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CONSCIOUSNESS AND PERSONHOOD IN SPLIT-BRAIN PATIENTS

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CONSCIOUSNESS AND PERSONHOOD IN SPLIT-BRAIN PATIENTS

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF PHILOSOPHY

BY

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1 INTRODUCTION

Much I owe to the Lands that grew--
More to the Lives that fed--
But most to Allah Who gave me two
Separate sides to my head.

Much I reflect on the Good and the True
In the Faiths beneath the sun,
But most to Allah Who gave me two
Sides to my head, not one.

I would go without shirt or shoe,
Friend, tobacco or bread,
Sooner than lose for a minute the two
Separate sides of my head!

Rudyard Kipling, "The Two-Sided Man"

Researchers Roger Sperry and Ronald Meyers first noted split-brain phenomena in the late 1950s. Initially they conducted experiments with cats, a staple of neurological research, and continued later with monkeys. In 1961 split-brain surgery was used on a human patient in an attempt to halt severe epilepsy that had not responded to standard pharmaceutical treatment. Other patients also were given the procedure.

Somewhat later than one might expect, given what was already known about the brain, researchers noted that such patients exhibited intriguing behaviors under certain experimental conditions. They were unable to share information from one hemisphere to the other, giving the appearance, at least under experimental conditions, of having two, separately functioning brains. Sperry and his student Michael Gazzaniga conducted further experiments in order to determine more precisely the relationship between the right and left hemispheres of the brain, hoping to gain insight into how the mind of the split-brain patient operated.

Controversy arose when the results of these investigations filtered out. Some thinkers argued that there were two minds in one patient, and but for the artificial experimental conditions, these minds worked in tandem. Others argued that there was still only one mind. Some even placed that mind *in* the left hemisphere and denied that the right hemisphere was a mind.

In this work, I look at only one component of the patient's life--namely, as that patient operates under the conditions of a Sperry-type experiment. A *Sperry-type experiment* is any controlled condition in which the hemispheres are given information but not allowed to relay that information to one another.

My ultimate position is that a duality of concurrent persons exist under such conditions. In particular, I argue that however many minds are operating in the patient before and after a Sperry-type experiment, there are two independent streams of conscious mental states, and ultimately two independent persons, while such an experiment is in progress. The project has three essential parts.

In part one, Cognition, I survey empirical investigations of split-brain phenomena. I first address some of the issues regarding brain anatomy and function, and some of the biological developments regarding asymmetry in animals, and then I move on to give a short history of the investigation of hemisphere specialization in human beings. Second, I give an outline of the essentials of brain information processing that bear on split-brain phenomena. I will argue that the right hemisphere has functionally distinct modules of cognition which support the sentience of the two isolated hemispheres. Third, I address neurological dysfunctions and note that some of them resemble various aspects of what occurs in split-brain experiments. Finally, I review and analyze the empirical side of various Sperry-type experiments. At the end of part one, I argue that the empirical evidence straightforwardly warrants the position that each hemisphere is legitimately reckoned to have the necessary cognitive structure to support consciousness and even personhood.

In part two, Consciousness, I lay out a position on just what is meant by calling the individual hemispheres *conscious*. I am concerned especially with defending the right hemisphere's status as conscious, since this often is at issue in debates about split-brain patients. Initially, I consider several alternatives for what might count as a fruitful definition of consciousness, since this is somewhat a term of art in the literature. Next, I consider two versions of Higher-Order Theories of consciousness. Next, I consider two key challenges to reckoning the right hemisphere as being conscious, one from Dennett (1978) and another from worries about "Zombies." Finding these surmountable, I discuss the essentials of consciousness, as they would apply to the right hemisphere. I address such issues as phenomenal vs. access consciousness, introspection, and the configuration of brain module function. Finally, I develop a criterion for detecting consciousness which is based on a modified version of the Turing Test. At the end of part two, I argue that if it is granted there is such a thing as consciousness at all, then the right hemispheres would qualify in virtually all respects.

In part three, Continuity of Identity, I re-affirm that not only are both hemispheres conscious, but they also are persons, even if short-lived persons. To this end, I first give a tentative definition of 'person', and sketch the main issues for establishing a coherence of identity of a person. Second, I discuss individuation, developing a theory about how minds are encarnalized by human brains. Finally, I analyze the unity of consciousness as a subject of mentality, specifically as it relates to the right hemisphere's being a person under the conditions of a Sperry-type Experiment.

I close out the project with a summary of the argument and conclusions.

2 COGNITION

2.1 Introduction

The lateralisation of the brain was noted early on under clinical conditions. In some instances physicians noted certain lateral injuries produced specific deficits in mental skills. In other instances, psychologists noted that the origin of certain emotive behaviors seemed lateralized in the brain. Eventually, neuroscientists, linguistic theorists, brain surgeons, and a host of people in other science-based disciplines came to appreciate the significance of lateralisation of the human brain. One could begin a legitimate approach to the study of split-brain patients from any *one* of the scientific disciplines that concern themselves with brain function. Or, one could begin from *all* of them, which is just what I do.

As a synthesis concerned with the kinds of knowledge that underlie human cognition, the details of human cognitive processing, and the computational modeling of those processes, cognitive science offers a good empirical starting point for unraveling the very surprising results coming from studies on split-brain patients. Bechtel and Graham (1998) define cognitive science as "the multidisciplinary scientific study of cognition and its role in intelligent agency. It examines what cognition is, what it does, and how it works"(3). Bechtel and Graham note that this definition is premature without further discussion of the history of cognitive science and that it comes across as far more definitive than it actually is. People differ on what creatures count as intelligent agents, or which scientific disciplines should be included in the study of cognition. Also, there are worries over what "cognition is, what it does, and how it works" (3). Among other strands in its history, cognitive science grew out of developments in computer science.

Information-processing models were applied to psychology. The object of this application was to specify the internal processing involved in perception, memory, and thought, which is precisely what is required for investigating split-brain phenomena.

In this part, I first outline some of the more essential issues regarding brain anatomy and function that will figure in a discussion of the cognitive activities of split-brain patients. Next, I give a sketch of the biological bases of asymmetry in the animal kingdom. After this sketch, I give a short chronological survey of early speculation about and recognition of hemisphere specialization. I also discuss some key neurological dysfunctions that share some resemblance to Sperry-type experiments, the latter of which experiments I explore in some detail.

2.2 Essential Issues in Brain Anatomy and Function

2.2.1 Anatomical Features

The brain is the part of the central nervous system that coordinates and controls a host of bodily activities. In humans, this includes not just control of movement, sensory input, and other physiological processes, but also responsibility for maintaining consciousness and personal identity.

The evolutionary biologist holds that the brain's primary function is to make decisions about how to enhance reproductive success. It is driven by rules that help it achieve this end. But the brain can do other things, such as store experiences and change its own structure to accommodate new experiences (Gazzaniga 1998, 35). These "other things" are what make the brain of such interest for study, for with an appropriate amount of neural complexity and under the right structural conditions, brains can give rise to minds. The ambiguity of that last clause about brains and minds might mean that any single

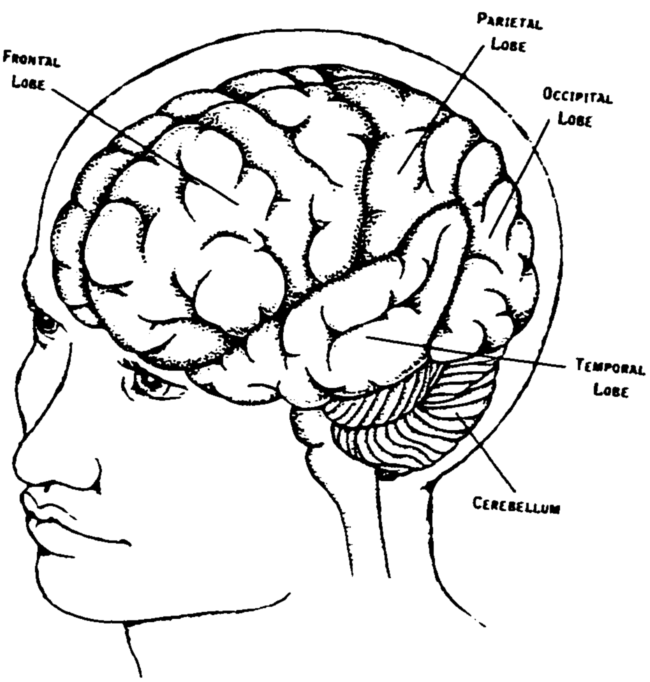

Figure 1: Gross Brain Structure (Restak 1995, 12)

brain could give rise to only a single mind or that any single brain could give rise to at least one single mind.

<u>2.2.1.1 Cerebral Hemispheres</u>

Even a cursory examination of the brain's gross structure reveals it is split into two halves. These, the two *cerebral hemispheres*, represent not only the largest portion of the brain, but make up 70 percent of the entire nervous system. Somewhat along morphological features, somewhat along arbitrarily divided points, the two hemispheres taken together (the *cerebrum*) are further divided into parts, called *lobes*. It is known that the lobes have different functions, but their structures have not been rigorously mapped (relative to the number of substructures that could be identified, in principle) nor their functions fully understood. The *frontal lobes* are concerned with the most complex abilities of the mind: judgment, reason, and emotional processing. The *parietal lobes* process taste and other sensations, "such as the ability to judge weight, shape, and textures," and allow one to identify what an object is by feeling rather than seeing. The *temporal lobes* are at the rear of the skull and house processing for visual modalities--size, color, form, movement, and distance judgment. Object identification occurs here by means of such modalities, and judgment of differences between similar objects is also discerned in this area--e.g., "bird" versus "airplane." Finally, the *temporal lobes* receive fibers concerned with speech, hearing, smell, and balance (Considine 1994, 2150).

2.2.1.2 Corpus Callosum

Corpus callosum actually means "thick-skinned body" (Restak 1995, 97). This white-matter connecting tract of more than 200 million individual neurons (in humans) is the major apparatus of communication between the two hemispheres in higher mammals. Other minor structures connect the hemispheres, including the *anterior commissure*. From a neurological standpoint, the corpus callosum's function is unclear. Some speculate it could synchronize oscillatory activity, as, for instance, when various objects pass through the different receptive fields of processing for vision. Others have speculated that the corpus callosum inhibits control of current processing for one or the other hemisphere (Gazzaniga, Ivry, and Mangun 1998, 328).

This would mean that the corpus callosum might not be a mechanism of information exchange, but a switch that inhibits one or the other hemisphere from being

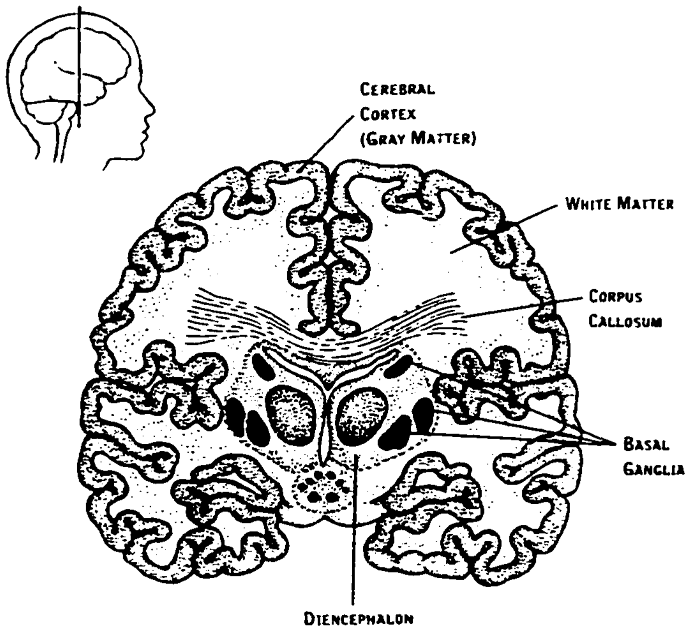

Figure 2: Sketch for locating Corpus Callosum (Restak, 1995, 15)

dominant. The signals traveling along the corpus callosum are not information signals, but signals that would inhibit control structures in one or the other of the hemispheres. Studies of neural nets modeled after the speeds of callosal fibers in humans, using both the limited human data and more accurate single-cell studies in primates, seem to show that "the delays associated with trans-callosal communication not only limit the degree of cooperation between the hemispheres, but may have provided the impetus for the development of hemispheric specialization." In networks trained with slower inter-hemispheric-like connections, such as the brain, the hemispheres operate most efficiently as independent processing systems. Under these conditions, it is thought that such slower processing systems are more likely to evolve non-identical computation capabilities (Gazzaniga, Ivry, and Mangun 1998, 341). The corpus callosum is sometimes partially or fully cut during surgery on severe epilepsy patients in order to isolate the hemispheres--thus, the origin of the phrase "split-hemisphere" or "split-brain" patients. This procedure limits the overly active electrical activity from spreading via the corpus callosum throughout the brain, thus keeping the patient from being fully incapacitated.

2.2.1.3 Medulla Oblongata

Underneath the brain and running into its central base, at a length of about an inch, the *medulla oblongata* appears at the top of the spinal cord. It looks like a somewhat widened, more nerve-packed part of the spinal cord, but it actually is far more complex in its structure. Its control centers are concerned with a wide range of brain activities, such as the basic biological functions of swallowing, breathing, digestion, and vomiting, and with some of the more advanced motor functions of speech. Apart from its involvement in these tasks, it is especially important to note regarding studies of split-brain patients that "in the medulla oblongata, the large bundles of fibers, which originated in the two halves of the cerebrum and which transmit the impulses of voluntary movement, cross to the opposite sides" (Considine 1994, 2149). This is where the crossover from the left side of the body is tied to the right hemisphere of the brain and vice versa. Thus, for example, when a split-brain patient points to items with the right hand in a Sperry-type experiment, the medulla oblongata has routed motor control and feedback information to the left hemisphere. Naturally, the right-hemisphere's left hand routing is controlled in the same manner.

2.2.1.4 Thalamus

The *thalamus* is often called "the gateway to the cortexes" because all sensory modalities except olfactory inputs are relayed through the thalamus before continuing into other sensory receiving areas. Like the brain, the thalamus is a bilateral structure separated along a midline by a ventricle, although some people do have both halves of their thalamus connected by what is called *massa intermedia* (Gazzaniga, Ivry, and Mangun 1998, 59).

2.2.1.5 Hippocampus and Amygdala

The *hippocampus* and *amygdala* are both structures located within the core temporal lobe. Studies by means of PET and MRI scanning, along with human and animal lesion data, find as a "reasonable conclusion that the hippocampus encodes new information and retrieves recent information when explicit (as opposed to implicit) recollection is involved" (Gazzaniga, Ivry, and Mangun 1998, 282).

The hippocampus also is involved in spatial processing. While the "hippocampus is a general purpose device for forming associations between stimuli--a red traffic light is linked to cars stopping--[the amygdala] has a narrower memory function. [It] provides an emotional tag to go with the association" (Gazzaniga, Ivry, and Mangun 1998, 450). Stimulation of the amygdala, whether by artificial means, such as electrodes, or by natural means, such as during an epileptic seizure, results in fear, fearful hallucinations, or memory episodes of some previous frightening experience (Kazdin 2000, 451).

It also should be noted that *pyramidal neurons* are a part of the hippocampal structure that project out of the hippocampus by means of the *fornix*, which is a large white-matter

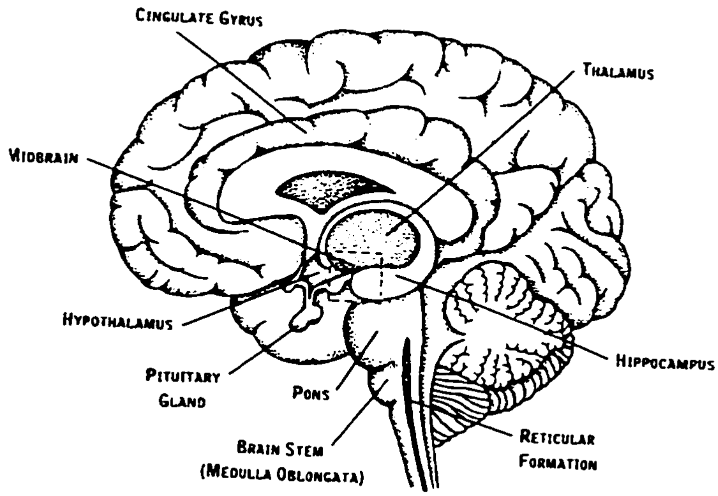

Figure 3 Sketch of basic brain anatomy

tract. Some of the fibers of the fornix cross to the opposite hemisphere (Gazzaniga, Ivry, and Mangun 1998, 59).

I have been reviewing the basic anatomical features of the brain, for all of these structures will eventually come into the discussion when the specific activity and information exchange between the two hemispheres is considered. Moreover, a general feeling for the type of neural activity of the brain will also allow one to better cash-out a workable definition of consciousness.

2.2.2 Modularization

2.2.2.1 Introduction

Regarding the modularization of brain function, I first suggest that chronometric evidence leads one to think that there are discrete modules in the brain dedicated to specific tasks. I next show how the brain can be artificially modularized by Wada procedures and partial callosal surgery. Finally, I give what appears to be an example of a brain module for a specific task, facial recognition, and I close with some remarks about the brain as a society of modules.

Showing that the brain is a neural network with discrete processing modules is essential for arguing that a large collection of such modules can form an independent mind over time. Obviously this would directly support my main goal of showing that the right hemisphere is an independent mind within the context of a Sperry-type experiment.

2.2.2.2 Chronometric Evidence for Modularity

A first reason for thinking that the brain is made up separate modules is that when given separate paths one can make *chronometric measurements*--that is, one can discuss the time it takes the brain to perform various tasks. For example, one might identify the relationship between two letters where they are physically identical; where they are identical in case; or, where they are both vowels or consonants. Taking these different categories and measuring response times for subjects instructed to differentiate letters into their proper categories, one notes that the response times are not all the same. This indicates that different neural processes are operant for different types of thinking tasks. One can further vary the inter-stimulus interval between presentations and watch how there is a correlation among the various thinking tasks (Gazzaniga, Ivry, and Mangun 1998, 95). Since matching chronometric measurements taken from the subjects are constant for like differentiation tasks, this is evidence for the modularity of brain processing.

2.2.2.3 Wada Procedure on Normal Brains

Second, one can take a normal functioning human who has not had a severing of the corpus callosum and apply what is called a *Wada Procedure*. Here one half of a patient's brain is put to sleep through chemical injection. If during this time, for example, the left hemisphere is put to sleep, and an object is placed into the patient's left hand during this left-sleep time, the patient, upon the reawakening of the left hemisphere, will deny that anything was put in the left hand. However, when the patient is shown a group of objects, he or she will decisively point to the correct object. Only after this will the left hemisphere indicate verbally that it remembers the object.

Gazzaniga (1985) takes this as strong evidence that the mind is made up of multiple modules and that information can be stored in particular modules without other modules having access to the information. In this case the language-producing module of the left hemisphere did not have access to the memories in the right hemisphere. He theorizes that the left hemisphere "remembers" the object only by observing bodily behavior and interpreting a consistent story for the now reunified brain's control of bodily motions (83-84).

