Ch 6. The Allocentric-Egocentric Interface Theory of Consciousness

§1. Introduction: Philosophy and Phenomenal Consciousness

The purpose of this chapter is to sketch in a relatively small amount of space a relatively comprehensive theory of consciousness, one that is both empirically warranted and philosophically productive. Recall from ch 0 sec. 5, the three questions of consciousness—the question of state consciousness, the question of transitive consciousness, and the question of phenomenal character. Central to many of the discussions of the book has been the question of state consciousness. A closely related question is the one of, for any proffered answer to the question of state consciousness, how can we be sure that it truly is about *consciousness*?

Recall from ch 3 that there are three questions to this question: deflationary Transparency, deflationary Transitivity, and WIL. Note that our confidence in a theory would be increased if it can be shown that the three means of identifying state consciousness converge on the same answer.

The theory I shall sketch is what I shall call "The Allocentric-Egocentric Interface Theory of Consciousness" or "AEI" for short. In brief, the theory posits that mental processes form a hierarchy of mental representations with maximally egocentric (self-centered) representations at the bottom and maximally allocentric (other-centered) representations at the top. Part of what it means to be higher or lower in the hierarchy is

to be further from or closer to the sensory and motor periphery of the nervous system.[40] Focusing on the processing of sensory information, we can trace the path of information from relatively egocentric representations of the stimulus in sensation through stages of processing that increasingly abstract away from egocentric information and represent things in memory in an allocentric way. Further, we can note top-down effects from relatively allocentric representations high up in the hierarchy to egocentric representations lower in the hierarchy. I hypothesize that phenomenally conscious mental states are to be identified with states that are relatively intermediate in this hierarchy. More specifically, conscious states are hybrid states that involve the reciprocal interaction between relatively allocentric and relatively egocentric states: a conscious state is composed of a pair of representations interacting at the Allocentric-Egocentric Interface. Unconscious mental states are states that are either too high up or too low down in the hierarchy or are not engaged in the requisite reciprocal interactions. What a person is conscious of is determined by what the contributing allocentric and egocentric representations are representations of. The phenomenal character of these states is identical to the representational content of the reciprocally interacting egocentric and allocentric representations.

§2. Concepts, Egocentric Representations, and the Sensory Processing Hierarchy

When we look at visual processing, we can characterize levels in a hierarchy of information processing. More specifically, we can characterize the levels in terms of how

[40] Being higher-level should not be confused, then, with being higher-order.

much the information has been processed, where the information is being processed, and what the nature of the processing is. The questions of how much and where can be answered simultaneously by tracing the flow of visual information from the earliest stages of processing in the eyes through to the latest stages of visual processing in the cerebral cortex. We get a rough estimate of how much information has been processed in terms of how many neurons a signal had to traverse and the question of where the information is processed can be answered in terms of where the neurons are. More specifically, we can trace the flow of information from retinal ganglia through the optic nerve to the subcortical structures of the lateral geniculate nucleus. Next information is sent to the first stages of cortical processing in occipital cortex in the primary visual area (area V1). Later stages of cortical processing involve sending information along two branching paths.[41] The first is the dorsal stream that sends information from occipital cortex to posterior parietal cortex. The second is the ventral stream that sends information from occipital cortex to inferotemporal cortex. Still later areas of processing involve areas in frontal cortex[42] as well as in the hippocampus[43] . It is worth noting that the flow

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[41] Milner, A., and Goodale, M. (1995) The Visual Brain in Action, Oxford University Press, New York.

[42] Olson, C., Gettner, S., and Tremblay, L. (1999) Representation of allocentric space in the monkey frontal lobe, in N. Burgess, K. Jeffery, and J. O'Keefe (eds.), The Hippocampal and Parietal Foundations of Spatial Cognition, Oxford University Press, New York, pp. 359–380.

of information is not strictly feed forward from sensory input to the highest levels of brain processing but also includes many instances of feedback or back-projections of information being sent back from higher levels to lower levels.[44]

The "where" and "how much" questions do not exhaust all there is to say about visual processing: there remains the question of *what* the nature of the processing is. I propose that, especially for consciousness studies, one fruitful general way of understanding what is happening to visual information as it progresses through the levels of the processing hierarchy is that what begins as a relatively egocentric (self-centered) representation of visual information becomes increasingly abstracted and increasingly allocentric (other-centered) in the higher levels. We are to find the most egocentric visual representations in the lateral geniculate nucleus and also in the primary visual areas in occipital cortex. The most allocentric representations are found in frontal areas and hippocampus. Intermediate areas of cortical visual processing contain representations that are intermediate between being egocentric and allocentric. To get a clearer grasp of the proposal that visual processing can be characterized in terms of egocentric to allocentric transformations of represented information, it will be helpful to consider a more detailed discussion of egocentric and allocentric representations.

