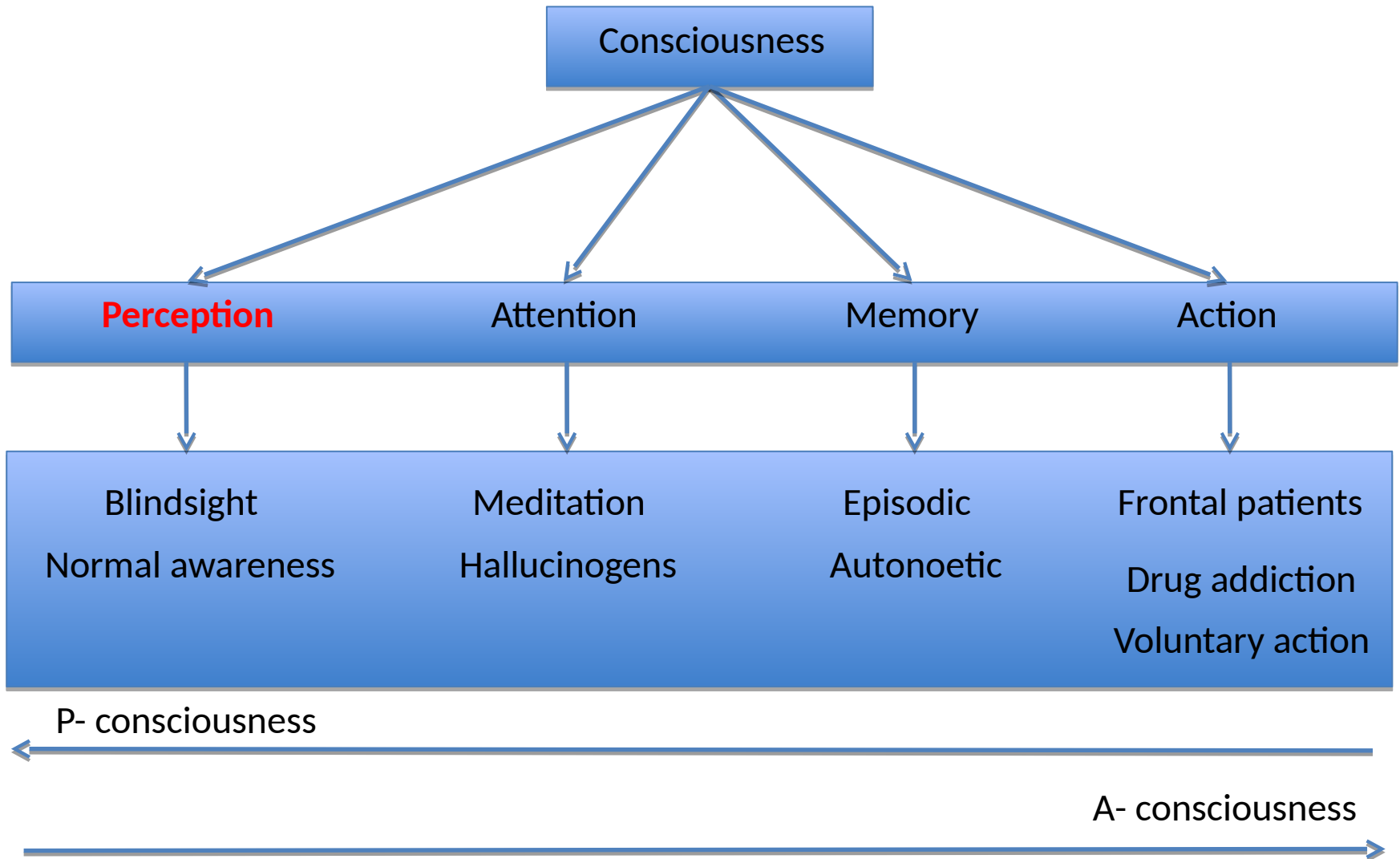
2. Consciousness and perceptual awareness

Public domain image

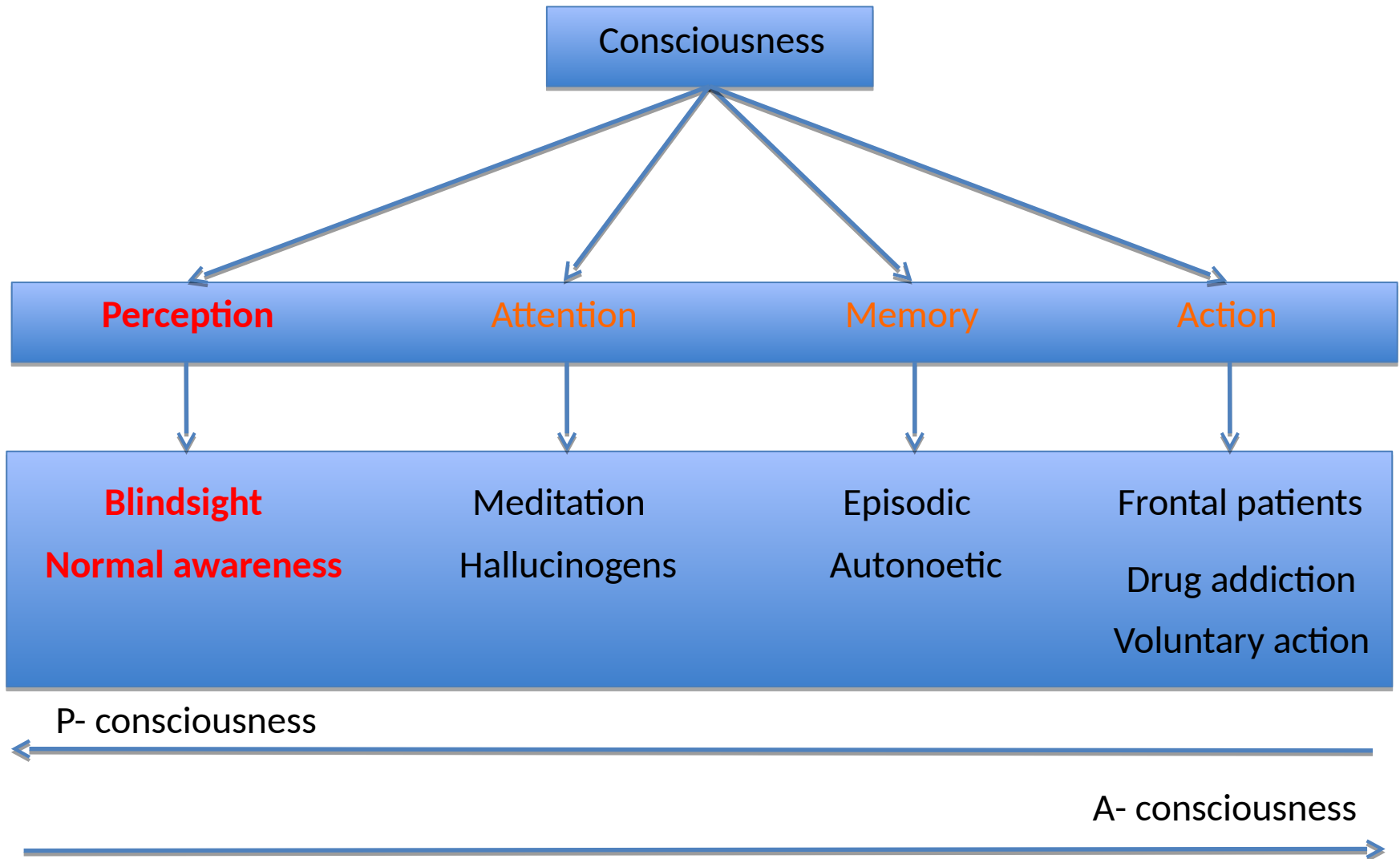
Scientific study of consciousness



Scientific study of consciousness



Scientific study of consciousness



Basic visual neuroscience...