One also might theorize that the access memory circuitry of the left hemisphere was unavailable at the time of left-sleep, and only when this circuitry comes back into operation does the left hemisphere gain the memories available within the right hemisphere. Gazzaniga, Ivry, and Mangun (1998) note that "encoding and retrieval process are lateralized in the left and right hemispheres, respectively" (283). This means that the memory *retrieval* for deeper, or what is sometimes understood as "longer-term," memory is done in the right hemisphere while the *encoding* of deeper memories is done in the left hemisphere.[1]

It is worth noting that the cortical areas and not the hippocampus are active during longer-term memories. So unless one can offer empirical procedures for differentiating confabulation[2] from cross-hemisphere memory access in these cases, one is unsure how to interpret the reports of patients after a Wada procedure. This worry surfaces again when the attempt is made to interpret reports of patients concerning what they remember about Sperry-type experiments.

2.2.2.4 Partial Callosal Surgeries and Selective Module Disconnection

[1] This harkens the common notion of 'memory' as being our faculty of retaining and recalling past experience

[2] 'Confabulation' is falsification of memory wherein a patient's gaps in recall are "filled by fabrications that the patient believes to be facts, often with made-up details that are believable." Confabulation often occurs in patients with head injuries, senile dementia, partial paralysis, and Karsakoff's syndrome (Corsini 1999, 204).

Third, modularity can be noted in certain subjects who do not have the corpus callosum fully severed. (Sometimes the severing of the callosum is accomplished in a two-step process, i.e., with separate surgeries.) Under this condition subjects can be presented with a word, say "knight," and asked to identify what they have seen. If, for instance, the word is flashed to the right hemisphere, the left hemisphere will be able to name only certain aspects of the stimulus. In one experiment, a patient reports having a picture in his mind and responds with such phrases as "ancient," "wearing uniforms," "on horses," "two fighters in the ring," but does not directly identify the word "knight." Eventually, the patient will ask, or offer, the word "knights." The left brain acquires fragments of information from reporting modules that are still connected through the partially severed corpus callosum. The left hemisphere then interprets the data and makes a guess based on inference (Gazzaniga 1985, 127). Not all patients, however, exhibit this same ability. The locations of various modules are not constant from person to person. Some patients will give no response even in partial callosal surgeries. Ultimately, it was patients who had the best right hemisphere language capabilities that gave the most interesting responses under the conditions of partial callosal surgery (128).

2.2.2.5 Brain Modularization and Face Recognition

Fourth, facial recognition, or more accurately, the lack of it in some persons, serves as a useful example of brain modularization. The inability to recognize faces is called *prosopagnosia*. People with prosopagnosia can indeed recognize that they are seeing a face, but they are unable to identify whose face it is. They are able to recognize normal objects, even the very details of a face. Also they are able to recognize very complicated objects, such as tools, vehicles, vegetables, and eyeglasses. Likewise, some patients have quite the opposite problem. After a head injury, they are able to identify faces quite easily but have extreme trouble recognizing everyday objects. Both the positive and negative aspects of facial recognition show there is an argument to be made for a facial recognition module.

It has sometimes been argued that prosopagnostics are unable to process the kinds of geometric features that are most useful in identifying faces (as opposed to the face itself, taken as a unit). Pinker, however, thinks that the distinction between recognizing faces and recognizing objects with a particular geometry is a meaningless distinction. He notes that the recognition of a face is more a holistic matter, the module being optimized for geometric features that distinguish faces (Pinker 1997, 273-274).

2.2.2.6 Modularity and the Social Brain

In *The Social Brain*, Gazzaniga argues that the brain is made up of many modules carrying out independent activities. This "confederation of mental systems" means we are best viewed as having a social brain (Gazzaniga 1985). This is essentially the view I advocate.

When one considers that the brain is a neural net, and that neural nets can be modularized to perform separate specialized tasks, it is not surprising that the brain operates in this way. Neural nets can function under degraded conditions, and split-brain patients just happen to be the most surprising instances of an artificially degraded neural net yet found. In acknowledging such specialization, I am, therefore, advocating in this work some version of a modularity theory of mind. Human minds are composed of various independent or functionally independent units (i.e., modules) that can be made to operate in various ways. Over time, these modules relate to one another in different ways to achieve an integrative synthesis. I acknowledge that there are other arguments to be made about how the human mind is related to the human brain, and, of course, talking about "human" minds is domain specific. I do not seek to take any expansive position on a universal solution to the mind-body problem--at least no position beyond that which is necessary for giving some reasonable account of how this occurs in humans.

2.2.3 Analysis of Particular Brain Substructure Functions

2.2.3.1 Introduction

Up to now, I have reviewed the anatomical features of the brain that are essential for understanding split-brain patients and have discussed modularization. I next provide some analysis of the roles of particular brain substructures for split-brain patients. I discuss the hippocampus, non-corpus callosum linkages, and the recurrent, 40 Hz pathways modulated from and by the thalamus. Although my discussion continually refers to brain structure and function throughout this work, it is helpful here to address some specific functions of a few key substructures before moving into a more general discussion of asymmetry.

2.2.3.2 Role of the Hippocampus and Some Hypothetical Experiments

The hippocampus is the part of the brain most employed in spatial processing (Gazzaniga 1998, 65). In split-brain patients, both hemispheres share the same hippocampus, which is not divided during the surgical procedure. On this basis, one might speculate that both hemispheres would have the same spatial processing capabilities. Of course, one must consider experiments to see if the spatial awareness remains the same for both. The hippocampus and associated substructures play an important role in providing information to the hemispheres; this information is drawn upon by the respective, isolated hemispheres and would be a component in maintaining personal identity, such as when a respective mind determines the boundaries of its body.

Two types of experiments would prove informative. The first would be a set of experiments that concern proprioception (the sense of body movement and position). The second would concern spatial ability.

The researcher might tell the patient (during the time when the hemispheres are working in parallel) that he or she will be flashed pictures of body parts and is to touch the body part shown. The researcher would separate the hemispheres, flash the pictures, and then observe what gets pointed to and what does not. Would the left arm point to the right leg, for example, when a right leg was flashed to the right hemisphere? Perhaps the right hemisphere would not know where the right leg was or that it even had a right leg. (This latter view would be comparable to a full bodily agnosia or to alien hand syndrome extended to the full contralateral side of the patient's body, which is again discussed below under the guise of neurological dysfunctions). Naturally, this procedure could be applied to the left hemisphere as well. If an individual hemisphere does not identify both legs or arms of the patient, it would be some evidence that the right hemisphere identifies the boundaries of its own body, apart from the fact that *its* body is connected to another.

What would occur if a split-brain patient were asked the following question under the condition of the experiment: "Do you have two hands?" Under the conditions of the experiment, the patient has control of only one side; for example, the left hemisphere can control only the right arm. But it would be interesting to know how the left hemisphere understands its proprioceptive space. Hemineglect patients will normally give various answers to why parts of their bodies are actually not theirs. It might be possible to correlate some of the standard responses with split-brain patient responses. Presumably the split-brain patient would indicate that he or she has two hands; or, at least, the respective hemisphere would do so, since it probably maintains a memory of an otherwise jointly controlled body. I am unaware of any studies that have asked this question of the left hemisphere. Speaking by presumption once again, since the right hemisphere seems to have proprioceptive awareness of the left hand, it would likewise answer -- i.e., indicate (nonverbally, of course) the question affirmatively, most likely also having a memory of jointly controlling two hands.

Another question worth asking would be, "What is your right (or left) hand doing now?" If the split-brain patient thinks he or she does have two hands, what would the patient report about proprioceptive monitoring? Persons generally can give accurate locations of their own body and its position. If one of the hemispheres could not do this, this might be construed as an argument, although an inadequate one, that the hemisphere is not actually a person, but something very much like a person, since it does not have full awareness of the location or limits of its body. This "full awareness" position would be too strong, however, for one can artificially induce paralysis and numbness into a normal human's body. Under this condition, the patient would be unable to give accurate proprioceptive monitoring, but this would not mean the patient was not a conscious self over time, i.e., not a person.(In both part two and part three of this project, I shall return to the issue of proprioception, as it has further implications for consciousness and personhood.)

Split-brain patients are aware when any part of the body is touched. That is, both hemispheres can respond that someone has touched the body. However, the touch seems to be limited to simple awareness, for under Sperry-type conditions when a split-brain patient holds an object in one hand, he or she is unable to find an identical object with the opposite hand (Gazzaniga, Ivry, and Mangun 1998, 337). However, no formal studies of isolated hemisphere proprioception have been performed on humans, though there have been some studies of mice and cats with full hemispherectomies (Burgess and Villablanca 1986; Whishaw and Kolb 1989). These have both shown that an intact neocortical hemisphere is not essential for contralateral limb use in reaching, but (not surprisingly) it does contribute to successful use of the limb. Furthermore, cats can be trained not to favor the contralateral fore-limb. Note, however, that proprioception in humans has subtle differences from mice and cats: "interestingly in humans, there appears to be comparatively strong gender differences in the perception of gravity. Females in tilted chairs with tilted visual environments will align themselves more with visual stimuli whereas males will align themselves more with gravitational stimuli" (NAN 2002). Thus any studies levied on split-brain patients concerning their proprioceptive abilities would have to carefully screen such gender differences.

Another experiment one might run concerns spatial ability. A single hemisphere could also be asked the location in a room of objects which it cannot immediately observe (because of having information from only one side of the visual field). Would it perhaps indicate its answer by pointing to where objects outside of its immediate perception lie (such as a table the patient would be required to walk around when entering the room)? If so, this would show a continuity of identity through spatial memory and would be evidence toward a view of unity of personhood. But if the right hemisphere could not identify such objects, then this would be evidence against a view of the unity of personhood under the conditions of hemisphere isolation. The results of studies by Lessard, Mariotti, and Wessinger (discussed below) show that when the right hemisphere is under Sperry-type conditions, it almost certainly would maintain such spatial relationship abilities.

Hemispherectomized patients can locate stationary and moving sounds. Persons with but a single hemisphere retain memory information of sounds and are able to indicate this by pointing to a location within sense perceptual range (whether within an anechoic chamber (Poirier et al. 1994) or along a horizon diagram (Lessard, Lepore, and Poirier 1999). This is a sure sign of continuity of memory.

Further, there is similar and better evidence regarding visual modality. Mariotti (1998) summarizes as follows the abilities of patients whose left hemisphere has been removed:

> Visuospatial abilities are clearly worse than in normal subjects and the most preserved visuospatial abilities seemed to be the less sophisticated ones. . . . The same pattern, that is, preservation of language and impairment of visuospatial abilities, also seems to occur in subjects who had undergone surgical removal of the right hemisphere; in other words, the cognitive pattern seems the same regardless of which hemisphere is removed. These observations suggest that no matter which hemisphere is removed, functional reorganization follows a

> hierarchical criterion that privileges the linguistic function, and the visuospatial functions most essential for independent survival. ( )

That either hemisphere retains such visuospatial ability seems to implicate substructures within the brain for processing spatial information.

Slightly earlier studies also had hinted that the hemispheres could remember information provided by such substructures. Wessinger et al. (1996) describe a study in which two patients with unilateral disconnection or removal of the entire occipital lobe were tested for residual vision in their blind field. Using image stabilization to eliminate eye motion artifacts, the central portion of each subject's visual field was tested, beginning 1 degree from fixation and extending outward to 13.5 degrees. It turned out that a narrow zone of residual vision was identified for each patient. When they did retain vision, each patient was able to detect stimuli and perform simple shape discriminations, but could not name complex line drawings. Most important, "the patients were *aware* of their vision within this zone." Moreover, "no residual vision, with or without awareness, was found in areas tested outside these zones." Wessinger et al. conclude that "given the complete absence of visual cortex contralateral to the observed residual vision, alternate structures *must* be mediating these abilities" (1129*ff.*, emphasis added). The studies of Lessard, Mariotti and Wessinger suggest there is memory of spatial events to which the isolated hemispheres have access over time.

2.2.3.3 Hemisphere Subcommunication and Emotional Awareness

As was noted earlier, pyramidal neurons that are a part of the hippocampal-amygdala structure project out of the hippocampus by means of the fornix to both hemispheres. Further, both hemispheres will exhibit behaviors commonly associated with emotional dispositions under experimental conditions. As a first example, the *left* hemisphere seemingly becomes irritated -- verbal complaints are uttered-- when it is unclear about what the right hemisphere is doing with objects, or when the right hemisphere is identifying objects that the right hemisphere previously perceived in a Sperry-type experimental situation but which the left hemisphere did not see. The right hemisphere shows no sign of such irritation.

As a second example, the *right* hemisphere seemingly becomes embarrassed when seeing risqué pictures, for the patient "will grin broadly and perhaps blush" (Nagel 1991, 434). The left hemisphere is (happily enough) vaguely aware of what apparently are the emotive responses of the right hemisphere, even though the left hemisphere cannot report why such apparent states occur. The left hemisphere (again, which controls speech) may say, "'Wow, that's quite a machine you've got there." (434).

In the latter case, perhaps the left hemisphere can feel the blush or detect the tautening of facial muscles which it normally associates with the kinesthetic feedback of otherwise commonly felt emotive states. But what is more important to consider is that although some reasoning and memory functions are operating independently in isolated hemispheres, mutual processing for emotion might not be operating *fully* independently, for there is at least crossover from emotive states of the right hemisphere to the left hemisphere in the hippocampal-amygdala substructure. What this means for developing a criterion for counting consciousness and personhood is a question that warrants further examination.

2.2.3.4 Hemisphere Linkages Other than Corpus Callosum

Because of the pathway linkages between the hemispheres other than the corpus callosum, the split between the hemispheres is not complete. The question becomes, 'What type of, and how much, information passes between the hemispheres along these other minor tracks' and 'Is that information sufficient to unify consciousness and support a unified identity for a person?'[3]

Substructures such as the thalamus, hippocampus, amygdala, and perhaps the medulla oblongata (which as a group I shall label, 'THAM') cannot themselves support personhood -- that is, no other animals that have these structures minus the greater mass are themselves persons. Of course it would be too quick to argue from the premise that 'these structures are not sufficient by themselves to *instantiate* a person' to the conclusion that 'they cannot transfer to the greater cerebellar hemispheres whatever information that is necessary to *maintain* a (unified) person.'

But that these structures are not found to themselves instantiate personhood is at least some evidence that they cannot transfer the necessary information for personhood, for all structures that are known to support a concept of self have considerably more neural mass than what is given in the THAM substructures. A given organic, neural mass can transfer only so much information per unit of time among its cellular elements-- whether by intracellular electrical activity or by intercellular ionized molecular activity. The difference in mass between THAM and the neural masses of animals with a concept of

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[3]Although I shall specifically discuss this term 'person' later, for now I merely mean a being that *both* has conscious states *and* recognizes that it has conscious states over time.

self is substantial. Hence, the warrant for thinking that the THAM cannot transfer enough information to maintain a unified person is likewise substantial.

2.2.3.5 Recurrent Pathways, 40 Hz Waves, and Consciousness

Up to this point, it occasionally has been noted that the human brain is a neural network; in fact, it is a very special kind of network. To be sure, it is probably a collection of many different types of networks, all interacting in and by an as yet inscrutable process. But some properties of the brain's networked configuration are identifiable. For example, it looks like the brain is a *recurrent* network: When neurons exchange information, there is a feedback loop.

Information may come into a set of neurons and then go out of that set of neurons into other neural pathways. But when some of the output is fed back into the input side of the neuron set, a loop or "recurrent pathway" exists. That recurrent pathway, some speculate, might serve for information storage. If so, then a set of neurons can be said to have a device that effectively functions as a type of memory. The human brain has such pathways, particularly in the intralaminar nucleus (located in the layer of fibers within the thalamus.) Signals move from the thalamus into the cerebral cortex, and then a feedback loop returns to the thalamus. The signals that rotate around this loop move at approximately 40 Hz (Churchland 1995, 215).

This loop is important in split-brain patients, for if one wants to argue that there are two centers of consciousness, one can ask, "Are these 40 Hz signals in phase in these patients?" That is, do the 40 Hz waves parallel one another moment by moment in both halves of the patient's brain? If so, the argument could be made, then there is only one person. However, it turns out that such an argument would not settle the issue.

To see why this is so, first consider cases where there clearly are two different people. Although both of their brains may be operating with a 40 Hz, recurrent feedback loop, both loops will not be running simultaneously (in phase). Hence, this would stand as evidence that there are indeed two persons, in the normal case, since there are two nonparallel firings of the 40 Hz waves.

Next note that in the case of split-brain patients, there would be a single 40 Hz wave, because this wave originates from the thalamus, which is not actually separated in surgery. Yet one cannot thereby conclude that there is but one center of consciousness. Why not?

It is conceivable, even if extraordinarily unlikely, that two different bodies, two different persons, in the otherwise common use of the word *person*, could have exactly timed 40 Hz waves, but this would not mean they were two tokens of the same person. One might simply point out that the neural structures that are traversed by the 40 Hz waves are quite different in configuration. One may conclude, therefore, that the presence of the 40 Hz wave is not sufficient for there being a single consciousness. Likewise, the presence of recurring, hemispheric, phased-match 40 Hz waves in the same patient is not sufficient for a particular patient's body housing but a single consciousness during a Sperry-type experiment, for these waves traverse paths of a quite different configuration.

These 40 Hz waves also figure in a more direct discussion of consciousness proper in part two of this work.

I have thus far been giving various forms of evidence in order to support that there are discrete modules in the brain. Showing that there are discrete modules in the brain helps forward my case for the right hemisphere being a superset of such modules. Later in my project I intend to give arguments that this superset has conscious mental states such that consciousness can operate in support of full personhood. But up to now I have been merely setting out evidence for establishing how the brain functions generally (as a set of recurrently networked modules), and showing that such functioning is often operant within a single right hemisphere (such as when observed in hemispherectomy patients)

2.2.4 Split-Brain vs. Split-Hemisphere: Terminology Implications

Finally, there is a bit of conceptual worry about how a patient whose corpus collosum has been severed should be identified.

The phrase *the patient* stands in for a proper name to identify the person operating under a split-brain type experiment. Of course this is open to analysis as a definite description:

1. There is at least one subject of consciousness within the patient.

2. There is at most one subject of consciousness within the patient.

3. Whatever subject(s) of consciousness within the patient there is, is (are) currently operating within the scope of a split-brain experiment.

Later, I shall specifically show why statements such as (1) and (2) have a definite truth value,[4] and over the entire course of this project, I shall continually argue (2) is false, for it underestimates the case.

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[4] This is against Nagle (1997) who has argued that such statements cannot be accounted as either true or false, given our ordinary concept of mind.

Another pair of terms must also be considered. On the one hand, such a patient might be viewed as having a functionally *single* brain, but one that is structurally, although not fully separated. The term *split-hemisphere* patient, therefore, seems appropriate. On the other hand, the patient might be viewed as having a functionally *double* brain, but the two brains happen to share common resources, akin to how some Siamese twins share a single organ or set of organs. The term *split-brain* would be appropriate under this latter view.

If one is inclined to argue that there is only one mind in such a patient, then deference to the term *split-hemisphere* would best. However, if one is inclined, as I am, to argue that there is more than one mind in such a patient, then deference to the term *split-brain* would be advised. And, of course, counting brains, minds, and persons is the whole issue of this work. Already, then, I am forced to lay some of the cards on the table by the very merit of the terminology being used. The term *split-brain* is preferred throughout this work unless an alternative term is expressively quoted from another source.

