

**Extended consciousness as revealed by  
the angular gyrus model of consciousness**

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*The Extended Consciousness builds on the strengths of the protoconscious and the core consciousness to add a sense of experience onto the basic alertness provided by core consciousness. The Angular Gyrus Model of Consciousness reveals some hints as to how the experiential image is built. In this article I explore the role of the*

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*Keywords:*

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*Angular Gyrus, TPFIA, Superior Longitudinal Fasciculus, Arcuate Fasciculus, Middle Longitudinal Fasciculus, Inferior Longitudinal Fasciculus, Inferior Fronto-Occipital Fasciculus, Orbital PreFrontal Cortex, Area 46, Working Memory, Area 10, Meta-Cognitive Area, Experiential Image*

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The Angular Gyrus sits at the joint between the parietal lobe and the temporal lobe and immediately above the Temporo-parietal Fiber Intersection area (TPFIA) an area where 7 white matter tracts intersect. Making this area uniquely suitable as a hub of communications between a number of areas of the brain. Because of its unique connectivity it is also well placed as a center of consciousness.

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The Angular Gyrus Model of Consciousness, reveals to us that this area is the seat of the experiential image an extended consciousness effect that makes the sense of experiencing things possible. By bringing together this knowledge and the knowledge of which parts of the brain are communicating with the Angular Gyrus, we can begin to see revealed some functional information about the nature of this experiential image and how it is built.

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It is early days yet for full understanding of the experiential image, if only because the research that tells us about the other areas of the brain, which communicate with the angular gyrus is as yet somewhat limited. Of especial interest but also of especial concern is the information on the prefrontal cortex which is fragmentary and still in its infancy with many contradictions between different researchers on what the roles of the prefrontal cortex areas are, and how they do them.

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Since the actual routing of the fasciculi (white matter tracts) that make up the TPFIA are still under research we are not even sure which areas of the brain are connected. But since the research tools to find them are useful, it is thought that this research will mature fairly quickly. Until then we can look at the approximate locations of connections and make judgements about which areas should be looked at more closely when the research matures.

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At the heart of this research are the 5 fasciculi that make up the TPFIA along with two parts of the visual system that do not actually communicate with the Angular Gyrus. The 5 fasciculi are: the Superior Longitudinal fasciculus, the Arcuate

50 Fasciculus, the Middle Longitudinal Fasciculus, the Inferior Longitudinal Fasciculus, and the Inferior Fronto-Occipital Fasciculus. Each fasciculus is a cluster of connections some of which are notable because they are at the end points of the cluster, and others which are less obvious because they link to the middle. The linkage to the Angular Gyrus is one of these sets of middle linkages that is not obvious in many cases, so I may make an error of commission in assuming that the links actually do exist in all cases.

55 The Superior Longitudinal Fasciculus [Schahman J. & Pandaya D. 2009] has the longest extent of any of the 5 fasciculi in the TPFIA it reaches from the prefrontal cortex back to the angular gyrus, and joins the Arcuate Fasciculus to connect to the language centers in the Human Temporal Lobe. Other primates do not have the close connections between these two fasciculi Which is possibly why none of them have the same facility with language that humans do. It is a toss-up whether language came first and then these two fasciculi joined, or whether the fasciculi joined and then language was invented.

65 The next longest fasciculus is the Inferior Fronto-Occipital fasciculus [Walsh M., et. al. 2011] which extends from broadman area 46 back to the occipital lobe it is possible that because this fasciculus is ventral to the Inferior Longitudinal Fasciculus that it links the What pathway to the Angular Gyrus, or then again it could be a link between the Working Memory and the visual system allowing not only the holding of visual memories but also allowing imaginary visualizations to filter through the visual system or both.

70 A similar effect might be found in the Middle Longitudinal Fasciculus [de Champfleury M. et. al. 2012] but it holds a connection between the superior temporal lobe (Auditory Areas) and the Angular gyrus. As such it might connect to the where pathway of the auditory system.

75 The Inferior Longitudinal Fasciculus [Manzor A. 2012] connects the Occipital Lobe to the Angular Gyrus. Because it is dorsal to the Inferior Fronto-Occipital Fasciculus it might connect to the where pathway.

80 The Auditory What pathway would be connected via the Arcuate Fasciculus. [Yeatman J. et. al. 2011]

85 To Understand what all these connections mean we have to look a little deeper into the interpretation of what the prefrontal cortex does. This is problematic because the science is spotty at best showing it's best understanding in other primates rather than humans. [Passingham R. & Wise S. 2012] This is not surprising because there are ethical concerns with human experimentation. We must accept the limitations of our knowledge to those things that can be determined non-invasively if at all possible in human research. As a result, some of the conclusions known to today's science are expected to be revised in the future, and some I may include for completeness are

just theoretically unproven and may stay that way.

One area that is an example in point is the Orbital Prefrontal Cortex the area just above the eyes at the front of the brain. This area has been described in a number of manners including as the ethical center for the brain. Damage to it has caused great dislocations in peoples lives making some people unemployable. But we don't really know all that it does, and knowing that it is connected to the Angular Gyrus is not all that informative either.

Theoretically the orbital prefrontal cortex is part of the forward model that lets us predict the future outcomes of our actions, and lets us avoid outcomes that don't meet our needs, but that is just a theory. We can't be sure that the theory is correct because we have no way as yet to prove it. It will take a psychologist with a particular turn of mind, to come up with a tool we can use to show that this theory is correct. In the meantime that is not the only controversial area of the brain. Area 46 has been described as the Working Memory, and as prospective memory, but there is controversy since area 46 is part of the primate neo-cortex, yet murine mammals have evidence of a Working Memory even though this area is not in their brains.

Another area of interest in the prefrontal cortex is area 10 the so called Polar Prefrontal cortex, which is theoretically associated with meta-cognition, (Cognition about Cognition). An example of which is the self signal which attributes action to the organism. Theoretically this works closely with the Causality Detector to create the illusion of will [Wegner D. 2002].

I hope that I have shown just how carefully we have to sift through the information available today, and how little credence we can give any statement of function for the prefrontal cortex, without putting you off the exercise I am attempting, which is to suggest how an experiential image might be formed.

For the purposes of this discussion, I am going to assume that the theories are correct, and that the orbital prefrontal cortex is part of the forward model, and that area 46 is part of the Working Memory, and area 10 is the center for Meta-Cognition, this may be unwarranted but it simplifies the theory somewhat since if they are not, I don't know exactly what they do.

For the purposes of discussion therefore, there is a linkage between the forward model and the Angular Gyrus, and between the Working Memory and the Angular Gyrus which allows feedback to form between the prediction of the outcomes of a particular goal, and the sensory mechanisms that monitor the environment including those that store visual images, real and imaginary and audio images real and imaginary.

Taste touch and smell sneak in around the edges of the Temporal lobe to give us our 5 senses. Thus we experience a sensorium that includes all 5 senses. The experiential

image is so powerful that we are not ever aware that we are reacting to an image rather than the real thing. The proof is in the information that we experience, coming as it does after the analysis is done, the image is better informed than a first try would be if we experienced the data directly as it erroneously seems to us, we do.

The experiential image is critical to our sense of self, in that it gives us a basis point against which to compare the difference between self and other, that is needed for proper attribution. As such the illusory aspects of a feeling of will, give us a needed vector for directing action even though they say nothing about the real reasons for action being directed in a particular manner, and even less about the mechanisms by which we direct action.

#### *Conclusions:*

Feedback from the Orbital Prefrontal Cortex, area 10, and area 46 might help form the Experiential Image of Extended Consciousness.

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