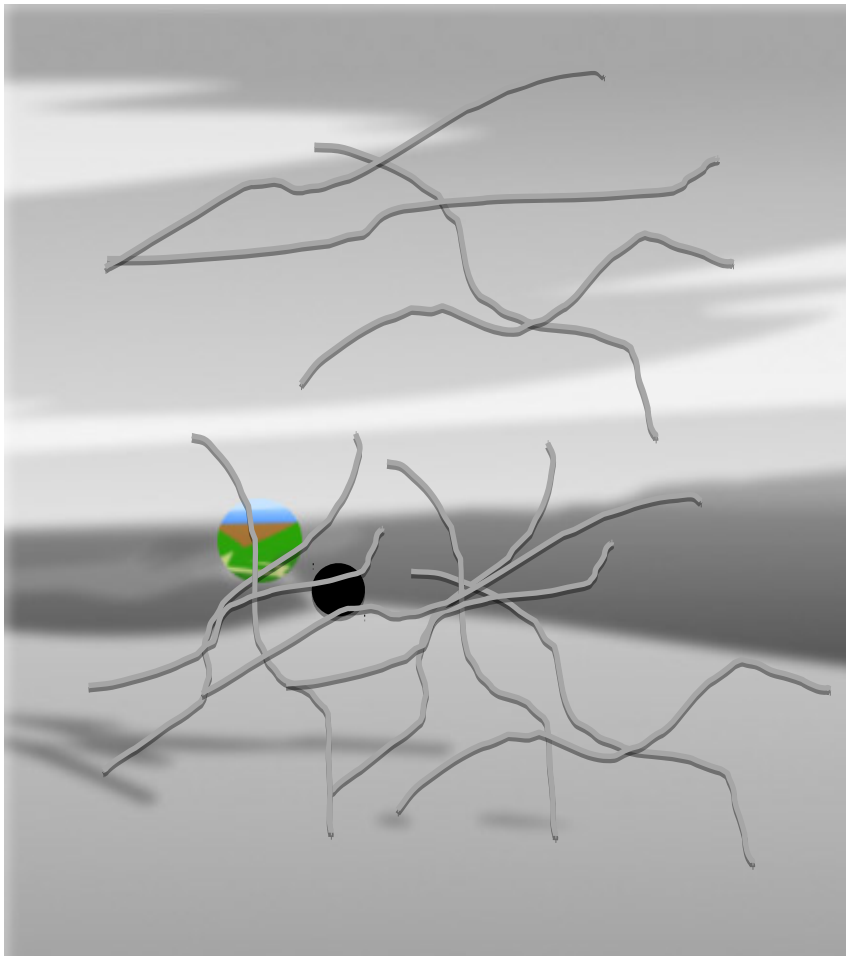
- How many different types of light detector do we have in our retina?
- Are they distributed evenly across the retinal surface?
- What resides between the lens and the light detectors?

Illustration of the problem



- How the world appears to us...

What we know about the input



- The information actually coming from our retina...
- Overall, then, the feeling of vivid, continuous, largely complete awareness of our visual surroundings is an illusion – a reconstruction?

“If I disappeared at the end of this sentence and was replaced by a different person, would you notice?”



Public domain image

Change blindness

- Good introductory review:

Simons, D. J., & Rensink, R. A. (2005). Change blindness: past, present, and future. *Trends in Cognitive Sciences*, 9 , 16-20.

- Great video (start at 1:40)

www.willslab.org.uk/vid/cblind/changeblind.mp4

Facts about change blindness

- We've known about failure to detect change during eye movements for some time (review - Bridgeman et al., 1994).
- Many recent lab demonstrations have used the 'flicker' effect (Rensink et al., 1997)
- Series of compelling demonstrations of the flicker effect
- www.willslab.org.uk/vid/cblind/
In order to get these to work, you have to enable looping on your media player.

See it now?



What's happening here?

- The two frames are separated by a brief flash of grey across the whole visual field.
- Without this, the change is trivially easy to spot.
- Interpretation:
 - We can distribute attention across 4-5 items at a time, but only a single *change* can be seen at any moment.
 - So, we need to be attending in exactly the right place to be aware of change!
 - Typically, most of the visual field is relatively stable, and the brain directs attention automatically (preconsciously) to those areas – exogenous cueing.
 - The flicker (or form) prevents that from happening.

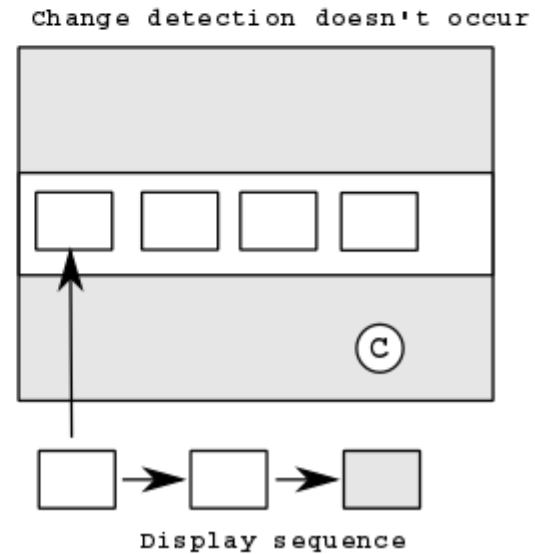
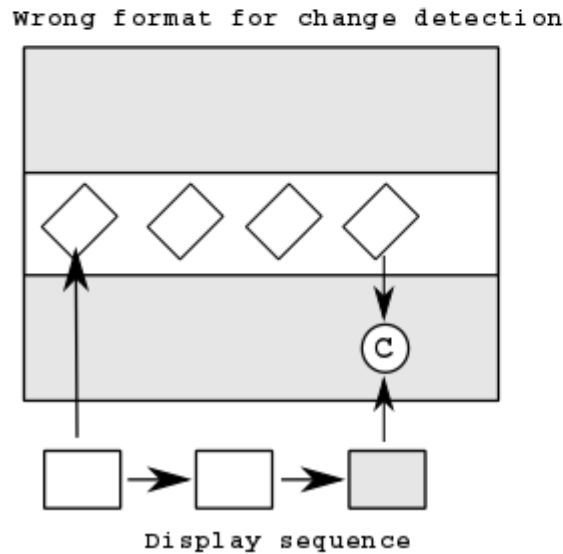
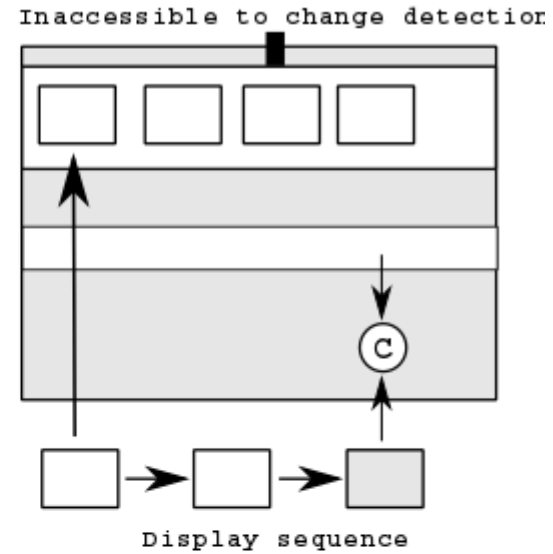
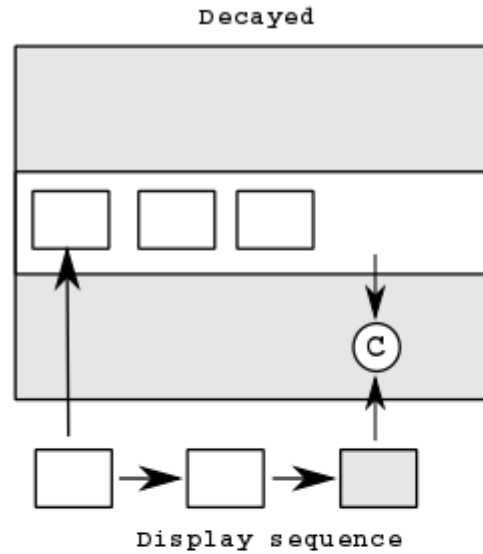
More on change blindness