2.3 Biological Bases of Asymmetry

2.3.1 Animal Asymmetry

There is patchy evidence of generalized hemispheric specialization in animals, and probably the safest view is that whatever hemispheric asymmetry appears in non-humans is probably slightly biased for emotion and, perhaps, for spatial representation. These biases, however, are fairly slight indeed. Studies across different modalities of behavior show only slight preferences among animals. Compared to other animals, the human being is very lopsided in hemispheric specialization (with the possible exception of the canary) (Corballis 1993, 270, 272).

An exception to this general finding concerns cerebral asymmetry in language (or more properly, in communication), where there is some notable asymmetric processing. Songbirds, such as canaries, white-throated sparrows, and chaffinches, all seem to have left hemispheric control over their singing. (This was established by cutting the hypoglossial nerve that directly controls the bird's syrinx, the equivalent of the human larynx.) Macaque monkeys show a right ear advantage in distinguishing among sounds of their own species. Female mice also show a left hemisphere advantage in recognizing communicative calls from their young during lactation cycles. Such asymmetries are all taken to suggest that, in some species, left hemispheric mechanisms are specifically developed to process events that serve a communicative purpose (Corballis 1993, 182-83).

2.3.2 Evolutionary Advantages and Disadvantages of Asymmetry

Yet an overall question needs answering: why asymmetry rather than not? Most animals do not have a marked asymmetry in brain functioning. Consider the advantages and disadvantages of asymmetry of neural functioning. It is sometimes thought that bilateral representation might serve as an additional reserve in the event of injury (Corballis 1993, 208). In the case of a human: when the right hand of a normally right-handed person is put out of commission, the left hand can take up the slack, even though it is uncomfortable for the user, and manipulation is not as efficient. Perhaps this same principle applies to cerebral representation. Duplicate memories or skills distributed in both hemispheres could provide backup in the event of brain damage.

Of course, there also has been some discussion about the disadvantages of

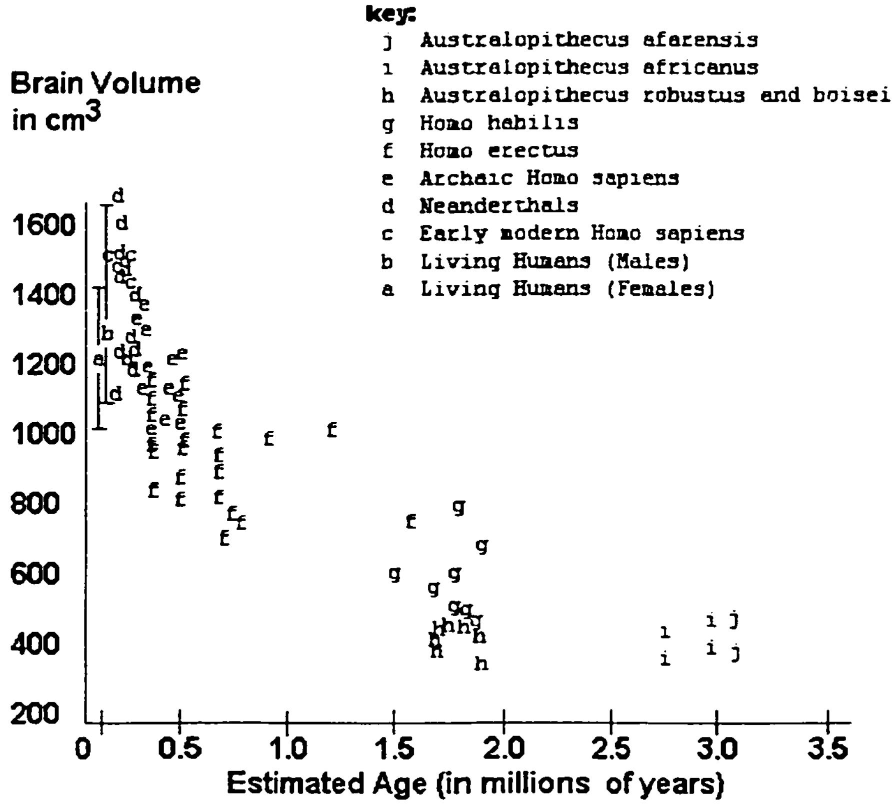

Figure 4 Chart showing increasing cranial capacity per half million years of human development (Data adapted from McHenry 1994)

asymmetry. One disadvantage is that double representation would depend upon the information moving through the corpus callosum, which would take extra processing time and, thereby, not be as efficient in ensuring survival. Execution and planning by means of coordination of the two hemispheres would take more time. Also, having symmetrical representation would not be an efficient use of neural space. It is known that the evolution and manufacture of tool use from *homo habilus*, of whom more shall be said in a moment, was correlated with an increase in brain size. Of course, this had to be solved evolutionarily in the birth of human beings, for the birth canal imposes a limit on the size of the brain. In response to this counter pressure, the human brain is convoluted so that it can be folded to fit into the skull, giving more surface area for neural packaging. Also, human infants are born prematurely relative to other primates, so that the brain can not only fit through the birth canal but also continue its growth after birth. Unilateral as opposed to bilateral representation of praxis skills may be one further way of cutting down the demand for neural space (Corballis 1993, 208).

The presence of bilateral symmetry in limbs for locomotion "was probably an adaptation enabling organisms to move along linear paths through an environment that exerted no overall constraints favoring one side or the other side" (Corballis 1993, 102). Corballis argues that the asymmetry of handedness probably arises when such locomotion pressure is no longer necessary, as two of the limbs previously used for locomotion in bipedals are now free to specialize. Opening fruit or working with tools requires complementary roles in hands. For example, one hand might hold an object while the other manipulates it. Animals such as the lobster show this asymmetry of manipulation in contexts where actions are essentially manipulative. Unlike other asymmetrical creatures, the differences in human hands are not structural but functional. This implies that the asymmetry resides not in the appendages themselves but in the brain structure that controls them (102-103).

2.3.3 Asymmetry in Earliest Humans

From what we know, the earliest humans to show asymmetry were *homo habilis*.[5] From *habilis* on, there is a rearward shift in brain matter that can be attributed in part to an enlargement of Wernicke's area (a general cortical region involved in the reception and processing of language). The sylvian fissure in *habilis* is also markedly like modern humans in that it is angled more steeply and upward on the right than on the left side of the brain (The sylvian fissure demarcates the parietal and temporal lobes of the brain.) (Corballis 1993, 185).

Even so, it is not clear what this developing asymmetry meant for cognition. Arguing from structural similarities in the brain of *homo habilis*, such as increased vein and artery sizes, hence blood flow, to temporal lobes, to actual speech in *homo habilis* is ill advised, since such structures need not be necessary or sufficient for spoken language. Indeed, Davidson and Noble (1989) suggest that "these structures were associated with vocalization, not true language, [and only] were exapted[6] for language at a later stage" (Corballis 1993, 186).

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[5] The name literally means "handy person", given because of the putative association between this early human and the beginning of stone tool manufacturing. "Their earliest date is close to two million years ago. Habilis cranial capacity ranged from 509 to 752 cc, with an average of 630 cc" (Harris 1993, 51). Today's humans have a cranial capacity of 1040-1595 cc. with an average size of 1350 cc. (Klein 1989, 101)

[6] 'Exaptation' is the utilization of a structure or feature for a function other than that for which it was developed through natural selection

2.3.4 Infant Lateralisation and Asymmetry

However, modern humans do show asymmetry of cognitive processing for language. Studies have found that even for learning speech, there is hemispheric specialization in infants. Various studies have shown that when the suckling reflex is correlated with left ear *music* stimulus and then with right ear *syllable* stimulus, the standard hemispheric specialization is apparent (Corballis 1993, 285-86).

Studies on infants also have shown that asymmetry of the human brain can be detected early on. One of the earliest detectable is what is called the *tonic neck reflex*, which occurs around the twenty-eighth week after conception but will disappear by about twenty weeks after birth. It is induced by gently turning the head to one side, whereupon the arm and leg on that side extend, while the arm and leg on the opposite side flex, producing what is sometimes called a *fencer's posture*. Most infants show the reflex in rightward rather than leftward turns of the head. It is possible that the tonic neck reflex is also responsible for infants' tendency to sleep or lie with their head turned to the right. This right sleeping persists in spite of the common practice of moving the infant's head to ensure equal turns for both sides (Corballis 1993, 282).

2.3.5 Language and Left Hemisphere Growth Spurt

Finally, between the ages of two and four, children develop the ability to construct grammatical utterances. Also, the left hemisphere undergoes a growth spurt during this time.[7] The left hemisphere's development of its physiological properties may show it to be

[7] I.e., the language hemisphere, which is the left for virtually all right-handed persons and most left-handed persons. Language usage and hemisphere specialization are considered in more detail later.

the primary mechanism, for this ensures language being captured in the quickly forming neuro-connections. During this time in development, children also are playing at construction with building blocks and other objects of interest, and a vocabulary of geons[8] may develop in parallel with the vocabulary of grammatical structures (Corballis 1993, 309).

As a synopsis, I have been giving various reasons why asymmetry has arisen as a biological phenomena. By doing so, I secure why the right hemisphere has the cognitive properties it does. Furthermore, noting the biological bases for asymmetry will aid me in justifying why certain limitations must be taken into account for any criterion that presumes to establish the right hemisphere as an independent mind.

2.4 Development of Hemisphere Specialization Studies

2.4.1 Early Speculations

The understanding that the brain has some lateralization of cognitive processing goes back to the early nineteenth century. Early on, speculation arose about there being two minds within a single brain.

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[8] Irving Biederman has "proposed a theory of real-time human object recognition that posits that objects and scenes are represented as an arrangement of simple, viewpoint-invariant volumetric primitives, such as bricks, cylinders, wedges, and cones, termed 'geons'. Geon theory has been implemented as a neural network (Hummel & Biederman, 1992) and has undergone extensive assessment in psychophysical experiments (see Biederman, 1995, for an overview)" (Biederman 2002). I had earlier cited Pinker as thinking that whether such geometric primitives operate as the basis for facial recognition is a moot issue.

In 1836, Mark Dax, a medical doctor in Montpelier, France, presented a paper to a local medical society in which he noted that among forty patients, many had suffered a loss of speech from observed signs of damage to the left side of the brain. He further noted that not a single case correlated with right side damage alone (Corballis 1993, 168).

While there were earlier speculations based upon the anatomical midline of the brain, with its apparent duplication, the first extended discussion of duality of mind probably goes back to 1844. Arthur C. Wigan, an English physician, speculated that the two sides of the brain function as separate minds, and that each would have a corresponding separate consciousness. Obviously, the notion has persisted (Corballis 1993, 247).

In the 1860s Paul Broca found that patients with damage to the posterior portion of the third frontal convolution of the brain suffered a loss of speech. He named this condition *aphemia*. In 1865, Broca made further claims about damage to the left hemisphere, but Gustav Dax, the son of Mark Dax, claimed that Broca had overlooked his father's contribution to theories of brain lateralization. Broca denied this, claiming he had not even heard of the elder Dax. Gustav, however, took initiative on the matter and had his father's work published, "thereby securing Mark Dax's place in history." The term initially coined by Broca was later replaced by the term *aphasia*, which refers to any general disorder of spoken language (Corballis 1993, 170).

Immediately after and even concurrent with Wigan's and Broca's work, there was continuing speculation about what roles the hemispheres played in human thought and action, although there was only a bit more attention being paid to observational justification. John Hughlings Jackson, a British neurologist, had noted that the right hemisphere was superior to the left in some non-verbal skills such as those involving spatial perception (Corballis 1993, 23). Corballis explains:

> In 1864, the perspicuous John Hughlings Jackson suggested that if "expression" resided in one hemisphere, then one might raise the question on whether "perception--its corresponding opposite" might reside in the other. A few years later, the French neurologist, Armand DeFleury and the Australian physiologist Sigmund Exmer independently made the similar suggestion that motor functions were represented more widely in the left hemisphere, while sensory representation was more widespread in the right hemisphere. (249)

In 1881 Jules Bernard Luys, a French physician, observed that differences of personality correlated with differences of left or right hemisphere damage to the brain. Those with left brain damage were less manic and hyperemotional than those with right brain damage. The left brain damage patients were usually passive and apathetic. Luys (1881) also argued that there was an "emotion center" in the right hemisphere (Corballis 1993, 249, 337).

2.4.2 Brain and Split-Brain Research in the Twentieth Century

At first, some brain scientists thought that the issue of the corpus callosum having some special function for thought had been put to rest. Sectioning procedures seemed to have no effect on a patient's thinking. As William Dandy wrote in 1936, when "the corpus callosum is sectioned longitudinally . . . no symptoms followed its division. This simple experiment puts an end to all of the extravagant hypotheses on the functions of the corpus callosum" (Corballis, 1983, 176). Scientists like Dandy did not have the technological apparatus to know how to look for symptoms. He could not have been more wrong.

From 1920 to the 1960, there was very little investigation of split-brain phenomena, perhaps because of a decline in the credibility of objective scientific activity in the face of hemi-hypnosis and other questionable techniques of affecting and interacting with non-split-brain patients. Behaviorism also was in full force, asserting a purely functional approach to the mind that was interested in "eschewing references to both mind and brain." In the 1960s, however, the tide turned back toward interest in the doubled brain, perhaps in part because of experiences with brain damage patients and the psychological consequences of brain damage as a result of World War II. Of course, the actual studies of split-brain patients in the 1960s represent probably the strongest factor in a return to investigations of these special patients (Corballis 1993, 250-51).

The studies of the 1960s, however, were still trying to determine whether the right hemisphere had any significant function. Corballis notes that the right hemisphere was generally regarded as inferior, even into the 1960s. At that time, there was still considerable speculation occurring about its contribution. For example, British zoologist J. Z. Young wondered as late as 1962 whether "the right hemisphere might be merely a 'vestige,' although he wisely allowed that he would rather keep his than lose it" (Corballis 1993, 249).

Two Los Angles neurosurgeons, Philip J. Bogel and Joseph E. Bogen, severed the main commissures, the fiber tracks that connect the two sides of the brain, in patients suffering from epilepsy. Although such surgeries had been performed in the 1930s, and while Sperry and others had done experimental procedures with animals in the 1950s, the effects on humans were not systematically explored or widely discussed until the 1960s, when Bogel and Bogen performed their surgeries (Corballis 1993, 22).

2.4.3 Popularization and Cultural Bias

As with any striking scientific achievement, the popularization of this science bred odd polarities. Even normal brains were caricatured as evenly split between the left hemisphere's linear, rational, and analytic thinking style, which of course is fundamentally a list of Western values, and the right hemisphere's divergent, intuitive, representative, and holistic thinking style, which is often associated with Eastern thought. Cultural biases were read into the scientific evidence in these simple ways, as were other dualities found within various cultures. Corballis (1983) gives an interesting list of

> confucian concepts of yen and yang, the Hindu notions of Buddhi and manas, and the vistross distinction between the positive and mythic . . . In the 19th century the duality gave expression to the common view that women and the people of other races were inferior to the white, European male. These undesirables, along with the insane, were relegated to the right hemisphere. (251, 252)

Of course, far more rigorous and controlled investigations were made by Roger Sperry and others.

By recounting the development of hemisphere specialization studies, one can more easily appreciate the trajectory of hemisphere studies as regards earlier views of the brain. Furthermore, one can appreciate how shocking this very counter-intuitive notion of having more than one consciousness within a single patient must have been, especially during the 1950's era where the study of psychology through the lense of behaviorism was very much in vogue within the American Academy.

2.5 **Comparative Neurological Dysfunctions**

Several key neurological dysfunctions share some resemblance to behaviors and dysfunctions of subjects under Sperry-type conditions. A quick survey of these dysfunctions is useful for comparing how the right hemisphere operates under neurologically isolated and thus informationally degraded conditions. Two sets of modules which share the same types of behavioral effects under degradation might very well share a common set of sub-processing activities. It is useful, therefore, to compare and contrast hypotheses about these other dysfunctions so as to form (or exclude) certain hypotheses about right hemisphere operation.

2.5.1 Blind Sight

Farah (1997) defines blind sight as the preserved visual abilities of patients with damage to primary visual cortex for stimuli-presented regions of the visual field, formerly represented by the damaged cortex" (206). She notes that the phenomenon was first documented by Poppel, Held, and Frost in 1973. They were studying patients with large scotomata, who, although they had no conscious visual experience of controlled light flashes presented to the scotomatus region, nevertheless were able to move their eyes with some accuracy higher than chance toward the region of the flash (206).

Originally, it was hypothesized that blind sight results from the lower (and more primitive) parts of the brain that were monitoring the environment through non-conscious pathways. Gazzaniga thinks that this is probably wrong, even if it was an initially promising conjecture. Instead, he thinks that blind sight processing is done in the newer (evolutionarily speaking) cerebral cortex. (Gazzaniga, Ivry, and Mangun 1998)

In Sperry-type experiments, split-brain patients share symptoms with blind sight patients, since the respective hemisphere has virtually no conscious visual experience of what the contralateral hemisphere sees. For example, the left hemisphere has no awareness of picture content when risque images are flashed to the right hemisphere. As was specifically noted earlier, the right hemisphere does exhibit behaviors which appear to show its awareness of the content.

2.5.2 Alien Hand Syndrome

Sometimes after a stroke, patients with lesions to the supplementary motor area (SMA) will arbitrarily reach out and grasp objects. They do so because externally guided lateral pre-motor pathways automatically initiate a motor plan at the sight of some object within reaching distance. The SMA concerns internal sources of activation while parietal motor activities are moved by external motivations--i.e., by perceptual situations (Gazzaniga, Ivry, and Mangun 1998, 405). This phenomenon is known as Alien Hand Syndrome.

'Alien Hand' (AH), first described as a sign in patients with callosal lesions, was an inability to recognize the left hand as one's own when touched by the right hand with the eyes closed. No mention was made of involuntary or uncontrollable movements; however, there was later reported a patient with a set of motor disorders bearing close resemblance to the current understanding of AH behavior, although the designation of AH was not used (Chan 1996, 287). "Bogen (1979), however, borrowed the term to describe the spontaneously self-unaware behavior of the left hand in split-brain patients."(Chan 1996, 287) Alien hand syndrome is also associated with intermanual conflict (IMC):

> The left hand, usually activated by verbal mediation or action of dominant (right) hand, moves toward objects with or without direct eye contact and can act independently of the right unless intermanual conflict occurs (IMC; left hand's antagonistic movements to the right) [...] It often behaves in a manner which the patient verbally describes as foreign, alien or at least uncooperative. Since Bogen's AH usually showed non-antagonistic, irrelevant or symmetric movements to the right, and it was considered a lesser form of IMC (Bogen, 1979), they together are synonymous with diagonistic dyspraxia (287)

This is yet further evidence for independent modularized processing in the human brain (as discussed earlier). If such independently initiated modularization can occur at the motor-control level, then this hints that separated modules of consciousness might similarly be able to act independently, even to the point of carrying consciousness and personal identity. Split-brain patients apparently are examples of just such independent action.

2.5.3 Integrative Agnosia

Patients with integrative agnosia are unable to group (or have trouble grouping) common elements together. As a first example, if one were to draw a geometric figure made up of two diamonds and a circle, the patient with integrative agnosia would not draw the circle and the two diamonds as independent parts of the whole. Instead, the patient would draw one side of the circle, then one side of the diamond, and then "skip around" as normal person would not, drawing each of the segments independently (Gazzaniga, Ivry, and Mangun 1998, 193).