A useful starting place in characterizing egocentric representation is the notion of

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[43] Milner, A., and Goodale, M. (1995) The Visual Brain in Action, Oxford University Press, New York.

[44] Pascual-Leone, A., and Walsh, V. (2001) Fast backpro jections from the motion to the primary visual area necessary for visual awareness, Science 292, 510– 512.

a receptive field. A good initial definition of "receptive field" is "area in which stimulation leads to response of a particular sensory neuron".[45] Retinal ganglion cells and neurons in the lateral geniculate nucleus have circular fields with either an excitatory center and an inhibitory surround or an inhibitory center and an excitatory surround. The locations of these fields are defined relative to retinal locations, that is, a particular cell in, e.g., lateral geniculate nucleus, is most responsive to a visual stimulus falling on a specific retinal location. The firing of such a cell is thus said to represent the location of a stimulus in a region of retinocentric space.[46]

Retinocentric representations are the lowest-level representations in a hierarchy from the most egocentric representations to the most allocentric. The progression of information up the hierarchy progressively abstracts away from the particularities of the maximally egocentric representations as in transformations from retinocentric to head-centered and body-centered representations. Examples of such transformations involve neurons in area 7a of posterior parietal cortex. These neurons exhibit different responses depending in part on whether eye-position is fixed. When eye position is fixed, these neurons exhibit retinocentric receptive fields. However, when eye position is not fixed, stimulus of a given retinal region results in a neural response that varies linearly with eye

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[45] Levine, M., and Shefner, J. (1991) Fundamentals of Sensation and Serception (2nd edition), Brooks/Cole, Pacific Grove (CA).

[46] Hubel, D., and Wiesel, T. (2001) Brain mechanisms of vision, in W. Bechtel, P. Mandik, J. Mundale and R. Stufflebeam (eds.), Philosophy and the Neurosciences: A Reader, Basil Blackwell, Oxford, pp. 179–198.

position. Under these later conditions then, these neurons have a linear gain field defined over eye position. Response in normal conditions, then, is a product of retinal stimulus location and eye position resulting in a neuron tuned to a particular location in head-centered space.[47]

The egocentric representations described above involve sensitivity to a spatial location relative to some part of the organism or the organism as a whole. However, egocentricity is not limited only to the responses of sensory neurons, but can be defined for motor neurons as well. For example, reach plans for arms are encoded in eye-centered coordinates. [48]

There is more to our mental lives than can be accounted for by egocentric representations. Many of our thoughts have a detached or objective character that abstracts away from peculiarities about us. For instance, my knowledge that Pi is an irrational number is not in any obvious way about me, regardless of how irrational I might be. Similarly, my grasp of the fact that neutrons and protons are more massive than electrons is not particularly a fact about me, in spite of the fact that much of my mass and volume is determined by neutrons, protons, and electrons.

Our capability to have detached, objective mental states is grounded in our

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[47] Andersen, R. (1995) Coordinate transformations and motor planning in posterior parietal cortex, in M. Gazzaniga (ed.), The Cognitive Neurosciences, MIT Press, Cambridge (MA), pp. 519–532.

[48] Batista, A., Buneo, C., Snyder, L., and Andersen, R. (1999) Reach plans in eye-centered coordinates, Science 285, 257–260.

allocentric representations. Allocentric representations have been postulated to exist in frontal areas as well as in hippocampus. The nature of allocentric or objective representations will be spelled out in further detail in chapter 8. But the basic idea can best be conveyed by saying that such representations may be defined as opposites of the kinds of egocentric representations characterized in the previous chapter.

§3. Locating Consciousness in the Allocentric-Egocentric Hierarchy

It is reasonable to ask where in the processing stream conscious states arise. I turn now to considerations that we should regard conscious states as residing neither at the highest most allocentric levels nor at the lowest most egocentric levels. Instead, visual consciousness resides at an intermediate level. We can arrive at this conclusion by first noting that neither fully allocentric representations nor fully egocentric representations are ever conscious states.