- Attending to the right location is necessary, but not sufficient – we often miss changes in attended items if they are irrelevant for the task at hand.
- Your “scanpath” is affected by your experience and expertise – drug users spot drug paraphernalia changes fast; football experts detect changes to football scenes fast.

Two kinds of lack of awareness

1. Lack of awareness of large changes (in cases where pre-conscious re-direction of attention is defeated).
 2. Lack of awareness of this limitation of our perceptual awareness (*change blindness blindness*). Most people believe they would notice such large changes.
- Our conscious experience of a changing world is largely determined by a pre-conscious system that directs attention towards change in things that are important to us.
 - Introspection is not a good source of information about the nature of conscious awareness.
 - Perhaps even that our representations of the world are very sparse?

Some other possibilities (Simons & Rensink, 2005)

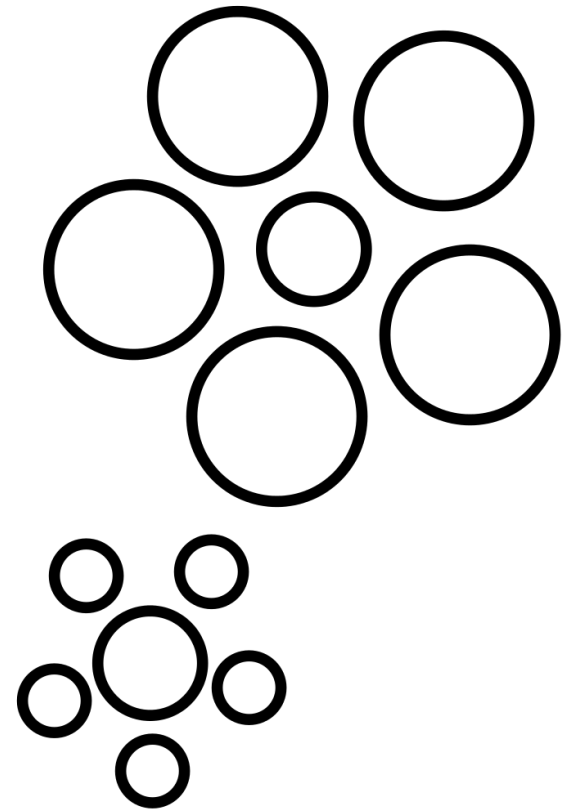


In other words...

- Change blindness tells us about the conscious perception of change. Not necessarily about the sparseness of our conscious awareness, or our representations (conscious or otherwise) in general.

Dissociation of awareness and action

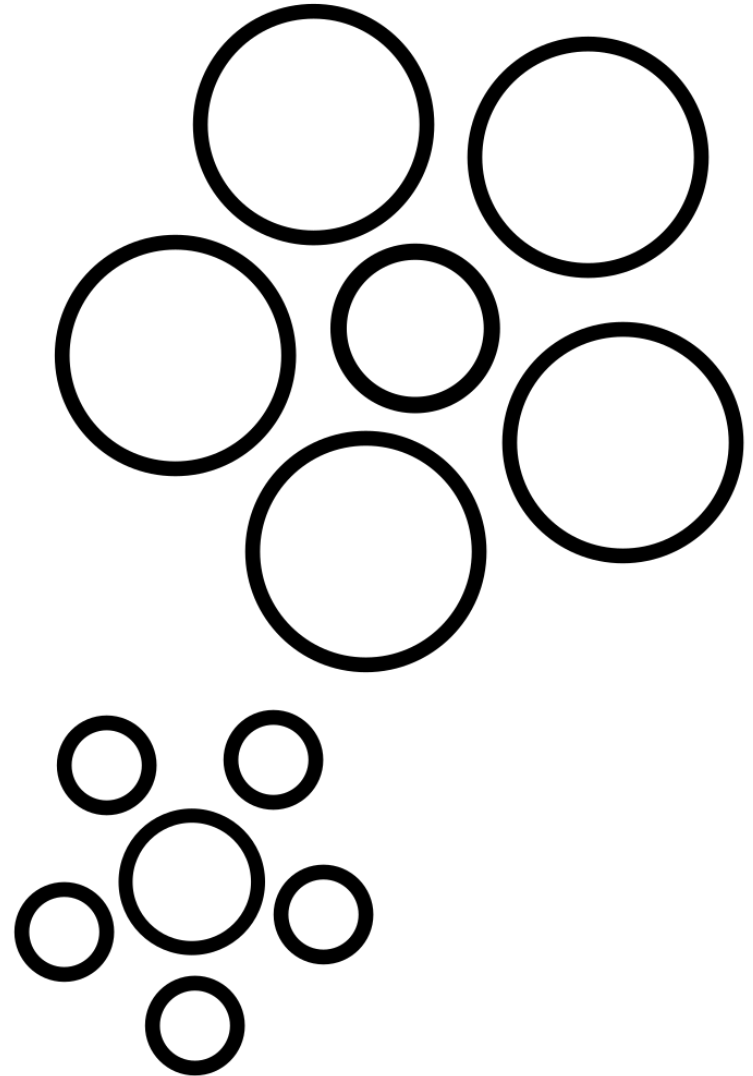
- Aglioti, S., DeSouza, J. F., & Goodale, M. A. (1995). Size-contrast illusions deceive the eye but not the hand. *Current Biology*, 5, 679-85.
- Titchener circles illusion.
 - To most people, the right-hand circle seems smaller.
 - They are the same size – it's the size of the surrounding circles that causes the illusion.



Public domain image

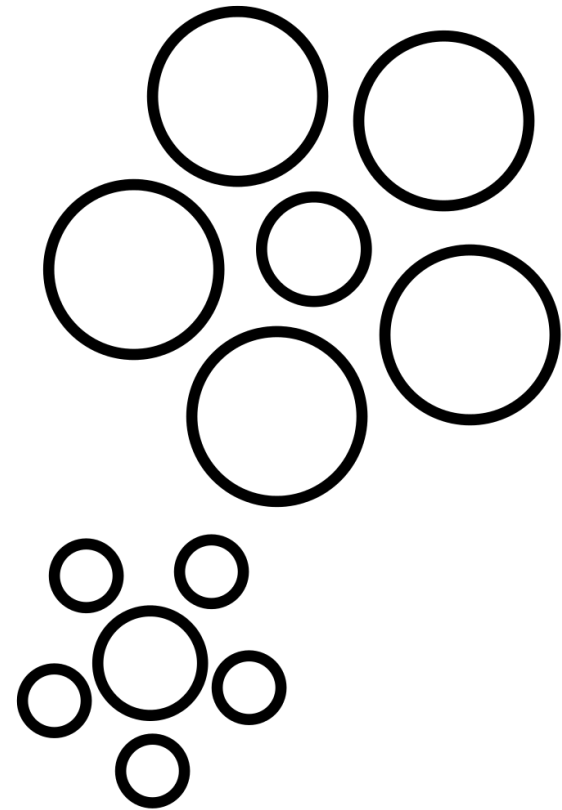
More on Titchener's circles

- You can make the circles look the same size by making one of them larger.