As a second example, a patient can be interviewed about what he or she sees in a picture--say, of a combination lock. The patient may claim it is a telephone, but be making combination lock-like hand motions. The patient may even adamantly insist that it is a telephone when told otherwise by the experimenter, all the while making combination lock-like gestures. However, if the patient looks at his or her hands and then is told to make a guess about the picture, the patient will probably announce it is indeed a combination lock. Yet if attention is not drawn to the hands, the patient will continue to insist that the picture is of a telephone. It is no coincidence that the patient says the combination lock is a telephone, since both share the property of having numbers in a circle. This indicates that some process involved with what the agnosia patient sees is occurring (Gazzaniga, Ivry, and Mangun 1998, 164-65).

These phenomena have been explained by the Warrington Two-Stage Model of object recognition. In this model, visual analysis occurs in both hemispheres when considering what one is directly looking at. The categorization begins on a perceptual level to filter out the perceived object from shadowing, patterns, and unassociated background objects. At just this level of processing the patient might be able to recognize an object but be unable to specifically name it. Naming occurs in a second state--namely, under *semantic* categorization. The first state and its process occurs in the right hemisphere, the second stage in the left hemisphere. In semantic categorization, the visual input is tied to long-term knowledge stored in memory that allows the person to identify the name and function of what is seen. The Warrington model can account for categories specific to agnosia, such as lesioning of the left hemisphere that results in associate agnosia and lesioning of the right hemisphere that results in integrative (also called *apperceptive*) agnosia (Gazzaniga, Ivry, and Mangun 1998, 186-87).

According to Warrington's analysis, it seems that understanding the perceptual parts is sufficient for giving us an understanding of the whole. But integration problems faced by patients who attempt to synthesize parts into a whole argue against this idea. Each of the isolated parts of a given figure of perception may be identified, but the patient is unable to integrate the parts with the whole component structure. For example, the parts of a combination lock--its numbers, its round dial, its clasp--all can be recognized by the integrative agnosia patient, but the parts cannot be tied together in gestalt fashion. Gazzaniga, Ivry, and Mangun write, "Object perception is truly a situation where the whole is greater than the sum of its parts" (197).

If a person can have integrative agnosia in which the *perceptions* are not integrated into wholes, it seems reasonable to hold that, along similar lines, split-brain patients could have a type of integrative agnosia in which the *memories* are not integrated. On this view, there could be an event--for instance, washing a car–about which the patient remembers touching the mirrors, spraying water on the windshield, rubbing wax on the hood, but would not be able to describe the whole event as washing a car. Instead, the patient would see the event as several unrelated, independent events.

The hemispheres of split-brain patients show differences of ability when under Sperry-type conditions. Perhaps the split-brain patient lacks an integrated view of consciousness. Different memories are not grouped together by a unified individual, and verbal reports by the patient, therefore, do not match up with what the body is actually doing--such as selecting objects for identification in a Sperry-type experiment. However, even if this were the case, the memories still appear integrated enough to motivate some researchers, Sperry among them, to call each isolated hemisphere conscious.

2.5.4 Hemineglect

It is not unusual to encounter patients with brain damage who exhibit hemineglect. They will ignore sides of their bodies and claim that those body parts are not their own. Likewise, in split-brain patients the two hemispheres will ignore one another as if they were separate entities, each performing as if an independent agent, and neither affirming that there are other components of the patient that are (or perhaps should be) accessible.

In split-brain patients, one hemisphere does not acknowledge the other hemisphere as a separate consciousness. Even though the left hemisphere is aware that the uncontrolled hand in a Sperry-type experiment has maneuvered to pick up an object, its explanations for that hand's movements are completely contrived.[9]

2.5.5 Juvenile Autism

Autistic children have been described as mind-blind. Their module for attributing minds to others is said to be damaged or malfunctioning. As Pinker (1997) explains:

> Autistic children almost never pretend, can't explain the difference between an apple and a memory of an apple, don't distinguish between someone looking into a box and someone's touching it, know where cartoon faces are looking but do not guess that it wants what it is looking at, and fail the . . . false belief task. (332)

The "false belief task" is pretending one thing while knowing another. Autistic children do not have normal social awareness, but see others, apparently, as dynamic objects in space, much like we might see a clock or a toy car.

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[9] Such contrived explanations will be covered in detail later under the topic 'confabulation behaviors'.

2.6 Split-Brain Experiments

"What God has joined together, let no man separate."
-- Traditional wedding ceremony liturgy

"So far as I know, this is the most radical disconnection of the cerebral hemispheres attempted thus far in human surgery."
- (R. W. Sperry 1967)

2.6.1 Animal Split-Brain Experiments

Roger Sperry, working with Ronald Meyers, discovered through experiments with cats that after a hemisphere separation surgery, when vision was blocked to one or the other eye while teaching cats a given task, such as pushing a panel with a triangle on it for food, it would result in the task not being transferred to the opposite hemisphere. The cats acted as if they had two different brains, hence the origination of the term *split-brain* (Gazzaniga 1985, 29).

Other experiments likewise demonstrated that visual discrimination learned by one hemisphere does not transfer to the other hemisphere in animal subjects. By means of food reward, cats also were trained to choose a "circle" over a "plus" stimulus. It was discovered that visual discriminations specifically presented to one hemisphere of the brain were not known by the other hemisphere of the brain when the connecting commissures were sectioned in a commissurotomy[10] (Gazzaniga, Ivry, and Mangun 1998, 329).

[10] A division of any collection of fibers connecting parts of the brain or spinal marrow via surgery

2.6.2 Primary Components of Sperry-Type Experiments

2.6.2.1 Handedness and Language Control by Hemisphere

Paul Broca, who had made some early observations on hemisphere specialization, assumed that the side of the brain responsible for language is the one that controls the dominant hand. In left handers, therefore, the right hemisphere would be dominant for language, just as in right handers the left hemisphere would be dominant for language. That was not quite the case, however.

Among right handers, anywhere from 96 to 99 percent are left hemisphere dominant for language. But the pattern is not simply reversed for left handers. In a Montreal study with 122 left and mixed handers, "70% had language represented in the left hemisphere, just as most right handers do. Of the remainder, 15% had language represented in the right hemisphere and 15% had language represented on both sides" (Corballis 1993, 192-93).

So while the data show that most right handers do obey what Broca hypothesized to be the case, most left and mixed handers do not conform. Persons who are not right handers are somewhat more mixed in their laterality (Corballis 1993, 193).

2.6.2.2 Text Processing in Normal Brains

In normal brains the presence of the commissures allows information to be transferred from one side of the brain to the other. Most people will recognize words, letters, and other items with more accuracy when these are flashed to the right side of a fixation point in a split-brain experiment than if they are flashed to the left side. Even when the relative flow of text is excluded--e.g., where English moves from left to right, some other languages move from right to left --there is still a small advantage for presentation to the right side of fixation. It is thought that this reflects left hemispheric dominance (Corballis 1993, 180). Studies with diachronic listening in aural tests also show a right ear advantage and provides further evidence of left hemispheric specialization.

2.6.2.3 Features of Hand-Arm Control in Normal People

Corballis (1993) notes that it has been shown that right handers have superiority in throwing objects, such as darts, but there is no superiority in blocking thrown objects, as, for example, in not being able to catch objects such as tennis balls. Throwing has a strong praxic element and has even been suggested as the originating evolutionary force behind handedness. But blocking a projectile is a direct response to a spatial event and is best accomplished symmetrically. Such a symmetrical response is stimulus bound: it is an action that occurs directly in response to events found in the perceptual environmental (206-207).

Language processing, text processing, and features of hand-arm control in normal people are the primary components in Sperry-type experiments. Empirical behaviors of split-brain patients are starkly different from the normal person's responses.

2.6.3 Sperry-Type Experiments

Sperry's idea to communicate with the hemispheres independently was not without precedent. One of the earliest techniques of (or perhaps, *attempted* techniques of) communicating with the hemispheres independently was developed by Gabriel Descourtis. Descourtis sought to hypnotize separately the two sides of the brain. There are accounts and even photographs of patients who were in a so-called double trance "with one side of the face smiling, and the other side showing fear," but the technique was based on hypnotizing a patient with each eye open in turn. The belief was that each eye projected to the opposite hemisphere (Corballis 1993, 250). This is now known to be false, and many were aware of this fact even in Sperry's time. The advance to come was in the ability of an experimenter to isolate the hemispheres, nevertheless.

2.6.3.1 A Typical Sperry-Type Experiment Setup

It is widely acknowledged that Sperry and his various associates at the California Institute of Technology carried out the first extensive psychological studies of split-brain patients. The operation that produces split-brain patients consists of sectioning the corpus callosum and sometimes certain other minor links that join the cerebral hemispheres. It is done to relieve severe epilepsy. Medically, this type of procedure is considered a success. Sperry writes, "A person two years recovered from the operation, and otherwise without complications, might easily go through a routine medical checkup without revealing that anything was wrong to someone not acquainted with his surgical history" (Marks 1980, 3). At first, the psychological results ran parallel to the medical results. After the operation, anyone acquainted with such patients failed to notice any dramatic changes in intellect, behavior, or personality. In fact, in the 1940s neither casual observers nor professional psychologists were able to find any interesting psychological result after interviewing and testing such patients. Because of there being no apparent effect on the person, there was speculation that the corpus callosum served no useful function for the hemispheres and was perhaps present only to provide mechanical support in order to keep the hemispheres from sagging (Marks 1980, 4).

Split-brain phenomena arise when the experimenter confines input from the senses to a single hemisphere. (This is not possible with taste, however.) The most common types of experiments control visual conditions in the following way:

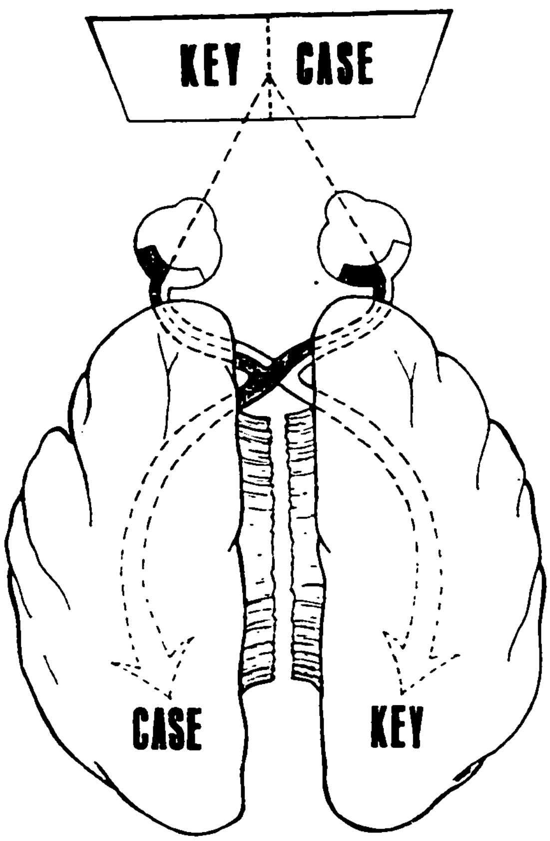

Figure 5 Things seen to the left of a central fixation point with either eye are projected to the right hemisphere and vice versa (Kolak 1991, 57)

A patient, McX, is instructed to focus on a central point on a screen. Two visual cues are then flashed on the screen for a short duration (around a tenth of a second). This duration is too brief to permit eye movement. If the eyes were given time to move, this would feed the visual information to the opposite half of the visual field and allow both

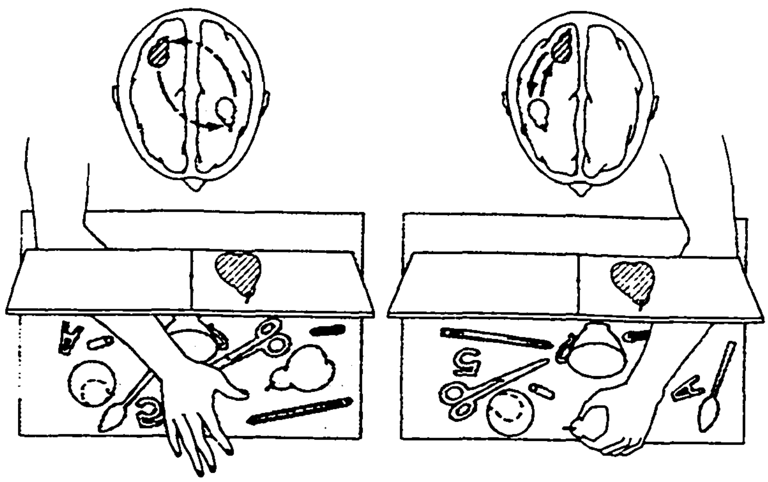

Figure 6 A Sperry-type experimental setup. Visuo-tactile associations succeed between each half of the visual field and the corresponding hand. They fail with crossed combinations in which visual and tactual stimuli are projected into opposite hemispheres. (Sperry 1967, 64)

hemispheres access to the information. However, when such eye movement is constrained properly, information taken from the right visual field feeds directly to the left hemisphere, and information taken from the left visual field feeds directly to the right hemisphere. The experiment then proceeds by flashing two objects, whether icons or words, at McX's point of focus--for example, the words "key ring" might be flashed, with "key" to the left of the point of focus and "ring" to the right of the point of focus. When McX is questioned as to what was seen, McX responds, "ring." Yet, further questioning about what type of ring is as likely to elicit responses of "boxing ring," "wedding ring," or "ring of a bell" as to elicit

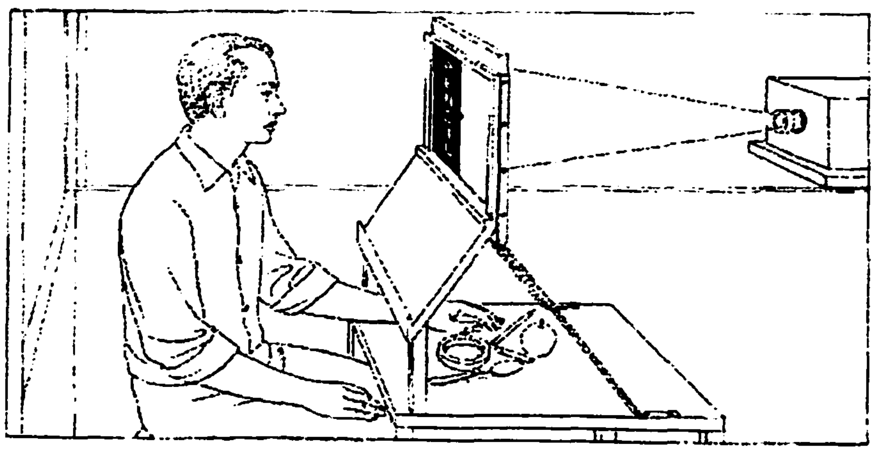

Figure 7 Another Sperry-type experimental setup (adapted)

"key ring." McX's verbal testimony shows no evidence for McX's perception of the word "key."

Contrary to this testimony, if McX is directed to retrieve from an array of concealed items via his left hand what he saw, McX will retrieve a key and reject any rings found among the array of items. Here, McX's behavior shows no evidence of perceiving the word "ring" but does confirm his perception of the word "key." If McX simultaneously sorts through the concealed array of items with both hands in order to pick out what was seen, both hands will tactually scrutinize independently. The left hand will acquire and release a ring before it maintains its final hold on a key, and the right hand will acquire and release a key before it maintains its final hold on a ring. Generally, in such experiments,

> when the response demanded is controlled by the left hemisphere, it indicates that [McX, in this example] was aware of "ring" and unaware of "key." When the response demanded is controlled by the right hemisphere, it indicates that [McX] was aware of "key" and unaware of "ring." Someone seems to have seen "key," and someone seems to have seen "'ring," and they seem unaware of each other. No one is aware of seeing "key ring." (Marks 1980, 5)

2.6.3.2 Regions of Specialties in the Corpus Callosum

In light of such experimental results, the corpus callosum, therefore, plays a truly pivotal role in integration of consciousness between the hemispheres. It is not merely for support, nor even just a general pipeline for information exchange; it is a well-organized communication system between the two hemispheres.

Consider other examples of only partial sectioning. In the spleinal region, which is the posterior area of the callosum, one finds that visual information is transferred between the hemispheres. In a sectioning of the corpus callosum, if this posterior part is spared, information exchange about visual perception still actively runs its course between hemispheres. But there is loss of a different kind. The patient may have no awareness when the experimenter requires that *tactile* information be shared between the hemispheres.[11] Noting this was not a surprise to neurologists, since animal data had shown there were major callosum subdivisions concerned with different modalities of sensation (Gazzaniga, Ivry, and Mangun 1998, 331).

The anterior part of the callosum, on the other hand, concerns the exchange of semantic information. If just this anterior portion is sectioned, a patient may observe the word "knight," which is fed into the right hemisphere. The patient may describe a mental picture, such as "two fighters in a ring," "wearing helmets," and "sitting on horses," yet guess the word as "knight" only after giving such descriptions. In other words, the patient does not offer a report without the presence of the descriptions. But if the corpus callosum is completely sectioned when the right hemisphere encounters the word "knight," the patient will report not seeing anything at all. The partial sectioning allows higher-ordered descriptions to transfer between hemispheres. The left hemisphere is then able to work on what was seen based upon the descriptions. The full sectioning halts all such transfers (Gazzaniga, Ivry, and Mangun 1998, 332).

2.6.3.3 Independence of Neural Devices

Implicit in this idea of transfer of information is the view of the brain as a collection of devices. Indeed, Gazzaniga, Ivry, and Mangun hold an evolutionary perspective on how the brain works. Our mental life reflects the actions of many, if not thousands, of neural "devices" in our brains. Based on this view, since there is already acknowledged to be a plurality of such devices, it is not a frightening thesis that when we

[11] This could be empirical evidence that a separate person is already present when the two hemispheres disagree on what was touched or that there are two "survivors" when tactile disagreement instantiates.

split the hemispheres separate consciousnesses arise, for what occurs is a reshuffling of the plurality of devices (Gazzaniga, Ivry, and Mangun 1998).

2.6.4 Task Specialization

2.6.4.1 Opposite Hemispheres and Execution and Perception of Tasks

Upon further study of the hemispheres when isolated in Sperry-type experiments, it was found that the hemispheres had differing strengths and abilities. But when dealing with the specializations of the left and right brain, one must distinguish carefully between the perception of a task and the execution of a task.

For example, the right brain is better at executing a task of stacking blocks. One might, then, erroneously assume that this hemisphere is better at perceiving and analyzing visual stimuli. However, that is not the case. Although the left and right hemispheres show marked differences in the ability to manipulate and stack blocks of different colors so as to match patterns, under conditions of a simple picture-to-picture match, apparent differences between spatio-visual stimuli in the two hemispheres disappear. One must not, therefore, mistake the mental capabilities of each hemisphere as being indicated by motor execution capabilities (Gazzaniga 1985, 54).