Purely egocentric representations are not sufficient for conscious states. Egocentric representations count among the most basic and primitive forms of representations. For example, the kinds of spatial representations that arguably underwrite taxes (movement toward or away from a stimulus) in organisms as simple as the nematode worm *C. Elegans* (a creature with a nervous system of only 302 neurons) represent spatial distances and directions in egocentric terms.[49] While such creatures are

[49] See Mandik, P. (2002) Synthetic neuroethology, Metaphilosophy 33(1/2), 11–29. See also Mandik, P. (2003) Varieties of representation in evolved and embodied neural

complex enough to support egocentric representations, few theorists would regard them as complex enough to support phenomenal consciousness.

Another consideration against thinking that egocentric representations are alone sufficient for conscious states comes from the case of Milner and Goodale's patient DF, a victim of carbon monoxide poisoning that resulted in bilateral lesions to lateral occipital cortex. DF's lesions gave rise to visual form agnosia, a condition in which DF reports being unable to see objects, especially aspects of objects concerning their shape or form. In brief, patient DF seems not to be visually conscious of the form of objects. Nonetheless, it can be demonstrated that in spite this lack of visual consciousness she is able to make use of certain unconscious representations of visual information about the form of objects in order to guide her actions. One demonstration of DF's condition is her performance on a task in which she had to put a card into a slot that could be variously oriented. For a given orientation of the slot, DF was able to orient the card correctly and post into the slot. DF's performance on this task was about as good as normal subjects. However, when asked to not put the card into the slot but instead to merely report on the orientation of the slot by holding the card in a comparable orientation, DF's performance was quite poor compared to normal subjects. The aspect of DF's performance that is relevant for our purposes is that while DF was not conscious of the orientation of the slot, her successful performance on the task indicates that her nervous system had unconscious egocentric representations of the slot. That she was able to correctly post the card into the slot demonstrates not only that she had representations of the orientation of the slot, but

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networks, Biology and Philosophy 18(1), 95–130.

also that the orientation was represented relative to her hand and was thus egocentric.[50]

One final consideration against regarding consciousness as purely egocentric involves making note of how frequently conceptual knowledge can affect what it is like to have various conscious experiences. For example, a pattern of black splotches on a white page can suddenly resolve as an image of a dog for someone who has a concept of a dog. The concept of a dog and the conceptual knowledge of what dogs are involve allocentric representations. The categorical knowledge that dogs are furry need not encode any information about the current relations of any dogs to oneself. Nonetheless, the way in which conceptual knowledge can be brought to bear on perceptual experience shows that concisions experience is not solely a matter of egocentric representation. Just as consciousness is not solely egocentric, neither is it solely allocentric. One consideration in favor of this view is that visual consciousness is perspectival in the sense of embodying a pictorial perspective. The different features that characterize perspective in paintings and photographs also characterize a key feature of visual consciousness. For example, the visual perception of a row of three houses, like a picture, contains information about the locations and distances relative to the viewer in a way that the purely allocentric thought that there are three houses does not.[51]

Another reason for believing that purely allocentric representations are

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[50] Milner, A., and Goodale, M. (1995) The Visual Brain in Action, Oxford University Press, New York.

[51] Mandik, P. (2001) Mental representation and the subjectivity of consciousness, Philosophical Psychology 14(2), 179–202.

insufficient for phenomenal consciousness comes when we realize that many propositional attitudes lack phenomenal character. Consider, for example, one's belief that Pi is an irrational number. It is implausible to suppose that this thought has any particular phenomenal character associated with it. As Jackendoff suggests, any apparent phenomenal character of the thought actually is the phenomenal character of associated sensory imagery, not of the thought itself.[52] And leaving the question of phenomenal character to the side momentarily, we can note that one can have a belief without it being a conscious belief. For example, the reader may have believed for many years that Pi is an irrational number, but this fact was probably not in the forefront of the reader's consciousness until this paragraph. Thus one can have allocentric representations (in this case, representations of Pi and irrationality) without those representations thereby being conscious. This is not to say that allocentric contents can never enter into consciousness. Indeed, the point of the above discussion concerning the influence that conceptual knowledge of dogs can have on visual perceptions of dogs was to demonstrate that allocentric contents do enter into conscious experience. The point here is that conscious experience is never solely allocentric.