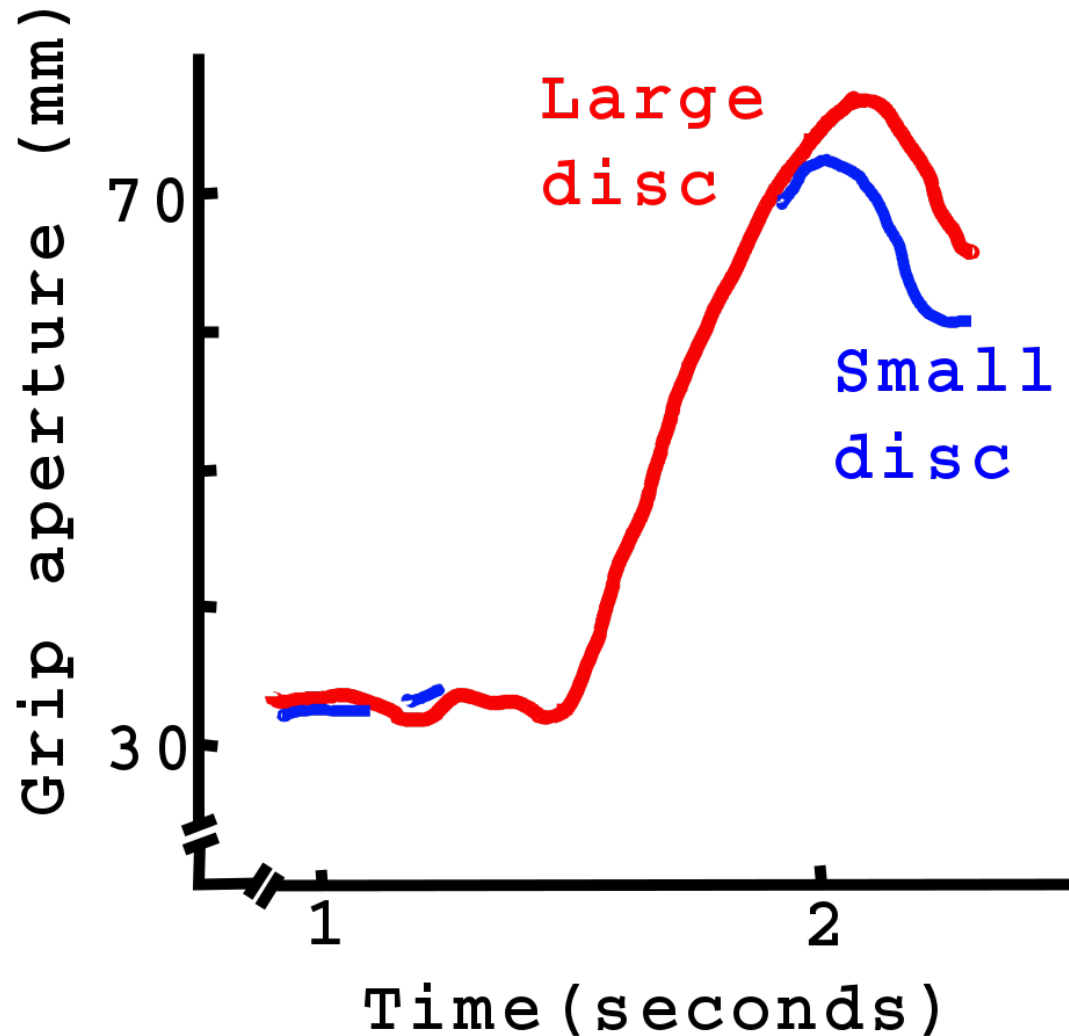
Compelling introspection...

- What we “see” drives how we act.
- It’s known that when we reach out to grasp something, we plan a motor movement before beginning to move, and that movement is affected by the size of the object.
- So, if we “see” those two circles as different size, then when we reach to pick them up, our grasp should be wider for the larger circle.
- *This is not the case.*