Sometimes hemispheric specialization claims are made on the basis of mistaking execution of tasks for differences in perception and processing. For instance, since there is a single, final common path where neurons can exit from the brain to enervate arms and legs, the non-speech capable right hemisphere will come to a tacit agreement with the left hemisphere. In this situation, the right hemisphere will take up tasks for which it is particularly capable, leaving other tasks, such as talking, to the left hemisphere. In this instance, what seems like specialization in thinking turns out to merely to be a distribution of labor over common resources (Gazzaniga 1985, 55).

2.6.4.2 Specialization of Hemispheres

That the right hemisphere has certain advantages over the left hemisphere in performing some tasks (such as spatial relation skills or more holistic analysis of sense data that comes in) is regularly noted. It can be argued, however, that the left hemisphere would be as proficient as the right hemisphere were it not somehow better at the task at which it excels (Corballis 1983, 254). That is, the left hemisphere may have a weakness in some tasks at which the right hemisphere is better simply because of the invasion of language and practic representation. Of course one is left wondering where one would find a functioning brain that happened not to have the language and practic areas active. But the point is that the division of labor between the hemispheres easily can be confused with their respective, inherent functions.

2.6.5 Inference Abilities

As was seen earlier, both the right and left hemispheres are able to read and choose between test alternatives (Gazzaniga, Ivry, and Mangun 1998, 527). But the right hemisphere's abilities for inference are limited. The right hemisphere cannot make same-difference judgments when two simultaneous figures are presented in sequence; at least, those right hemispheres that have no language capacity are unable to do this. Some right hemispheres, however, do have such language capacity. Some people are able to speak using either hemisphere, and others even have a wide vocabulary that is duplicated in both hemispheres (Gazzaniga, Ivry, and Mangun 1998, 548, 549).

The right hemisphere cannot make other simple inferences as well. For example, if the words "finger" and "pin" are presented to the right hemisphere, and various other words are presented as possible choices for inference by the patient, the left hemisphere easily picks out the word "bleeds" to associate the inference between "finger" and "pin." But the right hemisphere is unable to do this and merely responds with random choices. Even when the word "bleeds" is in the right hemisphere's lexicon, it cannot make such an inference. That the right hemisphere has not associated this link between "finger" and "pin" is probably not a catastrophic failure in performing any simple deductive inference, for the right hemisphere can maintain a memory of things it has seen in immediately previous stimuli and associate such memories together for semantic deduction. For example, the right hemisphere can put letters together to form simple words (Nagle 1991). Thus, some form of conjunction introduction would apparently be within its cognitive powers if it could infer plurals (e.g 'ants') from singulars (e.g 'ant'). Conjunction elimination would move in the other direction.[12]

Further inferences, such as ones drawn from mathematics and geometry, are likewise outside of its capabilities; this is true even if geometric puzzles are constructed at a second-grade level of complexity. Even patients who have right hemisphere language abilities are unable to make more complex inferences (Gazzaniga, Ivry, and Mangun 1998,

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[12] One caution here is that since conjunction introduction/elimination is supposed to work on propositions, and not letters, and since the case I've given is in regards to letters; it has not been established, therefore, that simple conjunction deduction is occurring. Perhaps the right hemisphere is holding (alleged) propositions in its (alleged) mind. But this issue is just as difficult to assess for otherwise normal minds. While I am prepared to argued that the right hemisphere has its own independent mind, I will remain prudently silent on just what and where propositions are.

549). This is somewhat surprising because the right hemisphere has fairly advanced abilities in spatial understanding.

As a contrasting example, the left hemisphere, when shown a picture of a pot and a picture of a pan, can readily point to a third picture of a pan with boiling water in it. The right hemisphere cannot do this. Certain types of inferences are apparently beyond the right hemisphere. Even though the gross anatomy structures and number of neurons in the right hemisphere is essentially the same as in the left, there are readily identifiable differences in their abilities for the types of tasks noted (Gazzaniga 1998, 153).

2.6.6 Hand Control

2.6.6.1 Split-Brain Patients and Bi-Manual Coordination

In experiments in which normal subjects were briefly shown two patterns (when the figures were flashed independently to each hemisphere) and in which they were instructed to re-draw these simultaneously with both hands, these subjects were able to draw symmetrical patterns but had severe difficulty when either of the patterns was rotated 90 degrees, thus eliminating the mirror symmetry.

In contrast, split-brain patents performed equally well under both conditions. They were able to draw the perpendicular patterns as easily as the mere symmetry patterns. (This also can be accounted as further evidence of the modularization of neural mechanisms.) It should be noted, however, that there was a distinction between the spatial and temporal activity of those who were doing the drawing, even though the split-brain patients could draw perpendicular patterns as easily as symmetrical patterns. The hands always operated in synchrony: each segment of a three-sided figure was drawn coinstantaneously; each segment was initiated and terminated at nearly the same time. It is conjectured that this synchronicity of bi-lateral hand action is regulated by sub-cortical mechanisms (Gazzaniga, Ivry, and Mangun 1998, 408-409).

2.6.6.2 Split-Brain Patient W.J. and Competition of Left and Right Hands

The case of W.J. is illuminating for understanding hand control in split-brain patients. In a simple test of arranging blocks, a patient is told to create patterns that match cue cards. Using his right hand, W.J., who had his brain surgery in 1961, could not arrange four simple red and white blocks into the pattern assigned by the experimenter. The systems in the right hemisphere had been separated by the surgery from the motor apparatus that controls the right hand.

Using his left hand, however, W.J. could easily arrange the blocks into the assigned pattern because the specialization of the right hemisphere allowed him to perform the task. In W.J.'s case, the right hand often would attempt to arrange blocks and the left hand would attempt to intervene. Ultimately, W.J. had to sit on his left hand so that the left hemisphere could use the right hand to attempt to accomplish the task. Even this was ultimately not successful; W.J.'s two hands could be seen competing again to arrange the blocks correctly. As the right hemisphere operated the left hand, the left hemisphere would upset the pattern of blocks with the opposite hand; hence, the hands were in competition (Gazzaniga, Ivry, and Mangun 1998, 323-24). This independent and competitive limb control is one of the most striking empirical examples of evidence that there are actually two consciousnesses within a single patient.

2.6.7 Spatial Abilities

2.6.7.1 Visual Testing as Primary Vehicle for Sperry-Type Experiments

The eye movements in a human being take roughly 200ms of perception time to respond. If a stimulus is presented at less than the 200ms window, the experimenter "can be confident that the stimulus was lateralized," which is to say it was picked up by only one hemisphere, given the short perception time. However, techniques have become available that can dynamically track the eye movements and present the stimuli to the split-brain patient in more natural fashion (Gazzaniga, Ivry, and Mangun 1998, 330).

Researchers of split-brain phenomena primarily use visual stimulation experiments because visual perception is the preeminent way in which humans encounter the world, and the visual system is also the most strictly lateralized of the various sensory systems.

2.6.7.2 Right Hemisphere and Spatial Manipulative Skills

In discussion of hand control, we noted that one test of split-brain patients concerns their abilities to stack blocks. DeRinzi worried that early studies of the right hemisphere may have overemphasized the differences in manipulating blocks, so that the right hemisphere is thought to be better at this task than the left hemisphere. He also has noted that some studies done in the early 1980s did not show the hemispheric bias of earlier studies of this particular task. The evidence in his time suggested that spatial manipulation skill apparently involves more spatial and sequential skills that are dependent on both left and right hemispheric processing (Corballis 1993, 254-55). But the most recent studies have seemed to reaffirm a notable difference in the spatial processing ability of the right hemisphere.

2.6.7.3 Left Hemisphere and Ability to Arrange Shapes by Parts

Pinker (1997), for instance, affirms that the left and right hemisphere approach spatial relationships differently. The left hemisphere is the seat of the ability to recognize and imagine shapes based on the arrangements of their parts. The right hemisphere, on the other hand, is good for measuring whole shapes. It is able to judge, for example, whether a rectangle is taller than it is wide or how close a particular dot is from some other object. Pinker reports on a neurological patient who had suffered a left hemisphere stroke that affected his ability to recognize shapes. "'When I tried to imagine a plant, an animal, an object, I can recall but one part. My inner vision is fleeting, fragmented; if I am asked to imagine the head of a cow, I know it has ears and horns, but I can't revisualize their places'" (271).

2.6.8 Hemispheric Attributes with Substructure Cross-Integration

Some attributes, such as attention, emotion attributes, and certain speech abilities although tied to a respective hemisphere specialization, also seem to rely on an integrated subsystem accessible to some degree by both hemispheres.[13] I shall briefly address these; since, for example, attention and emotion are important elements in my later discussions of consciousness and personhood.

2.6.8.1 Split-Brain Patients and Integrated Spatial Attention

Split-brain patients have easy control over the eyes in either visual field. They can use either hemisphere to direct their attention to any position, either in the right or left visual field. Because either hemisphere can control eye movement in spatial tests, it

[13] This was noted earlier in the section on substructures.

appears that the two hemispheres are relying on a common system that orients focus to a single area of attention. Furthermore, split-brain patients cannot divide their attention to independent points in the visual field. Certainly normal people cannot do this, but it was thought that perhaps the split-brain patients might have this ability. Tests indicated, however, that they could not divide their attention independently in the two halves of their visual perception. It seems, therefore, that there is only one "integrated spatial attention system." Just like normal observers, their attention system is unifocal (Gazzaniga, Ivry, and Mangun 1998, 338-39).

2.6.8.2 Emotion Attributes

The left hemisphere has complex cognitive machinery to distinguish between sorrow and pity. It understands the feelings associated with each of these states. The right hemisphere does not, however, have the same cognitive apparatus for such distinctions. It has only a narrow conception of awareness in comparison to the left hemisphere (Gazzaniga, Ivry, and Mangun 1998, 548).

In split-brain patients, when emotional stimuli are fed to the right hemisphere, the left cannot report what was seen by the right hemisphere, but the left hemisphere is able to report how it felt about the stimulus, such as whether the stimulus represented something good or bad. From this it is concluded that different pathways within the brain handle emotional and cognitive representations of the stimulus. Since this information came from studies of split-brain patients, it is assumed that the emotive information passes through the anterior commissure, perhaps from one side of the amygdala to the other through this minor commissure (Gazzaniga, Ivry, and Mangun 1998, 516). Of course, some people naturally have a split amygdala. One is left wondering, therefore, if the anterior commissure would be the only or primary substructure for such transfer.

Furthermore, there is some evidence to suggest that the negative emotions are housed in the right hemisphere processes and that the positive emotions are housed in the left hemisphere processes. One example of this comes from observations of patients who underwent a sodium amytal test. Boas (2001) gives an overview of this test:

> Fifty years ago John A.Wada developed the intracarotid amobarbital procedure (IAP), a test in which first one and then the other cerebral hemisphere is temporarily anaesthetized through direct intracarotid application of sodium amytal. The IAP was devised initially as a method to allow unilateral electroconvulsive shock therapy for psychosis. The method subsequently proved its value for the lateralisation of language and, following adaptation of the test protocol, for the assessment of memory functions. Thus the IAP became a standard test in the presurgical evaluation for resective surgical treatment of medically intractable epilepsy.

When the left hemisphere is anesthetized by this procedure, there will be a catastrophic reaction, which means the patient may have outbursts of weeping, despair, swearing, guilt, or aggression. But when the right hemisphere is anesthetized, the patient may have a euphoric or maniacal reaction. Damage to these hemispheres will at times lead to the same results (Corballis 1983, 264).

Further evidence for emotive differences in the hemispheres comes from experiments with facial expressions. Grimaces on the left side of the face, analogous to smiling, make people feel sad while grimaces on the right side of the face induce a more positive although more difficult to characterize emotional state. Corballis (1983) notes that because the left side of the brain controls the right side of the face, and vice versa, the results are again consistent with the idea that the two sides of the brain control complementary emotions, with the right side tending to evoke negative emotions and the left side positive ones (266).[14]

Such indications stand as further evidence that the respectively isolated hemispheres are *conscious*. At the very least, they maintain some set of emotional dispositions along with their cognitive processing, even if the right hemisphere does not have fully developed cognitive processing abilities. No studies have followed up on emotional memory of the respective isolated hemispheres. If these hemispheres could produce recall of the emotions they have experienced in the recent past under an IAP procedure, however, this would be evidence for an even stronger position--that they are also individualized *persons*.

2.6.8.3 Left and Right Hemisphere Interaction

Even in split-brain patients, if the left hemisphere is flashed a numeral "1" or "2," it can easily name what was flashed. However, contrary to what one might expect in a split-brain patient, if the right hemisphere is flashed a "1" or "2," and the left hemisphere is aware that the right hemisphere is being flashed a "1" or a "2," it can accurately name which of the two numbers was presented to the right hemisphere. Again, this would seem to indicate that there is still some sort of neural connection carrying information at an unconscious level between hemispheres. Clearly, the separation is not complete. But what is more interesting is that the left brain is not aware that the speech apparatus has communicated the correct information. The right brain somehow accesses the left

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[14] The reference in Corballis is to a study by Schiff and Lamon (1989).

hemisphere speech motor system and places the correct information for what was observed. This phenomenon occurs only if the left brain is not flashed its own information, for example, another, concurrent numeral "1" or "2." If both hemispheres are flashed a numeral "1" or "2"--for instance, when the left hemisphere is flashed a "1" and the right a "2"--then the left hemisphere will perform only at the level of chance in evaluating what the right hemisphere sees. Gazzaniga (1985) concludes from this that "this striking dissociation clearly demonstrates that a conscious system does not have access to all information that governs what is taken to be a conscious response" (120). This is accepted for normal persons, but it also is true for split-brain patients under Sperry-type conditions.

2.6.9 Confabulation Behaviors

When the left hemisphere confabulates a story on why the right hemisphere would pick out a shovel, while the left hemisphere would pick out a chicken coop (or some other otherwise reasonably associated object), each hemisphere has an awareness of what William James would call a *fringe*. A fringe is the consciousness of this halo of relations around the image by a name. When we think about different things, in turn, our thoughts must have a starting point for each element. For example, if we were to think of three letters A, B, and C, our consciousness of C is more intense than the consciousness of B, which is more intense than the consciousness of A. This process is like overtones in music. James claims that the ear does not separately hear them; they blend with the fundamental note and suffice it and sculpture it. Likewise do the waxing and waning brain processes at every moment blend with and suffice and alter the psychic effect of the processes that are at their culminating point (James 1997, 78).

Now, the issue at hand for the split-brain experiment is *when* did the experimenter ask the patient, "Why did you chose the shovel?" It turns out this interview question is asked *after* the experimenter releases the patient from the apparatus. Is the patient giving a description of why he did something based on his immediate, self-acquaintance with doing it, or is the patient giving a description based upon the mere description as communicated by the experimenter?

If the patient is giving his description by means of his own acquaintance, we know that the right hemisphere has somehow communicated its past actions to the memory it now shares with the left hemisphere. On the other hand, if the patient is merely giving a description based upon the experimenter's description of what happened, then the patient doesn't have a real acquaintance, for he is confabulating based either (1) upon his justified trust of what the experimenter said and not of what his own memories indicate; or (2) upon his piecing together the disjointed memories that remain transient from the experiment and confabulating the fine details that would make these disjoints coherent. (This would be analogous to the manner in which court witnesses involuntarily fill in details they didn't see about a car wreck that they did see.)

Is the patient reporting memories of events, or is the patient giving one or another subtle type of confabulation? In James' terminology we might ask: Does the left hemisphere have a fringe of selecting the shovel? The propositional utterance by the patient does not resolve what it is like to come out of the experiment. One would wish an experimenter would put the patient back under the Sperry-type condition and then show the right hemisphere a few token shovels and ask, "Which shovel did you pick?"

Moreover, the experimenter could do the same for the left hemisphere: present shovel tokens and ask it, "Which shovel did you pick?" If the right (or left) hemisphere could pick out the shovel last chosen in the first split-brain context, then this would show that there indeed had been some memory overlap, for the hemisphere would have only its own, isolated experience to go on.

In most experiments on split-brain patients the discussion centers on presenting pictures to each hemisphere and then inquiring about what was seen. But in some patients words can be flashed to the opposite hemispheres. For example, a simple command such as "walk" could be flashed to the right hemisphere. When this happens, a patient will typically respond by standing up and leaving the testing area. When asked why this happens, the subject will respond that he or she is "going into my house to get a Coke" (Gazzaniga 1985, 72). Here, the left hemisphere makes up an explanation of overt bodily behavior that was initiated by the opposing right hemisphere.

On the standard method for presenting different cognitive tasks to each hemisphere, Gazzaniga, Ivry, and Mangun argue that the left hemisphere will interpret what the left hand is doing even apart from obvious associations of what the left hand indicates with reference to what the right hemisphere is seeing. For example, if the left hemisphere is shown a chicken claw and the right hemisphere is shown a snow scene, the left hand, again which is controlled by the right hemisphere, will pick out a shovel in association pictures. But the right hand will pick out a chicken head in such picture sets. When asked, the left hemisphere will indicate that the left hand "picked a shovel because one needs a shovel to clean out a chicken shed." Gazzaniga, Ivry, and Mangun (1998) explain: "Here the left side of the brain, observing the left hand's response, interprets that response to a context consistent with its sphere of knowledge--one that does not include information about the left hemisphere snow scene" (543). What is not included here is a possible response of the right hemisphere. The right hemisphere, as is well known, is not verbal; hence, it cannot be queried at a linguistically behavioral level. One is left wondering: if the right hemisphere could speak, would it make up a similar explanatory fiction based upon the right hand pointing to a chicken head? It happens that some split-brain patients have language production from both hemispheres. What would be impressive is if a split-brain patient with language production in both hemispheres could give the experimenter a right hemisphere report under the same conditions of the experiment. Unless this can be done, Gazzaniga's positing of the left hemisphere as being the interpreter is suspect.

2.6.10 Language Issues

Language issues are also important for analyzing split-brain experiments, because how one understands language behavior often colors how one will categorize the right hemisphere–i.e., as having independent conscious states (or not). The left hemisphere is where the primary language functions are processed. The left hemisphere controls speech and can do so even when separated from the right hemisphere. The right hemisphere, in contrast, is mute and has no control over speech.

There is convincing evidence, however, that the right hemisphere can take over language when one reviews cases of patients who have had the left hemisphere surgically removed in order to avoid fatal brain conditions. The extent to which the right hemisphere can take over language correlates directly to the age at which the left hemisphere becomes incapacitated or is removed or both. If the left hemisphere is incapacitated before the age of about two, the right hemisphere is able, more or less, to completely take over language function. Any later than the age of two, recovery of language use declines. At the age of puberty or so, decapacitating the left hemisphere will result in essentially permanent aphasia. Adult patients who have had their left hemisphere removed usually have great trouble with expressive speech, although they often can recite automatic phrases or swear or perhaps even sing. Adult patients do not lose an understanding of speech, but they do have great difficulty in reading and usually cannot write at all. Generally, the adult hemispherectomy patient shows the same profile and language skills as does the right hemisphere of a split-brain patient (Corballis 1983, 288).

In a small number of cases, split-brain patients have been able to produce speech from both hemispheres--at least after a time. The right hemisphere maintains some plasticity for as long as ten, even thirteen years after callosal surgery. This development of speech in the right hemisphere, however, is very limited. For example, if an object is presented to each field of a patient's vision, both the left and right hemispheres might name the object but be unable to judge whether the named object is the same object. Both hemispheres might name a key, for instance, but if asked whether the object was the same or different, the patient would be unable to judge (Gazzaniga, Ivry, and Mangun 1998, 337).

