

The angular gyrus model of consciousness
(AGMC)

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05 *The Angular Gyrus sits at the point where the Temporal and the Parietal Lobe join. It is a point where integrative processes link together the what and the where pathways through the brain and link them to time. It is also the most likely location for at least two centers of consciousness. In this article the location is discussed and it's potential for a model of consciousness, that replaces the Declarative Memory Model of Consciousness (DMMC) previously put forward. It's main benefit over the Declarative Memory Model of Consciousness is that it allows for the preservation of consciousness despite the loss of Declarative Memory in cases of Medial Temporal Lobe Injury/disease. However Connectome Studies may support this model in that the temporo-parietal fiber intersection area provides 7 different white matter tracts that*
10 *intersect in this area.*

Keywords:

15 Angular Gyrus, Temporal Lobe, Parietal Lobe, What/Where Pathways, Consciousness, DMMC, TPFIA, White Matter Tracts, Recursive Awareness, Reflexivity, Feedback/Feedforward Loop, Re-entry, Superior Longitudinal Fasciculus, Arcuate Fasciculus, Middle Longitudinal Fasciculus, Inferior Longitudinal Fasciculus, Inferior Fronto-Occipital Fasciculus

20 Consciousness is too wide a concept for direct modelling, so for the purposes of this model I have chosen to limit what I am modelling to a portion of the many definitions of consciousness that can be captured in anatomical detail. While I am not of the opinion that the brain has a 1 to 1 correspondence to the mind, there are distinct correlations between the functions of the brain and functions of the mind, that suggest
25 to me, that mind is a consequence of the functions of the brain, and that as a result, nearly everything that we know about the mind, can be explained in terms of the operation of the brain. I leave open the chance that there might be things we know about the mind that cannot be explained in terms of operation of the brain, but leave those things for others to discover, my interest is how much we can explain, not how
30 much we can't.

By limiting the consciousness model to those things that can be captured in anatomical detail the model becomes tractable, and coherent and necessarily limited in its scope.
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If I am going to limit consciousness to what can be modelled from brain functions, then there are certain models of Consciousness that are too far from my model to be taken into account, these include models of Consciousness as a physics name for sub-quantum effects, and models of consciousness that include animals with little or no
40 brains, and models of consciousness of inanimate objects. My best guess currently is that this limits consciousness as I model it to the more advanced animals such as birds and mammals.

Given that a sophisticated animal is conscious, then, it must have certain brain
45 functions not limited to but including a recursive awareness. The act of being aware

of being aware is critical to my definition of consciousness, and implies a certain reflexivity to the processing circuit involved. This reflexivity is caused by the re-entry of awareness in a feedback/feedforward loop. Since awareness is itself caused by re-entry of a report on what was just experienced looped back into the experience log of the brain, I suggest that consciousness needs two stacked feedforward/feedback loops to attain. This on top of the normal levels of re-entry (as Edelman [Eddleman G. 1990, Eddelman G. 2004] calls feedback/feedforward) found in other parts of the brain.

The Angular gyrus as the area just above the temporoparietal joint is called, is in a critical location for just such re-entry signals due to its location at the join of the What and Where pathways of the brain. The Ventral or What pathway that terminates in the temporal lobe and the dorsal of Where pathway that terminates in the Parietal Lobe are critical for modeling the nature of objects and locations in our environment. Signals from these two pathways are combined with timing information to feed the declarative memory.

The fact that consciousness survives the loss of declarative memory, indicates that the nature of consciousness must lie somewhere after the joining of these two pathways and before the passing of information to the declarative memory via the para hippocampus and into the hippocampus. The nature of consciousness seems to suggest that involvement not only of what where and when information but Working Memory and Meta-cognitive information as well is involved the angular gyrus is well suited to such a function because of its proximity to major white matter tracts that intersect underneath it, some of which also feed centers in the Angular Gyrus or are in fact fed from them.

The Temporo-Parietal Fiber Intersection Area or TPFIA as it is called, [Martino J. et. al. 2012] lies immediately under the Angular Gyrus and involves 7 separate white matter tracts. The superior Longitudinal Fasciculus, the Arcuate Fasciculus, the Middle Longitudinal Fasciculus, the Inferior Longitudinal Fasciculus, the Inferior Fronto-Occipital Fasciculus, the Optic radiants, and the Tapetum. Some of these fibers do not actually link with the angular gyrus, but enough of them do, that it is one of the best connected areas of the brain. As such it is uniquely qualified as a center of consciousness.

Although in humans the sections of the Superior Longitudinal Fasciculus and the Arcuate Fasciculus are joined, in other primates they are separate tracts [Shahman J. Pandya D. 2009]. These tracts run from the pre-frontal cortex, to the temporal lobe where they terminate in the areas of the language system. The middle Longitudinal Fasciculus joins the superior temporal area to the angular gyrus and is thought to be based in the language system [de Champfleury M et. al. 2012]. The Inferior Longitudinal Fasciculus joins the occipital lobe and the angular gyrus and then extends into the temporal lobe [Manzor A. 2012]. The Inferior Fronto-Occipital Fasciculus links area 46 or the working memory to the angular gyrus [Walsh M et. al. 2011], and is thought to have a connection to the visual system. The optical radiants

are pure vision and connect the vision system to the occipital lobe, and the tapetum is also related to vision. The fasciculi are all complex bundles of white matter fibers and each have multiple functions.

95 In Damasio's work [Parvizi J. Damasio A. 2001] we find evidence of the possibility
of having a number of centers of consciousness including the proto-conscious areas,
core consciousness, extended consciousness and the autobiographical consciousness.
Depending on what attributes we have for core consciousness it can be in the
100 brainstem as Damasio suggests but this doesn't explain the experience of
consciousness which includes information only to be found in the cortex. This might
be the realm of the extended consciousness.

105 The advent of a number of areas that are protoconscious and could be involved in
extended consciousness being connected to a single location where integration of
other circuits in the brain is achieved suggests that even if core consciousness is
seated in the brainstem:

Conclusion:

110 The Angular Gyrus might very well be the location in which extended consciousness
is found.

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Conflicts:

150 The author claims no conflict of interest associated with this article

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