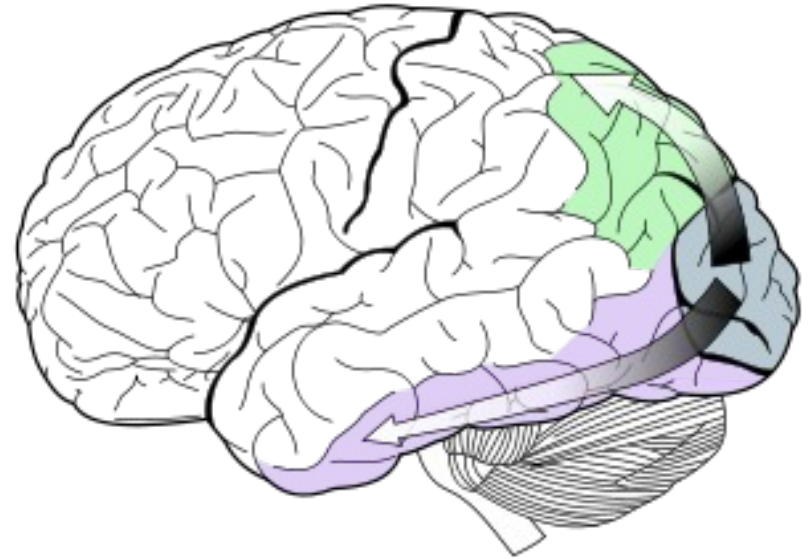
Aglioti's results

Perceptually same trial

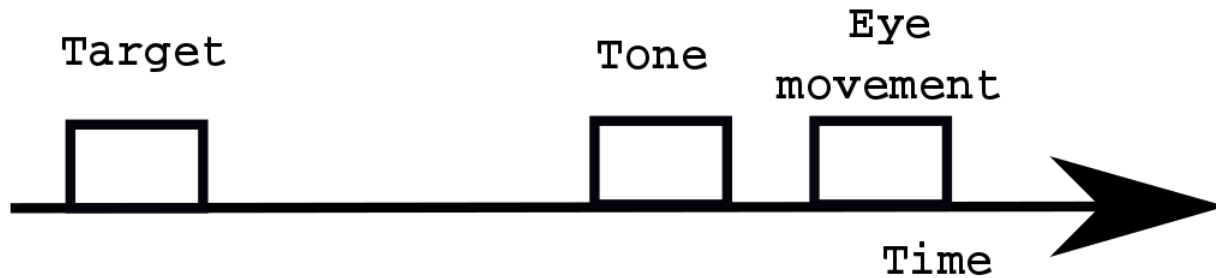
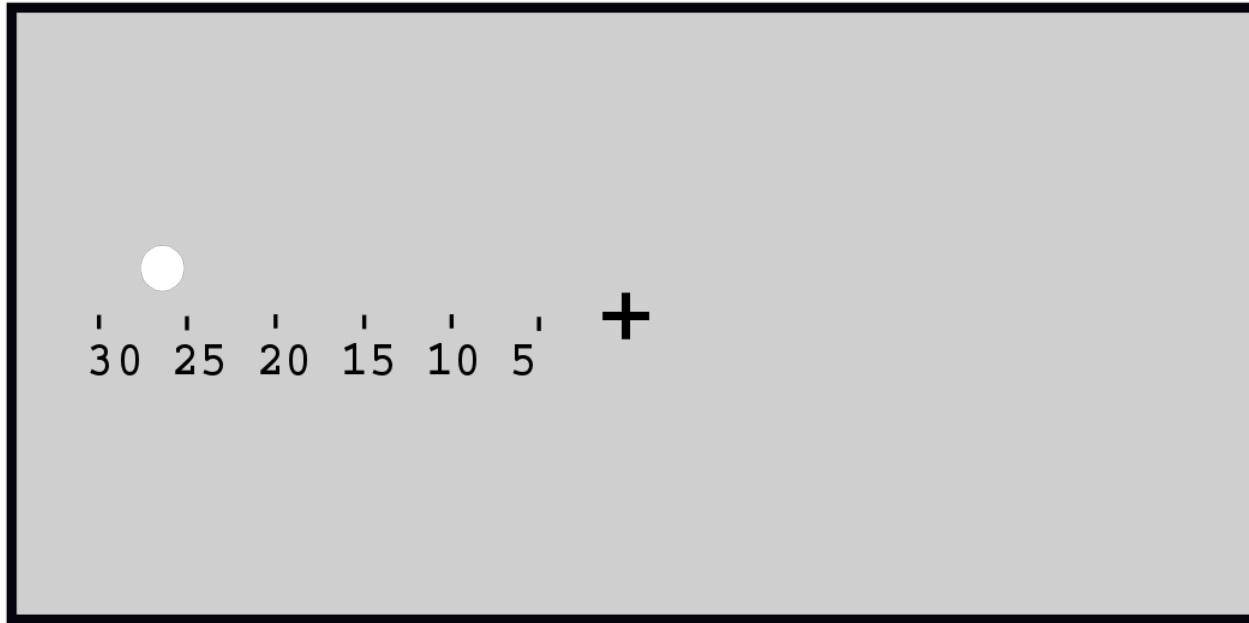


Why?

- This is a particularly compelling example of the presence of at least two visual processing streams.
 - Ventral stream (visual perception of objects)
 - Dorsal stream (action towards objects)
- NEXT: Yet more dissociable visual processing streams.



Blindsight - Weiskrantz (1986)



Defining blindsight

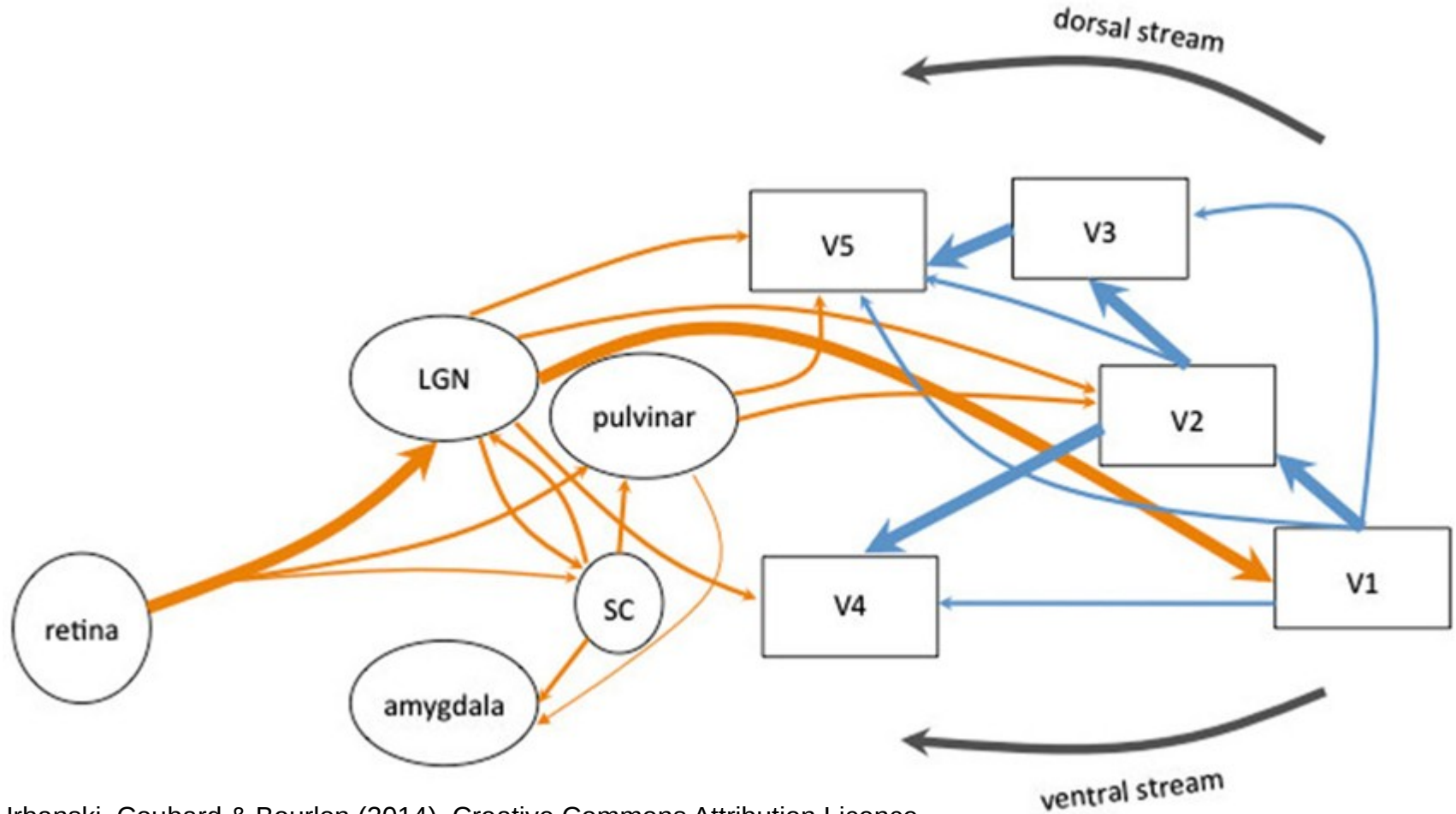
“Blindsight is the ability ... of subjects with clinically blind field defects to detect, localize, and discriminate visual stimuli of which the subjects say they are completely unaware”

- Cowey (2004, p. 577)

Useful review:

Cowey, A. (2004). Fact, artefact, and myth about blindsight. *Quarterly Journal of Experimental Psychology*, 57A, 577-609.

V1 MISSING!



Urbanski, Coubard & Bourlon (2014). Creative Commons Attribution Licence.

V1 is one part of a complex system.

It's sight, Jim, but not as we know it.



Public domain image

- Aside from the issue of conscious experience, sight in the blind field is **rubbish**.
 - Spatial frequency discrimination: So bad, even a seeing subject would be classified blind.
 - Colour discrimination – About x10 worse than normals.
 - Black and white -> OK. Shades of grey -> Indiscriminable.
 - Flicker fusion – About x4 worse than normals.
 - Orientation discrimination lousy (10 degrees at best)
 - True shape discrimination basically absent.

Do you see it ... !!NOW!!

- If e.g. a tone signals the exact time a stimulus would be present (if it occurs on that trial) then you get some of these striking blindsight effects.
- But if there is uncertainty about the time of appearance, even if only a few seconds, performance deteriorates massively.
- This is not normal sight in any meaningful sense.