A distinction is drawn between the chromatical and lexical functions when examining brain lesions in patients, and this is informative for dealing with split-brain patients under Sperry-type conditions. As the term is used here, the *lexicon* is the mind's dictionary in which words are associated with specific meanings. The lexicon's function is a memory of word strings operating as idioms. Whole phrases, such as "you can't teach an old dog new tricks," are probably each found in a single lexical entry. Such words and phrases do not reflect an underlying interaction of syntax and semantics (which would be *chromatical* functions), but are drawn directly from the memory system. As we have noted, language and speech are generally localized to the left hemisphere, although some right hemisphere patients have been seen to retain linguistic function. Yet the linguistic function that is retained is lexical in nature; thus, the limited language functions present in the right hemisphere are based on memory and not based on grammatical processing (Gazzaniga, Ivry, and Mangun 1998, 333).

Certain patients who possess some language in their right hemisphere, while they cannot use syntax such as word order to disambiguate stimuli (word strings), can still judge whether one set of utterances is grammatical. The right hemisphere can recognize a pattern of acceptable utterances in the grammatical sense but cannot use that information to actually understand the word strings (Gazzaniga, Ivry, and Mangun 1998, 334-35)

There has, however, been some controversy on just what the right hemisphere is capable of in its language and speech functions. The Peabody picture vocabulary test requires persons to pick out pictures corresponding to spoken words. Eran Zaidel used a contact lens technique in order to restrict viewing under the conditions of this test. He was able to test each hemisphere's comprehension. The right hemispheres of two adult split-brain patients had scores on this test equal to those of an average sixteen- and eleven-year-old, respectively. Zaidel later noted that the visual vocabularies of the patients tested were not as good, being about five years behind the auditory vocabularies (Corballis 1983, 177). Gazzaniga has some contention with Zaidel's early experiments on right hemisphere language comprehension and believes that right hemisphere comprehension is an exception rather than the rule. Zaidel replies that the two patients he tested extensively were selected because of being relatively free of complications. He felt his patients would most likely reflect the state of affairs in an otherwise normal brain (Corballis 1983, 179).[15]

While the right hemisphere has the ability to make only simple semantic judgments, surprisingly it also can read. It is limited, however: complex sentences, such as "the boy that was hit by the girl cried," are easily misunderstood by the right hemisphere. The right hemisphere is better at making distance semantic relations than the left hemisphere. For example, the right hemisphere can process words like "dog-horse" as being in the same semantic catalogue (Gazzaniga, Ivry, and Mangun 1998, 311).

Shallice and Saffran (1986) have further examined the possibilities that implicit reading-- that is, reading of a non-letter by a letter basis--is a reflection of operations in the right hemisphere reading mechanisms. True, the right hemisphere does not have as fine semantic distinctions, nor can it draw upon syntactic and morphological capabilities to the degree that the left hemisphere can. Examinations of split-brain patients (and normal subjects), however, show that the right hemisphere appears to be better at reading concrete words and higher-frequency words even though it is ignorant of morphology.

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[15] Corballis is referencing Gazzaniga (1983). See Zaidel (1983) for Zaidel's response.

The right hemisphere also is thought to be deficient at deriving the sounds of words from mere print (Farah 1997, 230).

To this point, I have been discussing a representative range of experimental data pertaining to split-brain patients under Sperry-type conditions. I have covered both the history and the typical components of a Sperry-type set up, and I have also noted various significant behaviors of the patients pertaining to handedness, text processing, spatial abilities, and emotive responses. Naturally, this is the data that will inform one's position regarding the status of the individual hemispheres, particularly the right hemisphere, over the course of a Sperry-type experiment.

I now move to discuss what Gazzaniga calls The Interpreter. I will agree with Gazzaniga that there is such a device, but I will disagree with him that there is only one, and that it is located only in the left hemisphere. I shall argue that the empirical data shows otherwise. Along the way, I will also consider whether positing an interpreter is just a new form of an old confusion which goes under the name 'Homunculaust Fallacy.' Eventually, I will find that such a fallacy is not committed by positing an interpreter. Positing an interpreter in both the left hemisphere and right hemisphere is important, since the interpreter functions as the necessary cognitive structure for tracking the narrative of the self, which is to say it is a necessary structure for both consciousness and personhood.

2.6.11 The Interpreter

Glover notes that some views describe a functional system within the brain as ones that "can generate a picture" wherein "I occupy my body as a driver occupies car" (Glover 1988, 96). On the assumption that the brain has a modular organization--and this assumption seems well founded--the role of *The Interpreter* module is to act as an executive system that caches and unifies all the parallel activity of the separate modules. Using Glover's metaphor, we can say that it is the interpreter that sits in the driver's seat. Gazzaniga holds that the interpreter is a necessary element, perhaps even necessary and sufficient element, for the formation of beliefs. The ability to form beliefs is important because this separates humans from being simply stimulus-response organisms in the face of the events of everyday life. "In many ways [the interpreter] is the system that provides the story line or narrative of our lives" (Gazzaniga, Ivry, and Mangun 1998, 545). It enables the reconstruction of the past, albeit very imperfectly, if even sometimes outright fictionally. Gazzaniga's most recent work *The Mind's Past* (1998) makes it very clear that the interpreter is the essential element of personhood, for it is "a left-hemisphere interpreter that constructs theories to assimilate perceived information into a comprehensible whole" (26). Even at the expense of accuracy of reconstructing the past, Gazzaniga thinks that the interpreter "is really trying to keep our personal story together" and that it "expands the actual facts of our experience into an ongoing narrative, the self-image we have been building in our mind for years" (26-27).

A question immediately arises. Split-brain patients presumably have a past, for in standard experiments both the left and right hemispheres can identify information that they considered just earlier--for example, what they recently picked up or what they felt underneath a table. Now if this interpreter is specific only to the *left* hemisphere, and this interpreter is what gives the mind the ability to track its past, one is left wondering how it is the *right* hemisphere can keep track of its past. For instance, if the left hand were to pick up, say, a smoker's pipe, and the right hemisphere were queried on what it held a few seconds ago, it can indeed draw a rough picture of a pipe.

This is a worrisome aspect for Gazzaniga's idea of The Interpreter as being the essence of the person. If there is not an interpreter in the right hemisphere, then this could be evidence that there is no person there, since there is no subjective line of continuity of consciousness; and since there is no neural substratum to link a memory of separate perceptual events together.

One is left wondering, therefore, how the right hemisphere comes to know that it had such a pipe a few moments ago? From Gazzaniga's position, it does not have an interpreter, at least not if the interpreter is identified as a left hemisphere neural device. But such an identification makes one suspicious that this position on the interpreter is more an abstraction about favored clusters of behaviors than an actual neural component.

Someone friendly to Gazzaniga's position might ask: If *both* the left and the right hemispheres are alleged to have such a neural device, is such a device a necessary component of a human consciousness? It would seem so, even if such a device could reach back only a few moments into the past (a problem some diseased patients have). If there really were no past to reach into, not even a second or two ago, the mind would exist in a complete jumble of chaos. Yet even in the diseased patients often described in the literature, this is not noted to be the case. Churchland (1995), for example, describes a patient for whom re-introductions would be necessary whenever Churchland left the room and returned. Yet as long as Churchland was in the room, the patient could keep track of who his visitors were. The train of memory was short, but present, nonetheless. Yet if there were no interpreter, moment by moment the mind (or better, *some* mind) would be encountering a new experience; in fact, everything would appear new. At best, having a mind under such moment-by-moment circumstances merely becomes trivialized to having an experience. The behavioral evidence justifies Gazzaniga's position that there is an interpreter in the brain's left hemisphere, but he understates the case. There also is evidence for an interpreter in the right hemisphere.

Before addressing such evidence, let me take a moment to address a possible counterargument to there even being an interpreter in either hemisphere. The worry is that in positing The Interpreter one is committing some version of the 'Homunculaust Fallacy'.

The argument proceeds as follows. (1) If The Interpreter is essential for tracking narrative changes of self over time (or of at least constructing some more or less accurate narrative of such changes over time), then does not it need a sub-interpreter that serves that role for it, and so on, all the way down? If so, then one has a vicious regress of non-explanatory constructs. (2) On the other hand, if The Interpreter needs no sub-interpreters, then the interpreter is yet another device for tracking narrative changes within the self, one which is posited to explain how the patient keeps track of these changes over time. But again, the explanation is vacuous; a like device is posited to explain the original device. Now one will either posit sub-interpreters or not. But this presents a dilemma: any claims to positing The Interpreter leads to either a regress or to a vacuous explanation.

Concerning the regress, I contend that the rhetorical question in (1) should be answered, "No." It turns out that one may have an interpreter without necessarily positing any sub-interpreters. While there may very well be sub-interpreters that maintain enough cognitive systems to themselves be identified as minds, there may also be sub-interpreters that are primitive in the sense that any sub-systems of those sub-interpreters cannot be identified as minds.

It turns out that a human mind is encarnalized through a particular configuration of modules exhibiting a particular information state.[16] If some subset or subsets of the brain exhibit the right configuration, then there actually would be yet another individuated, if attenuated, mind -- something akin to a homunculus, "a little man", but only as compared to an otherwise fully unified set of modules. The regress has a stopping point when a particular configuration of modules is not present in the human brain.

Thus, one avoids the dilemma, and thereby the accusation of committing the homuncular fallacy when positing an interpreter. I now move on to discuss there being evidence for an interpreter in the right hemisphere.

In split-brain experiments, the left hemisphere will often report on what the left hand is doing, after subjects have been presented with items to report about. For example, the left hemisphere would see a chicken claw while the right hemisphere would see a snow scene. When given association tasks, the right hand will select a chicken from a second set of objects, indicating association with what its controlling hemisphere (i.e, the left

[16] In part two of this project, I will talk specifically about important higher order relations among modules which brings this information state about. And in part three, I will develop a theory on individuating a mind as it is encarnalized through is associated brain.

hemisphere) saw--namely, the chicken claw. But when the left hemisphere is queried about why the left hand picks up a shovel, it will confabulate information in order to "weave its story in order to convince itself, and you, that it is in full control" (Gazzaniga 1998, 23-25).

At issue is whether the *right* hemisphere also weaves such a story. As earlier noted, the right hemisphere does not have the linguistic ability of the left hemisphere, and it does not operate at the level of cognitive maturity of the left hemisphere. (Generally, a right hemisphere operates with the cognitive maturity of a toddler.) Presumably, the right hemisphere could likewise confabulate a contextually consistent story on what the left hand is doing. And it will sometimes disagree with the verbal account of the left hemisphere. Thus, on the face of it, the right hemisphere is aware of a past. Gazzaniga (1998) says that *only* the left brain has an interpreter, and that this interpreter maintains "our general capacity to see how continuous events relate to one another" (24).

Under experimental conditions, however, the right hemisphere seems to have this capability, albeit to a lesser degree. When shown two sets of pictures, the right hemisphere is as equally adept as the left hemisphere in identifying whether a set of pictures in one series had appeared in an earlier series. But when the later set was replaced with topically related pictures, instead of exact duplicates, the right hemisphere performed better at relating the topically related pictures of the second set to the first than did the left hemisphere. The left hemisphere incorrectly recalled the first set of pictures as being related because of its proclivity for confabulating context. Even here, the right hemisphere is showing that it is aware of continuous events that were related to one another. Indeed, it knows that this second set does go with the first set, that there is a second set relative to some first set, and that the first set preceded in time the second set. Why Gazzaniga thinks that the right hemisphere is not functioning with some interpreter-like mechanism is quite odd. Interpretive behaviors are occurring, and if it is the empirical behaviors that lead to the positing of an interpreter, then the right hemisphere must likewise be accounted as having an interpreter, even if one of lesser capability.

It turns out, however, that there is some disagreement on how much the right hemisphere is aware of its past. Some writers, Gazzaniga foremost among them, seem to indicate that the right hemisphere lives only in the present. Other writers, such as Nagel (1991), however, note that the right hemisphere will sometimes disagree (by hand gestures) when the left hemisphere reports inaccurately about what the right hemisphere perceived during the course of a Sperry-type experiment. There is, therefore, at least some reason to think that the right hemisphere has enough short-term memory to compare what is perceived in the past with what it perceives in the present. For example, the right hemisphere is able to draw pictures of what it perceived during Sperry-type experiments, and this is possible only if there is an awareness of the past. Such awareness leads one to think it has at least the rudimentary narrative memory function for maintaining a personal identity.

In the overall task of counting persons over the course of Sperry-type experiments, it is important to posit an interpreter for the right hemisphere. Having an interpreter is a necessary element of personhood, for as was earlier noted, it tracks the very narrative of the self. Split-brain studies concerning the right hemisphere do not rule out its having an interpreter. Indeed, they seem to support there being such a device present. The right hemisphere, therefore, is legitimately thought to have the necessary cognitive structure to support consciousness and even personhood.

I shall now move to narrow down just which aspects of consciousness are important for getting a clearer understanding of split-brain patients. Naturally, I am particularly concerned to show that the right hemisphere is conscious. But just what do I mean by *conscious*? Ultimately, I shall find Lycan's position on the matter of defining consciousness to be the most fruitful.

3 CONSCIOUSNESS

This consciousness that is my self of selves, that is everything, and yet nothing at all--what is it?

-- (Julian Jaynes 1976)

3.1 Introduction

In addressing the status of the right hemisphere, one must first take a stand on consciousness. I claim there is indeed such a thing. Of course, that divorces me from the skeptics on consciousness and the radical eliminative materialists who would change the language locutions of mind and limit our ontology to the clean and controlled entities of physics or, at the very least, to what we can pretend to be the clean and controlled entities of physics.

Indeed, I find it necessary to throw all caution to the wind and claim that consciousness can, in principle, be explained. This is a faith claim on my part, as no one seems to have done it; and perhaps it is even a modal faith claim--I have faith that someone *could* do it. From a phenomenological point of view, I certainly think I am conscious, in the sense that there is something that it is like to be me and something it is like to see red versus seeing blue, versus hearing middle C on a piano, versus being kicked in the shins.

Admittedly, introspective reports are notoriously inaccurate. Psychologists and sociologists take great delight in showing us exceptions to our own accounts of *why* we do what we do and *what* we were thinking, when we were thinking it. At any rate, even if my readers do not think they are conscious, I certainly think I am conscious and proceed upon this assumption as if it applied to all other homo sapiens who exhibit behaviors of the same type as my own. (Some justification for this assumption is given in the discussion of *qualia* below).

Of course, by the very employment of the word *consciousness*, one is apparently committed to some meaning of that term. It is not an unreasonable request for someone to ask, "What do you mean by 'consciousness' when you say that you are conscious?" One might then lay out the connotation of the word, perhaps even aiming for a definition. This is an overly optimistic hope for several worrying reasons that are noted in the section that immediately follows.

Naturally, an analysis of a definition (an alleged definition) would lead to further questions about the constituent terms. One is always tempted by, yet usually well advised to jettison, profound, continental-sounding phrases such as "the something likeness of my perceptions" or "the being-what-it-is of my experience." Unfortunately, getting some hold on the meaning of the term *consciousness* demands a certain embarrassing and unpleasant participation in such talk. Yet, at this point, it seems the only business available within which to sell a description of consciousness to one's readers. It is hoped the price is not too high.

3.2 Defining Consciousness

3.2.1 Worries over Defining Consciousness

Stuart Sutherland (1995) captures something of this embarrassment in his definition of consciousness, although he is a bit more pessimistic about the subject, if not the definition, than is necessary.

> CONSCIOUSNESS: The having of perceptions, thoughts, and feelings; awareness. The term is impossible to define except in terms that are unintelligible without a grasp of what consciousness means. Consciousness is a fascinating but elusive phenomena: it is impossible to specify what it is, what it does, or why it evolved. Nothing worth reading has been written about it. (95)

A more toned-down view is expressed by George Miller (1962) who writes that "consciousness is a word worn smooth by a million tongues [...] Depending upon the figure of speech chosen, it is a state of being, a substance, a process, a place, an epic phenomenon, an emergent aspect of matter, or the only true reality" (25).

Dretske (1997) resorts to making an ethical judgment on the matter, writing that "no useful theory of consciousness can hope (nor, I think, should it even aspire) to capture all the subtle nuances of ordinary usage" (773). Finally, Lycan (1997) admits that he can only hear a natural sense of the phrase "conscious state" as meaning the state one is conscious of being in, but he makes a somewhat disarming analysis of how the word 'consciousness' is used. He notes, "The philosophical use of 'consciousness' is by now well and truly up for grabs, and the best one can do is to be as clear as possible in one's technical specification" (759). We should admit that consciousness is a cluster concept with the most difficult aspect to explain being *qualia*,[17] itself another another cluster concept (Bunnin and James 1996, 180-82).

But there are aspects to consciousness that do not have qualia as a key component, such as the mechanisms of the unconscious, the attentive and control components of consciousness, and its representational aspect. Güzeldere (1997a) thinks that these other,

[17] I directly address qualia later, but for now I can roughly define this term as the subjective feel that certain mental events exhibit.

nonqualitative aspects of consciousness *can* ultimately be understood or explained apart from the quality of aspects (22).

In the next section, I try to hone the definition by moving through, at first, very broad, nebulous definitions offered by key writers. As more definitions of the term are reviewed, I try to narrow the scope of the discussion to what I take to be a controlling view of consciousness, even if I offer no outright definition of consciousness.

3.2.2 Precising a Definition of Consciousness

While not himself one to dwell on definitions, Pinker (1997, 134-35) gives four meanings for how consciousness often is described by writers on that subject. These are descriptive for all that they take in:

1. First, as in the writings of Stephen Jay Gould, a well-known theorizer about evolution, consciousness is used as a synonym for *intelligence*, albeit of a very lofty kind.

2. Another meaning for consciousness is *self-knowledge*. Consciousness is understood as an internal model of the world, and this model contains the self. In this sense, a conscious entity can feel pain, can see blue, and can think of itself as doing these things. Pinker holds that this ability is no more mysterious than any other topic in memory or perception. He asks, "If I have a mental database for people, what is to prevent it from containing an entry for myself?" (Pinker, 134) It is often noted that midlife, adult chimpanzees, orangutans, and human beings are able to recognize their own reflections in mirrors. This is supposed to be evidence for consciousness, and no doubt Pinker has in mind this self-knowledge definition of consciousness. In light of this he asks again, "If I can learn to raise my arm and crane my neck to sight a hidden spot on my back, why

couldn't I learn to raise a mirror and look up at it to sight a hidden spot on my forehead?" (Pinker, 134) Indeed, Pinker points out that even pigeons have been trained to recognize themselves in mirror. He also adds that any beginning programmer of a robot could construct software so as to allow the robot to recognize itself in a mirror. Self-knowledge, he says, is a common topic in cognitive science but not a paradoxical mystery. He notes that because it is so easy to say something about self-knowledge, writers can crow about their "theory of consciousness."

3. A third sense of consciousness is in terms of *access to information*. Here one might be referring to products of vision and contents of memory for the reasons behind decision making and rational thought or to internal calculations of vision, automatic gut-level responses, repressed desires, or other systems that are not directly accessible to a self that has consciousness. Again, Pinker holds that this is not the most mysterious sense of consciousness since even computers have access to information about their internal state, and, likewise, they do not have full information about all internal states, as they cannot report upon why they are in such states. For example, a computer may recognize a printer is not responding but not be able to say why the printer is not responding, even if the printer itself does have access to that information, such as in a paper jam. Pinker sees this as a very close analogy to the way human consciousness is sometimes cashed out in terms of access to information, but he nevertheless does not find this a satisfying account of consciousness.