Since conscious experience is never solely allocentric or solely egocentric, it is never to be found at either end of the allocentric-egocentric hierarchy. This lends plausibility to the hypothesis that conscious states are to be identified with representations at an intermediate level of the processing hierarchy. Of course, another

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[52] Jackendoff, R. (1987) Consciousness and the Computational Mind, MIT Press, Cambridge (MA).

reason is due to implications of the Transcending Zombies argument, but I postpone further discussion of this point until section 5 of the current chapter.

Additional evidence comes from research on the neural correlates of consciousness in binocular rivalry. In binocular rivalry research, human and animal subjects are presented with contradictory stimuli to their eyes, such as horizontal stripes to the left eye and vertical stripes to the right eye. While two stimuli are presented, both stimuli do not enter into the conscious percept but instead compete in the following way. At one moment the subject will see only the vertical stripes and at another moment the subject will see only the horizontal stripes. Neuroscientific investigations look for which neural activations seem most closely associated with the conscious percept. Monkeys can be trained to indicate which of the two stimuli they are aware of at any given time and single cell recordings can indicate whether activation in a cell is correlated with the conscious percept. Logothetis found that among monkey cortex cells associated with the conscious percept, 90% were in inferotemporal cortex whereas only 40% were in extrastriate cortex (regions of cortex adjacent to area V1).[53]

§4. The Allocentric-Egocentric Interface Theory of Phenomenal Consciousness: Empirical Evidence

According to the AEI theory, not only are conscious states to be identified with representations at the intermediate level of the egocentric to allocentric processing hierarchy, they are, more specifically, to be identified with representations for which

[53] Logothetis, N. (1999) Vision: a window on consciousness, Sci. Am. 281, 69–75.

there is a mutual influence between egocentric and allocentric representations. That is, conscious states are hybrid representations in which there is both-bottom up influence of egocentric representations on allocentric representations and top-down influence of allocentric representations on egocentric representations.

Evidence for the necessity of reciprocal interaction between egocentric and allocentric representations comes from multiple sources. Already noted was the way in which conceptual knowledge can influence the nature of a perceptual experience. Additional evidence comes from studies of the relative contributions of low and high levels of the processing hierarchy conducted by Pascual-Leone & Walsh.[54] They applied precisely timed pulses of trans-cranial magnetic stimulation to different regions of visual cortex so as to test which areas seemed necessary for a conscious percept. In particular they looked at the relative contributions of area V1 and the relatively higher-level adjacent area known as MT or V5. Activity in neither area was alone sufficient for a conscious percept (a perception, in this case, of a moving stimulus). The conscious percept arose only when information was allowed to feedback from MT to V1.

We can relate the allocentric-egocentric interface proposal to the phenomenon of motion induced blindness. As already mentioned above, parietal areas—relatively intermediate in the processing hierarchy—are implicated in the phenomenon. Especially noteworthy are the contributions of relatively allocentric representations to the phenomenon. Bonneh and Cooperman investigated what frames of reference seemed

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[54] Pascual-Leone, A., and Walsh, V. (2001) Fast backprojections from the motion to the primary visual area necessary for visual awareness, Science 292, 510– 512.

most implicated in the motion induced blindness and found that head-centered and object-centered mechanisms are involved in the disappearance effect. [55]

Another promising line of evidence concerning the role of higher-level processes concerns the processes implicated in the kinds of learning that seem to involve consciousness. For example, there is evidence from fear conditioning studies that trace learning but not delay learning depends on consciousness. In the trace learning, there is a time gap between the conditioned stimulus and the unconditioned stimulus and in delay learning the two stimuli overlap. Additionally, it has been suggested that trace but not delay learning depends critically on hippocampus and certain prefrontal structures.[56]

The question arises of whether Milner and Goodale's dual systems theory of vision is inconsistent with the AEI theory of consciousness. One way of seeing a tension between the two accounts involves reading Milner and Goodale's view as the hypothesis that consciousness arises only in ventral stream processes and never in dorsal stream processes whereas the AEI theory allows that consciousness (at least sometimes) involves parietal processing. Two main points need to be made to ward off any threat that might be posed by Milner and Goodale's account. First we need to see that parietal areas do indeed sometimes get implicated in conscious states. The second point is to give an account of what distinguishes the occasions in which parietal processing affects

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[55] Bonneh, Y., and Cooperman, A. (2003) Motion induced blindness is affected by head-centered and ob ject-centered mechanisms, Journal of Vision 3(9), 221.