Artefacts 1: Pre-ocular effects

Public domain image

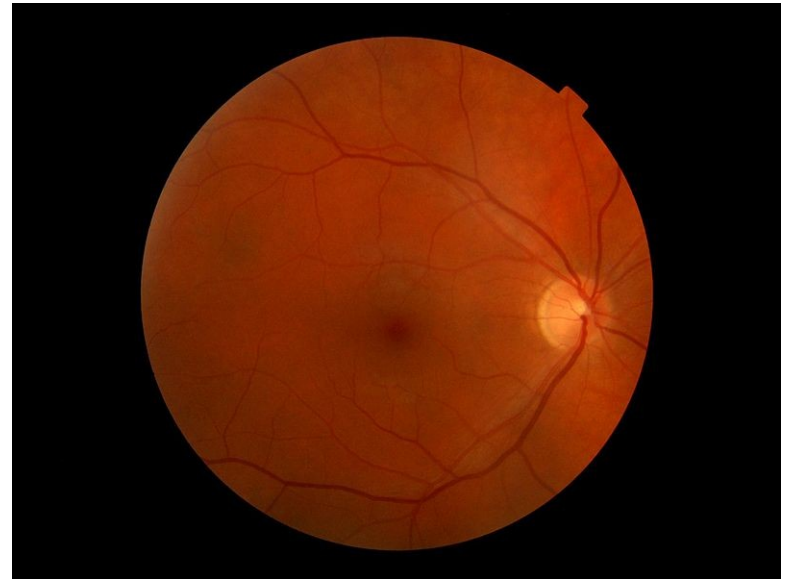


Is this person armed?

- Reflected light – even off your nose!

Intra-ocular effects: Lambertian scatter

- Some of the light from the “blind” region may be scattered by the substance of the eye to the non-blind region.
- The cunning blindspot control
 - In other words, an object, detectable by blindsight, should become undetectable when moved into the retinal blind spot.
 - Some cases of this control being used – but in most cases the object presented is larger than the blindspot, so it’s not possible to tell.

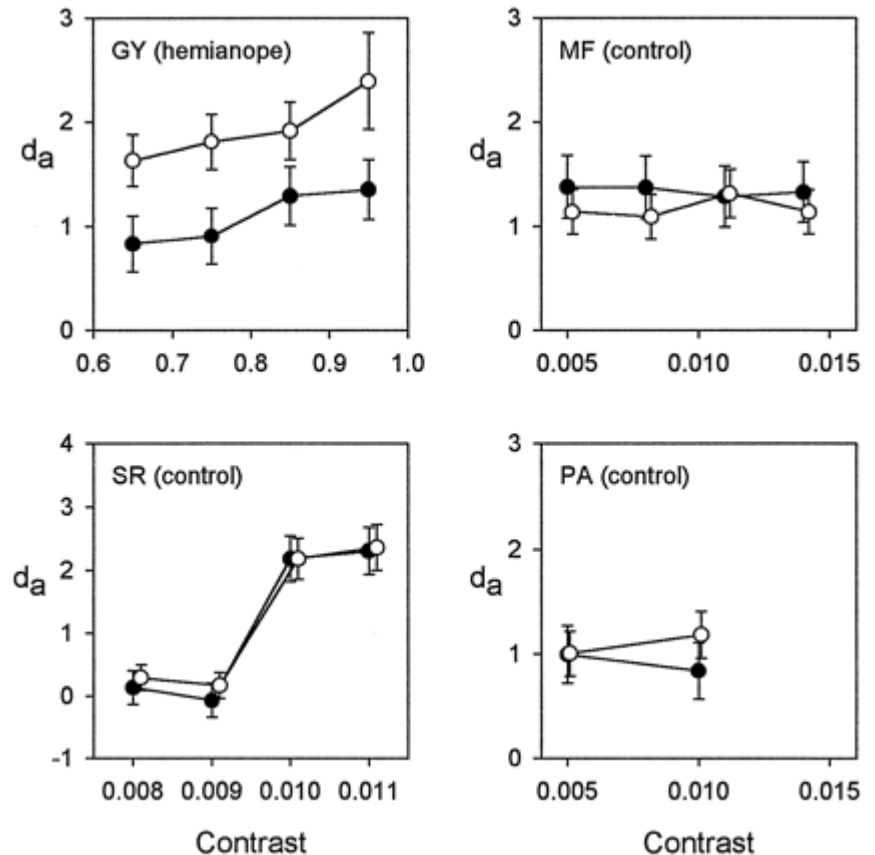


Alexander Churkin. GNU Free Documentation Licence.

Sensitivity and bias

Image credit: Azzopardi & Cowey (1997). Proc. Natl. Acad. Sci., 94, 14190. Copyright (1997) National Academy of Sciences.

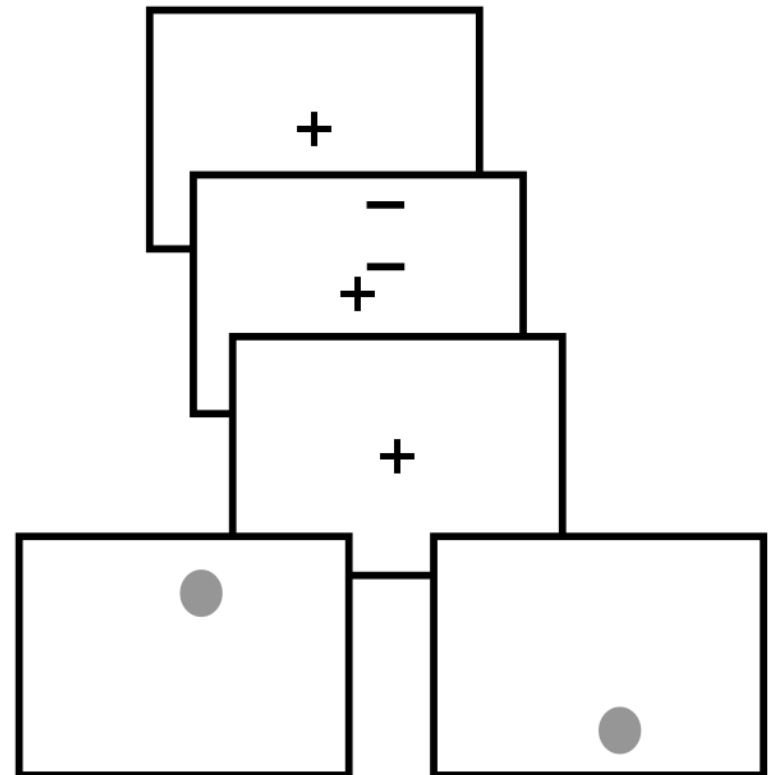
- Azzopardi et al. (1997)
- If you say “no” all the time, you’ll make a lot of errors (assuming “no” and “yes” are equally often the correct answer)
- Perhaps the only difference between the report of visual percept (seen / not seen) and the test performance (showing preserved function) is of bias.
- Signal detection theory is a mathematical method that allows one to distinguish bias (β) from sensitivity (d')
- Sensitivity is what we are interested in here.
- Graph shows not only that GY has a d' greater than zero but that also the type of question affects the discriminability for GY but not for controls – blindsight is not only less good than normal sight (GY’s stimuli were about 2 log units brighter), it also seems to be different.



Black circles – Yes / no
White circles - Two-alternative forced choice (first interval; second interval)

Directing attention without “seeing”

- Kentridge, R. W., Heywood, C., & Weiskrantz, L. (1999). Attention without awareness in blindsight. *Proceedings of the Royal Society: Biological Sciences*, 266, 1805-11.
- This patient (GY again) is phenomenally blind in their right field.
- The task is to press one key if the target (signalled by a tone) appears above fixation, another if it appears below.
- Before the target, cue lines appear above or below fixation. 2/3rds of the time the cues predict where the target will appear (valid trials).
- This is basic peripheral cueing of attention – in normals, the result would be higher accuracy and lower RT on valid trials compared to invalid trials.
- GY shows the same pattern, despite saying he has no awareness of cues or targets.
- Interestingly, this has some properties of *endogenous* attention – specifically if a cue above fixation predicts a target below fixation, GY is still better on valid trials.
- This is interesting, because endogenous cueing of attention is often assumed to require conscious attention.