4. Finally, the most interesting sense, in Pinker's view, is consciousness understood as *sentience*: subjective experience, phenomenal awareness, raw feels, first-person present tense, "what it is like" to be or do something, if you have to ask, you'll never know. Marvin Minsky has called consciousness a "suitcase" word.[18] By this he means there are a host of things the word might mean, depending on where it is used and on who utters it. If this is the case--and I think it is--one can see that Pinker is fully packed! One can easily discern overlapping areas among Pinker's four-fold senses. Minksy's perplexity dates back twelve years previous to Pinker's work and he asks questions that any such broad, all-encompassing map of the term *consciousness* must face: "What do we mean by words like *sentience, consciousness*, or *self-awareness*? They all seem to refer to the sense of feeling one's mind at work–but beyond that, it is hard to say whether there are any differences in what they mean" (Minsky 1985, 152).

Earlier in his career, it looked as if Gazzaniga (1985) was defining consciousness as something capable of affecting action. A brain module is considered conscious, because it is "very capable of affecting action" (117). Yet just because a brain module cannot internally communicate to the language and cognitive system does not mean it should be characterized as *unconscious*. In more recent works, however, Gazzaniga holds that consciousness is a feeling about specialized abilities. These feelings center on the objects we see, hear, and feel. Consciousness also includes feelings about our capacity to think and use language (Gazzaniga, Ivry, and Mangun 1998, 546, 548).

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[18] Speech given at computer game developers conference (1999).

Gazzaniga's change is a first hint of a chasm in the discussion about consciousness--what Chalmers (1995) and others since have distinguished as the "easy" and "hard" problems of consciousness. Güzeldere gives a short survey of the difference: The "easy problems" are those concerning the explanation of various cognitive functions: discriminatory abilities, reportability of mental states, the focus of attention, the control of behavior. Chalmers's point is that "there is no real issue about whether these phenomena can be explained scientifically" (29). They can be. "What makes 'the hard problem' of consciousness a different *kind* of problem," Chalmers maintains, "is its resistance to all the methods that explain, or have the potential to explain, the rest of the problems" (29). Generally, "the really hard problem is the problem of experience" (30). More specifically, it is the *subjective* aspect of every experience that resists explanation. "There is something it is like to be a conscious organism and have experiences. In other words, 'what it is like to be' constitutes the subjective character of the experiences of the organism in question" (30).

When the heterogeneity of subjective feel is emphasized, consciousness becomes "a superordinate term meant to cover all mental states, events, and processes that are *experienced*—all the states that there is *something-it-is-like for the subject of them to be in*" (Flanagan 1997b, 97-98). This, supposedly, is what gets the "hard problem started." Flanagan, however, thinks a naturalized account can give us a respectable science of mind (107).

Following Rosenthal (1990), Dretske (1997) distinguishes two types of consciousness. *Creature consciousness* is where "agents are said to be conscious in an intransitive sense of this word (he regained consciousness) and in a transitive sense (he was conscious of her.)" In contrast, *state consciousness* always has an intransitive sense in that certain internal "states, processes, events, and attitudes (typically in or of conscious beings) are said to be conscious." Dretske further notes that "transitive creature consciousness implies intransitive creature consciousness." One "cannot see, hear, taste, or smell something without thereby being conscious." He adds, for example, that one cannot be aware that one's checkbook doesn't balance or conscious that one is late for an appointment without being a conscious being (777; all quotations from Dretske).

Dretske's position is also echoed by Goldman (1997), who holds that consciousness may be *consciousness of* a particular object or event. Goldman writes, "To be conscious *of* an object, x, is to be in some (partial) state of phenomenal awareness that includes a representation of x. In other words, x is the referent or intentional object of a conscious state or representation" (111). Goldman admits this is a reasonably accurate, although only approximate definition of consciousness, since it already uses a synonym of "phenomenal awareness" in its definition. My point here is just to give another shade of meaning of consciousness that is not exclusively based in qualia but has a vector or sense of pointing outside itself.

The word "outside" here does not merely refer to things "outside the head," as the phrase is oft-quoted, but means more specifically "outside the module." But even this is not quite right, for there very well might be a self-directed view that also counts as "outside," perhaps akin to how statements about English sentences, meta-statements, can themselves be English sentences. – e.g., 'This English sentence ends with a period.'

Lycan (1997) defines consciousness as "the functioning of an internal attention mechanism directed upon lower-order psychological states and events" (755). He further defines attention mechanisms as "devices that have the job of relaying and/or coordinating information about ongoing psychological events and processes" (755).

From all of these definitions, several aspects concern an analysis of the right hemisphere being conscious, and, therefore, of there being more than one person present in a single patient over the course of a Sperry-type experiment. First, although there will no doubt be some aspects of consciousness that are attenuated, or even not present, the suitcase, as it were, must be sufficiently packed with what we normally think of as essential aspects of consciousness. Second, being conscious must affect action in some discernable way, as contrasted with unconscious actions. Third, questions about whether the right hemisphere has the "what-it's-likeness" of experience must also be addressed, even if a rigorous and satisfying explanation for subjective feels cannot be completed. Finally, if the right hemisphere is conscious, some account of what it is conscious of must be attempted, which entails making statements about what is represented by the right hemisphere. Representations "outside" the module shall be noted, with attention given specifically to how internal monitoring mechanisms of the brain coordinate information about mental psychological events and processes.

3.3 Identifying the Essential Issues in Consciousness

3.3.1 Introduction

In this section I discuss essential issues of consciousness. I first make a few remarks in order to absolve myself from having to solve the mind-body problem in order to talk about consciousness. Second, I outline why consciousness is not an all-or-nothing affair. Consciousness comes in degrees, but that requires I explain just how this can be. Therefore, third, I outline a modular systems approach to consciousness and use that as a basis for my supposing a higher-order theory of consciousness. Fourth, I consider two representative samples of higher-order consciousness theories, Rosenthal's and Lycan's, and then defend why the latter is the one I find preferable. I also give some special attention to introspection, since it would be the highest form of consciousness within higher-order theories. Fifth, I consider challenges to consciousness, one from Dennett and the other from the possibilities of "Zombies." The latter challenge demands I take up the discussion of qualia. Finally, I close out my discussion of the essentials of consciousness by laying down a Turing-like criterion for detecting consciousness and by considering how the various essential issues of consciousness might fit into my overall position that a Sperry-isolated right hemisphere is indeed conscious.

3.3.2 Absolving the Mind-Body Problem

Bernard Baars (1997) notes that there already is a great deal of reliable, empirical information available on consciousness, although it has been based on decades of research under other labels. He believes we are in principle able to treat consciousness as a variable, one that can be studied if we hold the content of consciousness as constant as possible.

Even apart from solving the mind-body problem, psychology has had the ability to make some reliable generalizations about conscious experience, such as research on recollection from long- and short-term memory, voluntary vs. involuntary control of attention, and activities of sense perception. The very success in these areas shows that critical facts about consciousness can be specified without either evading the issue or requiring that we first solve the mind-body problem (197).

In this work, I take up Baars's gambit--namely, that it is not necessary to solve the mind-body problem in order to make claims about consciousness. Obviously, one cannot completely ignore metaphysical positions on the mind while addressing consciousness, so I at least make some preliminary remarks about my position on the mind-body problem.

Ultimately, I hold that consciousness is a configuration of mind, and that human minds are encarnalized through the neuro-network of the human brain.[19] Minds are not properties (at least not straightforwardly) but particulars (of a special type). They are of a class of metaphysical entities known as "superficial particulars" (Casati and Varzi, 1995). Minds are dependent particulars: they cannot exist alone; they need a host, within which they find a place to be.

The configuration of consciousness, therefore, is not a simple sum of the parts of individual neurons. Consciousness is a configuration of a higher-order entity (the mind) encarnalized through lower-order entities (neurons, along with their components). The correlation between brain events and phenomenal events is evidence enough that our high level capacities exist because of low level interactions. Although I have metaphysical biases here, as much as possible I try to avoid judgments on whether a given configuration of mind is just a high level description or an actual ontological state. I recognize that this

[19] Perhaps minds can emerge from other structures, perhaps even non-brain or non-organic structures. I take no position on this here.

is a most interesting question, but it is one that I cannot properly address until part three of this project.

Even if some configurations of mind are just descriptions, they are descriptions that we should levy not only at other persons but also at persons whose hemispheres are split under experimental conditions. The right hemisphere, I argue, has the sufficient capacities for us to attribute consciousness to it. It has, although to a lesser degree, the same traits that we otherwise attribute to configurations of normal minds.

3.3.3 Degrees of Consciousness

Earlier, the word *degree* was used in regard to attributing consciousness to the right hemisphere. It is not always desirable to talk of consciousness in a binary fashion. Patients with critical brain damage range along the full spectrum of functionality. Some lacking all brain functions are unresponsive to any test. Others with only an attached brain stem can track light with their eyes, react to pain or reflex stimulation, yawn, sigh--all of this on their own while otherwise maintaining only standard metabolic functions. Güzeldere (1997b) also believes that it is sometimes necessary to talk about degrees of consciousness, which allows one to say that normal human beings are "more conscious" than those with brain damage, that brain damaged patients are more so than those without a brain stem, and so forth (47).

Speaking against Searle (1997b), who holds that consciousness is an on-off affair, Lycan (1997) argues that consciousness comes in degrees, or what he describes as "degrees of richness or fullness." Humans are said to be richly conscious, and less complex animals, while still conscious, are less fully so. Of course, a minimal level of attributes is necessary for consciousness to obtain, but this is consistent with what Lycan has written elsewhere. Lycan holds that "a thing is conscious, at all, if it is conscious to any degree at all--that is, if it has at least one internal monitor operating and contributing, etc" (766) to its mental activities. He goes on to argue that if something has more monitors, integrates more, or integrates more efficiently for control purposes, then that thing would be considered more richly or more fully conscious (766).

As we consider the richness of consciousness, we have some trouble contemplating a spectrum-degraded, loss of consciousness, since we exist with such a rich and full, what Lycan calls "remarkably non-gappy," luxury of sense modalities (766). By analogy it is difficult for us to abstract with our short-term memory (which commands only five to nine "chunks" of information) just what, say, a quintillion objects would be like. Nevertheless, we have some ability to formulate a notion of one quintillion and can make sense of such talk. Mathematicians do this regularly. Likewise, we can abstract very low degrees of consciousness, even if it is highly implausible that we can render by such an abstraction the notion of being only as conscious as an ant or a slug.

3.3.4 A Modular Systems Approach

Earlier, I discussed the modularization of brain function and found, for instance, that chronometric evidence supports there being discrete modules in the brain dedicated to specific tasks. Another instance of this was face recognition. I also noted how modularity could be artificially induced, either by a Wada procedure or by surgeries. Ultimately, I claimed that the brain was a society of modules.

The mind is a result of the processing and configuration of these modules. I must now concern myself with determining how consciousness fits in with such a view of modularization. Ultimately, I want to show that the right hemisphere is conscious. I must, therefore, discuss how some set of modules can be coordinated into consciousness at all.

Although I did not define a module explicitly in part one of this work, "Cognition," I shall borrow Garfield's (1995) definition in order to show how consciousness results from coordination of brain modules: "Broadly speaking, a module is a relatively autonomous component of the mind--one that, while it interacts with, receives input from and sends output to, other cognitive processes or structures, performs its own internal information processing unperturbed by external systems" (442). A module is a neuro-system that is independent to some degree from other components of the mind.

Sometimes, consciousness is viewed as being a property of certain specific neuro-systems that are joined to other neuro-systems, which are not conscious. But Kinsbourne (1988) theorizes that a better way to view consciousness is as a state of integration among different neuro-systems (Farah 1997, 225). As an example of his theory, patients who have neglect do not lack for the transmission of perceptual information between systems that normally result in conscious awareness. Rather, the problem is a weak or degraded representation of the stimulus such that it has not gained sufficient influence over all other concurrent patterns of activity. A brain would otherwise use these patterns to create a new global brain state into which representation is integrated (Kinsbourne 1988, 225). This is in contrast with other accounts (cf. Damasio 1990) where one might have normal percepts, but there is a disconnection of these percepts from other neuro-systems in the brain (Farah 1997, 225). For my purposes, I favor the Kinsbourne view of a coordination (= integration) among various brain modules.

Thinking more generally, Van Gulick (1997) reviews Baars (1988), who holds that one of the most important functions of consciousness is to broadcast information throughout the nervous system. It has the function of making information widely available. Building upon this view, Van Gulick notes that objects within our phenomenal awareness are represented from many different perspectives and modalities and yet still harmonize and agree. Conscious phenomenal awareness, therefore, probably involves large-scale and higher-order patterns of brain activity, which encompass many different sensory and representational modalities. "Because of their highly integrated and multi-modal content, conscious phenomenal representations require rich associative networks of activation as their basis. Thus, any type of brain activity able to serve as the neuro-substrate for phenomenal representations would seem of necessity also able to fulfill the function of 'broadcasting information'" (Van Gulick, 440).

Regarding such associate networks, there is an especially relevant point worth noting here. In the case of the right hemisphere, although it does not have the full associative networks of a normal brain, there are still plenty of connections and modularization of sensory modalities and apparently representational modalities, since split-brain patients operating from the right hemisphere are able to engage short-term memory, kinetic memory, and a basic ability to report what they have grabbed or pointed to.

The big question is how the myriad of modules is bound together for coordination. Stich jibes that "consciousness is inferentially promiscuous" (Pinker, 137). It is available to a large number of information processing components in the brain rather than to a single component (Pinker, 137). Currently there is no sure answer to this, but there is a tempting option, one that seems almost irresistible. It comes from the work of Francis Crick and Christof Koch (1997) in their study of vision:

> Because any object will have different characteristics (form, color, motions, etc.) that are processed in several different visual areas, it is reasonable to assume that seeing any one object often involves neurons in many different visual areas. The problem of how these neurons temporarily become active as a unit is often described as "the binding problem." As an object seen is often also heard, smelled, or felt, this binding must also occur across different sensory modalities. (284)

Of course this question could be asked not just concerning the modules that coordinate vision, but for all of the modules that coordinate for consciousness.

Crick and Koch have put forth an interesting hypothesis that subjective awareness is linked to oscillation patterns in a range of about 40 Hz in relative groups of neurons. The relevance is in terms of the neurons involving certain decoding tasks where 40 Hz oscillatory spikes are synchronized. These 40 Hz oscillations have been found in the thalamus, the olfactory bulb, single neurons, and neuronets in the retina, among other places. Llinas and Ribary (1993) have suggested there is a nonspecific system consisting of the thalamocortical loop that finds contentful states of 40 Hz oscillations for particular modalities. An example of this is where a neuro-system subserving a sensing modality such as sight provides the content of an experience while the more generalized system, which consists of the resonating activity in the thalamus and cortex loop, provides the temporal binding of this content into the cognitive experience that we subjectively experienced as a single conscious state (Flanagan 1997b, 103).

So Crick and Koch have suggested that synchronization across visual areas helps bind conscious awareness of visual stimuli. Dimasio (1990) proposed a similar identification, although more globally. He suggested that these 40 Hz oscillations bound *all* of conscious awareness, vibrating across different modalities specific representations of an object rather than just being limited to the visual system, as in Crick and Koch's account (Farah 1997, 205).

Even with this tantalizing evidence of 40 Hz oscillations, Flanagan (1997b) warns that it is unclear whether this phenomenon is "a marker, a constituent component, or a cause of a vivid conscious experience (which one it is, is of course very important)" (103); thus, sometimes the sense of what 'binding' means shifts around in discussion. Even further complicating the matter, Crick and Koch think it possible that there might be several forms of visual awareness (Crick and Koch, 281;284), and, by extension, even more forms of consciousness in general.

3.3.5 Higher-Order Theories of Consciousness

You cannot think about thinking, without thinking about thinking about something.

– Seymour Papert

If modules can be coordinated--i.e., if there can be one module that has as its inputs the outputs of yet other higher-level modules, then this would easily lead one into discussions of Higher-Order Theories (HOT) of consciousness. I have been purporting that such coordination is possible; I now explain and develop a position on Higher-Order

Theories of consciousness. This is important for my overall project, as I have affirmed that the right hemisphere is made up of modules. I now need to show how those modules might be configured to maintain consciousness.

Higher-Order Theories of consciousness have come from several different camps. Armstrong, Churchland, Lycan, and Rosenthal have all put forth versions. No doubt there are more. Higher-Order Theories state that an organism is in a conscious mental state when that mental state is the object of a second, higher mental state. One mental state is said to be "higher" than another when the first mental state is about or directed toward the second mental state. Therefore, consciousness is not the property of any single mental state, but a relation--I have been using *configuration* so that sets of relations can be allowed--between two (or more) mental states.

The idea of higher-order mental states is not new. Descartes held that consciousness was a type of higher order of awareness, what is called "second order awareness" today. In a letter to Arnauld dated 29 July 1648, he wrote:

> When an adult feels something, and simultaneously perceives that he has not felt this before, I call this second perception *reflection*, and attribute it to the intellect alone in spite of its being so linked to sensation that the two occur together and appear to be indistinguishable from one another. (Cottingham, Stoothoff, and Murdoch 1991, 221)

Descartes had also written in June 1640, "Pain exists only in the understanding," where understanding, in Descartes' view, is itself part of the mind (Cottingham, Stoothoff, and Murdoch 1985, 85). What is new is that higher-order mental awareness, consciousness, is not a property of *every* mental state, but only of *some* mental states.

One might classify HOTs as being closer to or further from Descartes' original stance on higher-order awareness. Consider two representative samples: Rosenthal and Lycan.

3.3.5.1 Rosenthal

On the one hand, Rosenthal (1997) explains that there are "serious theoretical reasons" to reject Descartes' view of consciousness, for "if all mental states were conscious states, it would be impossible to give any nontrivial, informative explanation" of the nature of consciousness. Yet, on the other hand, Rosenthal does not completely reject Descartes, for he still thinks "nothing in nonmental reality seems suited to explain what it is for a mental state to be conscious." The big move for Rosenthal is to have an intermediate step: "We still would not explain consciousness directly in nonmental terms, but the explanatory chain would reach nonmental reality by way of some nonconscious but mental intermediate. The intermediate step would dispel the apparent unintelligibility of explaining consciousness straightaway in nonmental terms" (735).

One can see some explanatory advantages to a *via media* view. First, perhaps there is not a bifurcation of mental states, where some are conscious and some are not. More likely, there is a spectrum of conscious mental states, and at somewhere along that spectrum falls attention. Attention is not quite consciousness and is not quite pure mental state, but a more or less intermediate state between these two. We can, therefore, account for the mental operations[20] we share with higher animals and yet still save introspection and higher-order thought as higher than mere attention and, thus, beyond what animals are able to exhibit.

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[20] This may be what Güzeldere is obliquely complimenting, 800 fn. 4.