[56] Carter, R., Hofstotter, C., Tsuchiya, N., and Koch, C. (2003) Working memory and fear conditioning, Proc. Natl. Acad. Sci. 100(3), 1399–1404.

consciousness and when it does not. Regarding the first point, it has already been noted that motion induced blindness may be modulated by transcranial magnetic stimulation of parietal areas. Further, parietal activity is implicated in conscious motor imagery.[57] Regarding the distinction between conscious and unconscious parietal activity, the distinction can be drawn as follows: direct projections from parietal areas to pre-motor areas do not result in conscious states, whereas projections from parietal areas to pre-motor areas via prefrontal cortex do give rise to conscious states.[58] This fits nicely with the Allocentric-Egocentric Interface theory given the role frontal cortex plays as a high-level area of visual processing implicated as a locus of allocentric representations.

§5. Philosophical Implications of the Theory

5.1. The Convergence Upon an Answer to the Question of State Consciousness by WIL and Deflationary Versions of Transparency

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[57] See Decety, J., Perani, D., Jeannerod, M., Bettinardi, V., Tadary, B., Woods, B., and Mazziotta, J. (1994) Mapping motor representations with PET, Nature 371, 600–602. See also Grafton, S., Arbib, M., Fadiga, L., and Rizzolatti, G. (1996) Localization of grasp representations in humans by PET: 2. Observation compared with imag- ination, Experimental Brain Research 112, 103–111.

[58] Boussaoud, D., di Pellegrino, G., and Wise, S., (1996) Frontal lobe mechanisms subserving vision-for-action versus vision-for-perception, Behav. Brain. Res., 1–15.

and Transitivity. Also: Remarks Regarding the Two Other of the Three Questions of Consciousness

The time has come to relate AEI to more explicitly philosophical concerns of consciousness. The first point to note is the way in which the three means of characterizing conscious states—Deflationary Transitivity, Deflationary Transparency, and WIL—converge according to AEI. As a matter of *empirical* fact, states at the allocentric-egocentric interface are (1) states *of which* subjects reporting them are conscious, a (2) states *with which* the subjects are conscious, and (3) states *for which* there is something it's like to be in them. Many philosophers will demand more than just empirical facts concerning these issues and I will remark on WIL, Transitivity, and Transparency in 5.2, 5.3, and 5.4, respectively. These sections will not only further illuminate AEI's answer to the question of state consciousness, but also AEI's answer to the questions of phenomenal character (5.2) and transitive3 consicousness (5.3 and 5.4).

5.2. WIL, AEI, and TZ

Talk of zombies helps express various doubts about the ambitions of reductive accounts of phenomenal character and the Transcending Zombies argument helps show how such doubts may be laid to rest. If we take seriously the claims of first-person knowledge of one's own qualia claimed by many consciousness theorists, then we must, I argued, acknowledge that any specification of my properties sufficiently fine-grained to capture my conceptualized egocentric contents will be sufficiently fine-grained to capture my qualia. Now, the Transcending Zombies argument does not, of course, alone suffice to single out as superior AEI as a reductive theories. There are possible if not actual

versions of HOR and FOR (and others besides) that, insofar as they build in essential roles for conceptualized egocentric contents in the constitution of qualia, satisfy the demands of the Transcending Zombies argument.

5.3. AEI and HOT

A conscious state need not be an object of meta-representation because of the kinds of considerations raised in connection with the Unicorn Argument. The most relevant considerations are those concerning how being a conscious state cannot consist in being the object of a representation since nothing can consist in being the object of a representation.

Neither does a conscious state need to itself be a meta-representation. This is because we can have conscious mental representations that are not representations of vehicular properties. They do not involve the application of concepts of vehicular properties.

5.4. AEI and FOR

The above remarks help indicate why higher-order representations play no essential role in the account of conscious states. This is not, however, to agree with FOR-heads and Transparency advocates that conscious states are necessarily first-order, as was the major aim of chapter 2 to spell out. Thus, following the thesis of neuro-introspection from chapter 2, if a person had the conceptual knowledge that consciously perceiving motion involved reciprocally influencing activity in areas V1 and MT, and acquired the skill of being able to automatically and without conscious inference apply that conceptual knowledge to experience, then that person would be able to be conscious of the vehicular

properties of that experience. One consequence of this view that concerns phenomenal character is that when brain states are directly introspected it is not the vehicular properties of experiences that contribute to phenomenal character but instead the representational content of the introspective states (which, of course, represent vehicular properties) that contribute to phenomenal character.