Type 2 blindsight

- Type 1 – Unaware
- Type 2 – Aware, but not of a percept.
- For example, GY’s eyes tracking a moving grating that he could not “see”, but he was “aware” of movement in the visual field.
- Awareness via feedback – My eyes are moving, therefore they must be tracking something that is moving.
- Are Type 1 and Type 2 qualitatively different?
- Or is Type 2 blindsight a model of normal consciousness?
Awareness by feedback?

Perception without awareness (without brain damage)

“It is possible to conclude with considerable confidence that stimulus information can be perceived even when there is no awareness of perceiving” (Merikle et al., 2001).

Useful review article:

Merikle, P. M., Smilek, D., & Eastwood, J. D. (2001). Perception without awareness: perspectives from cognitive psychology. *Cognition*, 79 , 115-34.

Williams (1938)

Circle, triangle, or square?

(a) Saw clearly

(b) Saw something but doubtful about your choice.

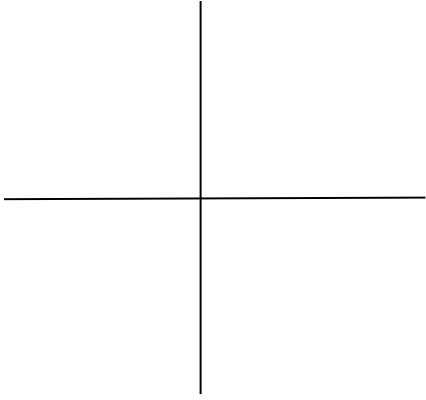
(c) Saw nothing, and your choice was a complete guess.



Mack & Rock (1988)

- Present a series of crosses. Your job is to say whether the vertical and horizontal arm of each cross is the longer.
- Crosses will appear in different locations.
- They'll only be presented very briefly (200ms)
- Each preceded by a small central fixation cross.

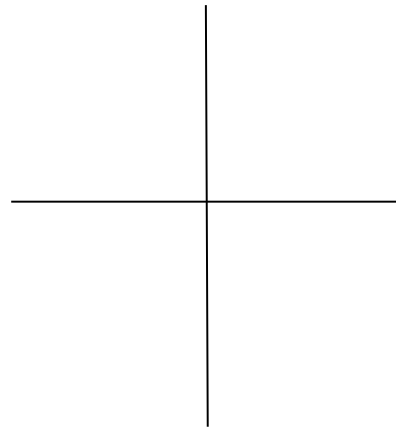
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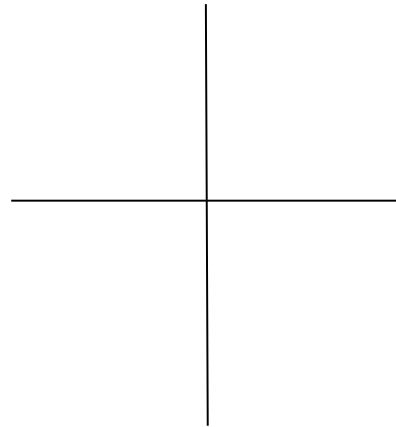
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flake



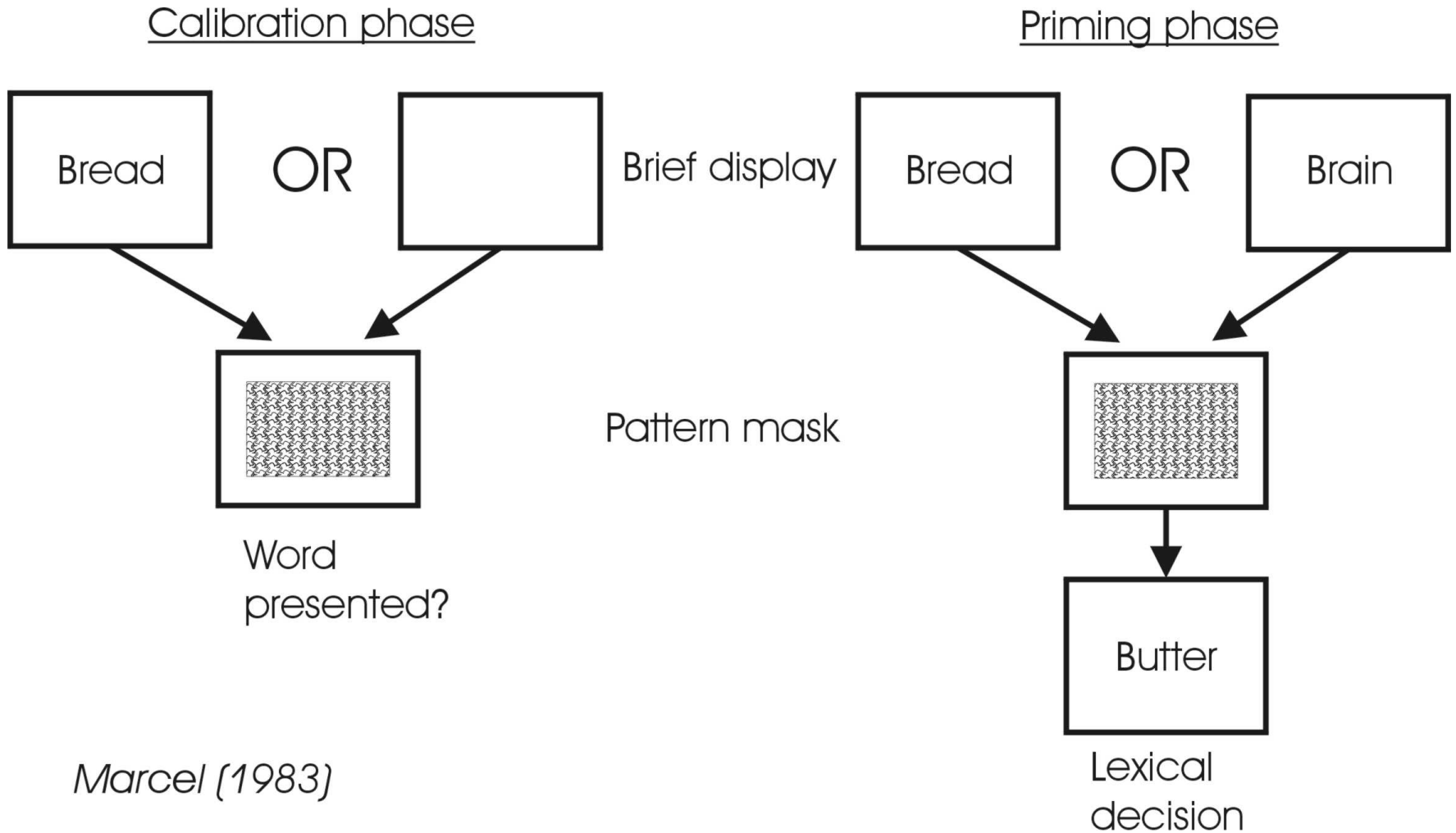
Mack and Rock (1998)

- 60% indicated they hadn't seen the word, and that the 3rd trial was like the first two.
- But above chance on forced-choice recognition, and on stem completion ("fla")

Sensitivity criterion

- Both of these demonstrations suffer from the possibility that people have low-confidence conscious knowledge.
 - It's low confidence, so they don't report it in an open questioning.
 - However, where forced to make a choice between alternatives – and hence a choice between using low-confidence knowledge or deliberately ignoring it forcing a guess – they go for using the knowledge.
- Much more on all this in Shanks & St. John (1994) – not in the reference section of the handout, but optional additional reading for those who are interested (ask me for full reference if you can't find it on WoS).
- Some studies overcome this limitation...

Marcel (1983)



Unconscious or differently conscious?

- It's perhaps a fool's errand to search for evidence for situations where everyone is going to be convinced there is no conscious access to what has been perceived.
- Instead, it might be more interesting and informative to attempt to characterize how the relationship between perception and attention/memory/action varies as we approach the threshold of conscious experience ("barely conscious" experiences).

McCormick (1997)

- Is an “X” or an “O” presented?
- The X or O will be preceded by a bar.
- On 85% of occasions, the bar will appear on the opposite side to the letter.
- So, when you see the bar, re-direct your attention to the other side

+



+

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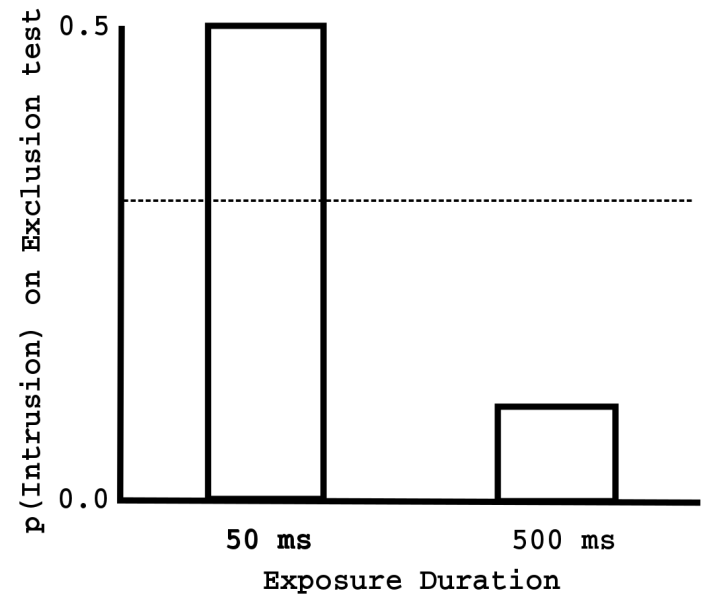
X

McCormick (1997)

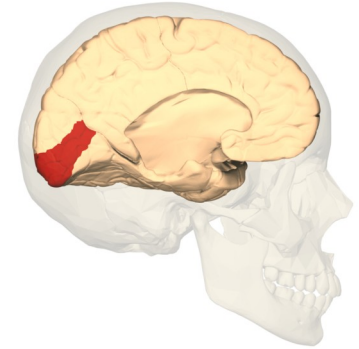
- Makes use of exogenous vs. endogenous cueing
- Some cues are “unconscious” (very faint), some are “conscious” (high contrast).
- Feint cues / cues participant reports as “not seeing”, lead to exogenous cueing.
- High contrast / “aware” cues lead to endogenous cueing.
- Compare GY – who shows endogenous cueing for cues and targets he can’t “see”.
- This, plus the Azzopardi data suggests there’s something fairly odd about the experience of blindsight patients – what we can conclude from them (if anything at all) may not bear much resemblance to dissociations between attention and awareness in non-brain damaged individuals.

Debner & Jacoby (1994)

- Word presentation followed by fragment completion.
- 2 presentation intervals – 50ms, or 500ms.
- Inclusion test (use the first word that comes to mind)
- Exclusion test (use any word other than the one just presented).



Awareness without perception



- Le Bihan et al. (1993)
 - fMRI
 - Show patterns vs. imagine those patterns in their absence.
 - In both cases, primary visual cortex is activated.

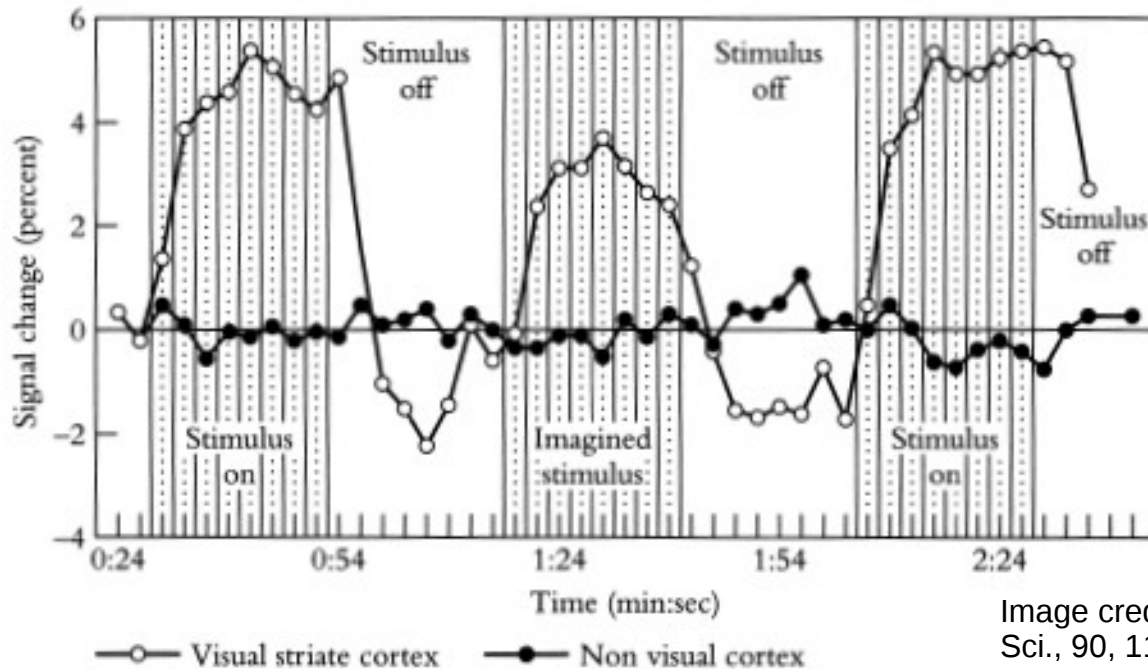


Image credit: Le Bihan et al. (1993). Proc. Natl. Acad. Sci., 90, 11802. Copyright (1993) National Academy of Sciences.

Perception and awareness

1. Our awareness of changes in our environment is different, and poorer, than most people expect (change blindness).
2. Our visual awareness possibly corresponds to just one aspect of a multi-process system for processing visual information
 1. Classic visual illusions sometimes affect what we see but not what we do (Titchener circles).
 2. Loss of V1 (which seems to determine our consciousness visual experience) does not mean total loss of perceptions that can control attention and action (blindsight patients).
3. Things we can't see nevertheless affect our behaviour when forced to make a choice (Williams), even over an interval where long-term memory is implicated (Mack & Rock), and even where a low-confidence explanation seems unlikely to work (Marcel).
4. Perhaps more interestingly, stimuli on the edge of consciousness seem to affect behaviour in a less flexible way than stimuli we clearly "see" (McCormick, 1997; Debner & Jacoby, 1994).
5. We can be aware of visual information about things which are not present (imagery; Le Bihan).

OVERALL – The relationship between perception, attention, memory, and awareness is much more complex – and multi-faceted – than most lay views would suggest.

THE END

(until the next bit...)