Second, Rosenthal asks perhaps one of the essential questions, if not the essential question about consciousness. Since consciousness does not reveal itself as an extrinsic property of conscious states, can we not conclude on the basis of introspection that it is an intrinsic property?[21] Eliminative materialists such as Churchland are often quick to indicate that introspection is not a reliable way to understand mental activity, and here, Rosenthal agrees. He notes that the deliverances of consciousness are compatible both with its being an intrinsic property and with its being an extrinsic property. On either account, intrinsic or extrinsic, consciousness is mute about its own nature (1997, 739). Yet, even if consciousness is not *prima facie* an extrinsic property of mental states, Rosenthal will remain with the HOT approach, for, as he earlier noted, "it is only if we regard being conscious as a relational property that we can explain what such consciousness consists in" (737).

It should be noted that Rosenthal seems to have quite a bit riding on the precise status of the extrinsic property of consciousness. Elsewhere he has written that "a state's being conscious is its being accompanied by a roughly simultaneous higher-order thought that one is in the target mental state. So being conscious is an extrinsic property of those mental states which are conscious" (1991, 16). As was earlier mentioned in passing, this being conscious of a higher-order thought introduces a *third-level* relationship between mental states.

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[21] Rosenthal (1997) stipulates that a property is intrinsic "if something's having it does not consist, even in part, in that thing's bearing some relation to something else" (736). A property would be extrinsic otherwise.

Rosenthal argues that generally a false dichotomy appears when one thinks that the only way to explain consciousness is in terms of what is not mental or in terms of conscious states. The former is impossible; the latter is trivial. If one holds this dichotomous position, it looks like one must acquiesce to not having the ability to give a genuine explanation of consciousness at all. The best one can hope for is to render the phenomenon in terms of conceptual connections that hold among such primary notions as consciousness, mind, viewpoints, objectivity, person, perspective, and self. However, Rosenthal, himself, thinks this is a false dichotomy. He argues that we should explain consciousness in terms of mental states that themselves are not conscious states (1997, 735).

The gulf between creatures with consciousness and the nonmental components that makes them up can be bridged by an intermediate capacity of creatures to draw upon nonconscious mental states (Rosenthal 1997, 749). The relationship between nonconscious mental states and nonmental states would be lower on a tier of explanation than the relation between conscious states and mental states. This allows one to sustain a naturalistic explanation of mind and yet allows an intermediate step to dispel an apparent un-intelligibility of consciousness while still using mental terms. Yet, whatever the case about naturalism, Rosenthal cautions that no nontrivial, informative explanation of state consciousness will be possible unless we reject the idea that all mental states are conscious (735).

3.3.5.2 Lycan

Lycan's HOT is further away from Descartes than Rosenthal's, for he does not build his "Inner-Sense" theory of consciousness around the object of a higher-order "thought" but around the object of a higher-order "scanner" (or "monitor"). "The Inner-Sense theory has it that conscious awareness is the successful operation of an internal scanner or monitor that outputs second-order representations of first-order psychological states" (1997, 762). A monitor makes for consciousness when what it monitors is itself a psychological[22] state or event (765-66). In particular, Lycan's HOT of consciousness is concerned to draw a distinction between "conscious *simpliciter*" (or intransitive consciousness) and "consciousness of *such-and-such*" (or transitive consciousness). The former is concerned with simply being awake as opposed to asleep or comatose; the latter is concerned with "perceiving *such-and-such* or aware of *such-and-such*" (Lycan 2001).

3.3.5.3 Mental Representations: Güzeldere's Objection

Güzeldere (1997a) summarizes contemporary materialist theories of mental representations as understanding *mental representations* to be states of the nervous system, which represent to the subject in whom they occur various objects in--in fact about--the subject's environment and bodily states (793). He goes on to point out that the higher-order perception theories hold introspection as some form of "direct access" to one's brain states, in terms of the intrinsic, physical properties of those states. Lycan's view is certainly no exception to this analysis, for he defines an internal monitor as "an

[22] By "psychological" here, Lycan is not assuming what he attempts to define; he merely means perceptions, memories, anticipatory organization, or combinations of these factors into learning. The monitoring of all of these--this is where consciousness would obtain.

attention mechanism that presumably can be directed upon representational subsystems and stages of same" (1997, 762).

Güzeldere qualifies his claim a bit, for even if not every representation is a state of the nervous system, at least introspection is held to be such on one of two interpretations for the higher-order perceptions. Still, introspection can also be understood as where internal objects somehow share the properties of the external objects of which they resemble or are taken to resemble.

Güzeldere wants to argue that this is (what he calls) "the fallacy of the representational divide" (1997a, 796): either the properties of the representation are taken to be the properties of the represented, where we identify what is in our head with the properties of what we perceive outside of our head, or the properties of the represented are taken by us to be properties of the represented, where we somehow import the properties of what is outside our head as the properties inside our head. Güzeldere asks rhetorically, "Why should we expect . . . to find out all about the cup a subject sees by examining the neuro-properties of the visual state that subject happens to have in looking at that cup?" (1997a, 798).

But there is an easy answer here: because the image is isomorphically outlined at the neural-level in some sensation brain area. A straightforward example is in the visual sense modality. It turns out that the V4 area neurons at the back of the brain literally map out isomorphs of external scenes. The relations between objects perceived and the representational brain structures are more than just representations at the receptor services, i.e., at the neuronal representation on the retina surface of the eye. Ultimately, it would appear that different modules in the brain act as *homunculi*[23] that maintain a scanning relation to other modules of the brain. Although there is no singular homunculi or single theater in which a homunculi sees everything, there are a multitude of homunculi that holistically allow the scanning to take place. It is not the infinite regress of requiring a yet second "internal eye" to account for the perception of what goes on external to our heads, as Güzeldere charges. (We see here an analogue to the earlier charge of regress when positing an interpreter module in the brain.) It turns out that in a footnote, Güzeldere reveals that Lycan had corresponded to him about the V4 area being a literal first-order resemblance. Güzeldere essentially argues that since it doesn't preserve all the properties that we perceive, "a topographical relation of a very crude sort," it does not lend any support to a classically empirical "mind's eye" support for mental representation (Güzeldere 1997, 804). Apparently something can be in the head, materially incarnated as the topographic order on the brain's neurons, but that does not get to count as mental representation because of one's aesthetic feelings of the matter. Perhaps we should take the hint that Güzeldere will resist any defeasible criterion for establishing an empirical "mind's eye" view of mental representation.

In the end, most of Güzeldere's arguments against HOTs of consciousness, whether higher-order perception or higher-order thought, hinge upon this very weak understanding of homuncular activity or upon the fact that no one can fill in the details of neural science to explain the exact order of representation or information structure of how

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[23] '*Homunculi*' is being used here for referring to active monitors, in this case a collection of the brain's modular subsystems, that executes functions specified entirely in those formal terms described by cognitive science.

thinking takes place in the brain. Essentially, Güzeldere's arguments gain their strength either from our current ignorance of neuroscience or our too-easy acquiescence to his simplistic homuncular charge (1997a, 798, 799).

3.3.5.4 Supervisory Systems among Modules: Shallice's Caution

Lycan's position is nicely compatible with Shallice's arguments concerning blindsight. Neuro-psychology studies of blindsight find that consciousness must be posited within the scientific investigation of this phenomenon. This is because the higher-order control systems are in conflict where the language system and episodic memory are not coordinated with the contingent scheduling of motor activities. The conflict occurs because no single supervisory system, in Shallice's view, coordinates all control systems simultaneously. Moreover, he maintains, there are a variety of high-level systems, and to say that one system controls all the others is too strong a claim. He believes that equality of higher-level systems influences the activation of schemata, each of which, in its specific way, will, if selected, determine which modules will be operative and modulate their activities. Normally, however, the various control systems operate in an integrated way. He believes that the process that corresponds to having a conscious experience is one that necessarily involves more than one of these control systems. One can therefore see why investigators could take any one of the different control systems or subsets of them and produce plausible arguments about why the properties of conscious experience map with what is happening in the particular control system that the investigator happens to be investigating (1997, 270).

Ultimately, Shallice cautions that the word *conscious* cannot be unambiguously applied, for strong inputs to one conscious system could interfere with the smooth integration of other systems. If, for example, the supervisory system was in conflict with attention scheduling, it would not be appropriate to say of people in the situation either that they are conscious of how they are acting or that they are not (1997, 271). Consistent with this, Lycan notes that "it should trouble no one that he or she has proper parts that are conscious." What troubles some "is that he or you or I should contain subsystems that are conscious on their own though we know nothing of them, and whose conscious contents are not at all like ours" (1997, 765). A monitor functioning within one of a person's subordinate homunculi might be doing its special job for that homunculus rather than for the person himself; for example, it might be serving the homunculus's event memory rather than the person's own proprietary event memory (763).

Since these monitors are already admitted to be independently interacting, it becomes easy to see how the right hemisphere can be called conscious. Although it has less homunculi in action, by merit of it being only half a brain, its intermonitoring activities are of no exception to what would normally go on in a full brain.

3.3.5.5 Taking Sides: Why Lycan's HOT over Rosenthal's HOT

First, Lycan's view fits so nicely with module theory. We know, for example, that different components of visual processing are broken down into distinct processing areas and that different components of the visual system monitor one another. Since the morphology of vast interconnections in the visual system are not exceptions to the morphology of the brain in general, we are justified in thinking that such division and monitoring, "scanning" to invoke Lycan's term, happens throughout the brain.

Second, Rosenthal is committed to both naturalism and a respect for evolutionary considerations. That much is agreeable with Lycan's position. Rosenthal, however, thinks that the higher-order representations are not best thought of as perceiving (or, better, scanning) some part or parts of the brain. Instead, he thinks the higher-order representations are thoughts. Rosenthal does not hold consciousness to be an intrinsic property, but a relational one. Consciousness is not a higher-order thought *causing* a lower-order mental state to be conscious, but the consciousness apparently emerges as *the relation between* a higher-order thought and a lower-order thought. One will feel only as comfortable with Rosenthal as one feels with emergent types of properties. But what is worse than the mere presence of some emergent property is that this emergent property must have influence. After all, Rosenthal holds that one conscious state can influence another. But not causally. So one is left wondering: But how?

Finally, one who is committed to *fully* naturalizing consciousness should be reticent to use the linguistic, yet ghostly baggage of talk about "thought." It makes perfect sense to say, "I shall meet you at sunrise," for we know that the sun does not actually move about, and we can translate 'sunrise' into a precise set of statements which explain the (apparent) phenomenon. So far, it has been quite another matter when speaking about issues of mind, as when terms such as "mental," "thought," and "consciousness" are kicked around. I am just enough of a reductionist to want to minimize such language, and Lycan's system is more amenable to this bias. Yet unlike the eliminative materialist, I do not think we need to throw out the traditional vocabulary of mind any more than we need to throw out, say, the traditional vocabulary of astronomy. The sun *rises*; the sun *sets*. Planets *circle* the sun. We look *up* to see stars. The case is similar with consciousness, as Crick and Koch (1997) write:

> No neural theory of consciousness will explain everything about consciousness, at least not initially. We will first attempt to construct a rough scaffold, explaining some of the dominant features, and hope that such an attempt will lead to more inclusive and refined models. (278)

Along with fitting so well with module theory, Lycan gives one a way to address consciousness with a minimum of metaphysical scaffoling. So then–although I continue to draw from Rosenthal where useful, it is hoped this taking sides now will set limits on just how far Rosenthal's notion of "thought" can be pressed into the service of resolving the consciousness of the right hemisphere.

3.3.6 Introspection

Introspection would be the highest form of consciousness within Higher-Order Theories, for it is consciousness recognizing its own processes. Since I want to claim that the right hemisphere is a person, I have interests in establishing what it would mean to say that the right hemisphere can exercise its consciousness introspectively.

3.3.6.1 Rosenthal: Introspection and Higher-Order Consciousness

Rosenthal notes that introspection involves more than a mental state being a conscious state. Introspection in his view is a kind of higher-order consciousness. It has a transitive component that one is conscious of--in this case conscious of one's mental states. Introspection is a bit more focused than consciousness. Introspecting a mental state is deliberately and attentively focusing on that state whereas conscious acts need not be so. Consciousness requires no special act of attention. As he writes, "Every introspective state is therefore a conscious state, but not conversely" (1997, 745).

Introspection, then, is a type of higher-order thought or thinking. "A mental state is non-introspectively conscious when accompanied by a relevant higher-order thought; introspection occurs when there is a third-order thought that makes the second-order thought conscious" (Rosenthal 1997, 745). This is an accurate enough statement so long as we acknowledge that thought is still reckoned as a successful operation of an internal scannner or monitor that outputs second-order representations of first-order psychological states.

3.3.6.2 Churchland: Introspection and First-Person Accounts

Churchland (1997) identifies another important factor of introspection--its inherent first-person view. He notes that what makes an account a first-person account does not depend on the content of an account. Instead, a person who gives a first-person account has learned to use content as the vehicle of spontaneous conceptualization in introspection and self-description. He writes, "Only familiarity of idiom and spontaneity of conceptual response are required to make it a 'first person account'" (576). We might even become familiar with the operations of the internal scanning process and thus be able to discuss first-person accounts in a whole different way. Churchland gives us a picture of how this might occur:

> We all of us, as children, learned to use the framework of current folk psychology in this role. But it is entirely possible for a person or culture to learn and use some other framework in that role, the framework of cognitive neuroscience, perhaps.

> Given a deep and practiced familiarity with the developing idioms of cognitive neurobiology, we might learn to discriminate by introspection the coding vectors in our internal axonal pathways, the activation patterns across salient neural populations, and myriad other things besides. Should that ever happen, it would then be obvious to everyone who had made the conceptual shift that a completed cognitive neuroscience would constitute not a pinched and exclusionary picture of human consciousness, one blind to the subjective dimension of self [...] Rather, it would be the vehicle of a grand reconstruction and expansion of our subjective consciousness. (576)

Whether it all comes to a "grand reconstruction" or not, at the very least it looks like one could in principle make sense of introspective talk using a different vocabulary than what has traditionally been the case.

3.3.7 Two Challenges to Consciousness as One Thing

I have been discussing the essential features of consciousness, trying to establish consciousness as some one thing--or at least to establish that there is some one aspect of consciousness to which I am referring. If there really is no singular thing, no Cartesian theater of mind as Dennett would say, then perhaps it is a multiplicity of processes. Is any talk of consciousness as one thing a reification, an abstraction singularized from a multitude of abstractions about various functions?

Or from another angle, if consciousness is really not one thing, then perhaps it is a mistake, as Wittgenstein would say, "to speak of 'turning my attention on to my own consciousness' . . . . This is surely the queerest thing there could be!" (Wittgenstein 1958, Sec. 412, 124e). Is it possible that beings could be all that we are physically, and yet there be no phenomenological tinges of consciousness within such "zombies"?

In sum, consciousness might be a plurality, or consciousness might not be at all. That consciousness is and is one thing must be defended against both these contenders.

3.3.7.1 Challenges from Dennett: It's More Than One Thing

Although Dennett's position ultimately creates problems for understanding consciousness as one thing, his position on how the brain operates as a conscious mind is consistent with the general, Lycan-friendly position that has been developed up to now. Whatever other concepts we subsume into consciousness, it is also and perhaps most importantly an 'intentional system': "We take an the intentional stance towards a system - a person, a bat, a computer - when we attribute rationality to the system and predict what the system will do given the beliefs and desires ascribed " (Flanagan 1995, 186-187).

Dennett (1995) argues that "the way to explain the miraculous seeming powers of an intelligent intentional system is to decompose it into a hierarchically structured team of ever more stupid intentional systems, ultimately discharging all intelligence debts in a fabric of stupid mechanisms." And Dennett himself accepts Lycan's labeling him as a homuncular functionalist (240).

Dennett (1995) believes that consciousness is tied to one of two senses he distinguishes for dubbing a creature "aware." One sense of 'awareness' is cashed out in terms of the creature's behaviors while the other sense of 'awareness' is cashed out in terms of a creature's linguistic reports. The prior can apply merely to "honey bees and thermostats alike" (238) while, in addition, the latter can apply to beings like us, who "are speaking creatures (we have a sort of print-out faculty), and--at least to a first approximation--that of which we are conscious is that of which we can tell, introspectively or retrospectively" (Dennett 1978, 152).[24]

Prima facie, it looks as if only creatures that can speak would count as those that are aware in the important sense for consciousness, but it seems pretty straightforward that users of sign-language, indeed users of any communicative vehicle that could move propositional information back and forth, would count as a "speaking creatures" in Dennett's view.

Dennett argues vehemently against *Cartesian materialism*--that there is a central, physical place where phenomenal consciousness or a theater of the mind all comes together (Dennett and Kinsbourne 1997, 141). The worry here is that the same old philosophical mistake is being made, even if the stuff of mind has been negotiated. Take Descartes' pineal gland and add more neurons, move it to the left side of the head, and, surprise, once again we are playing the same philosophical game that Descartes played around 1641. In Cartesian materialism, one *has* discarded the Cartesian dualism where some singular part of the brain mitigates the interaction of two different substances, but one has *not* discarded the associated imagery of a central material place where it all comes together, a central locus in the brain (143).

Note, however, that Cartesian materialism is not quite the same as saying there is a functional place in the mind where all conscious events occur as a system; this latter view would be what Block titles *Cartesian modularism* (1997a, 178). Such a modularism fits

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[24] Originally he labeled these distinctions "computational-" and "public-" access, but he admits to redrawing these distinctions in different ways later in his career to account for various objections and suspicions on the part of his readers.

nicely with my Lycan-friendly position and provides good support for the position that the right hemisphere is conscious.

One might take a stance that it really is a confusion to think of split-brain patients has having a split consciousness, at least on Dennett's "Multiple Drafts" view of the stream of consciousness. Really, all one has done is further separate the several, already separate discriminatory and representational cerebral mechanisms concurrently operating in the human brain. There is no Cartesian theater of the mind where all of these discrimination mechanisms present their results. Discriminations are made only once (Dennett 1997, 84). The distributive content discriminations yield what we can take as a narrative stream of consciousness, but it would be a mistake to suppose, argues Dennett, that there is a final single narrative, a special draft among the many drafts of discrimination that is the true consciousness.

I begin by claiming that no one can legitimately deny that the brain is a massively paralleled network device. There are indeed many simultaneous operations occurring among a terrifying complexity of neurons and other cellular-like structures. But how are we to interpret the continuity of memory? I do have many memories, and they give me a "vector" of presentation; there is a sequence where it is recognized that some memories are chronologically prior to other memories. These memories are not isolated, but they are a unified collection.

The fact that there is a vectored collection of memories--somewhat discrete, somewhat interrelated--perhaps just is what we mean by a *Self*, or at the very least this is a necessary component of a self. (I directly address such issues in part three, Coherence of

Identity.) Dennett seems to be playing off the classic "Problem of the One and The Many," when he says:

> Look, there is all these different types of memories, tactile, sensual, memories of our imagination, event, memories of our kinetic movements, etc., but it is just plain wrong-headed to presuppose that there must be some single representational state in the brain (smaller than the whole brain) where the results of all the various discriminations are put into registration with each other. (1997a, 85)

A lot rides here on what we read into "state." In as much as the brain has a module that both encodes memories and encodes a vector for those memories--this would be akin to a type of linked list--perhaps this is just what we should claim: that there *is* a place (though apparently not the same place) where various discriminations register with one another. If so, one can abstract out the constituents of the Self, which is of interest to both cognitive science and philosophy.

One suspicion here, when I speak of abstracting out the constituents of the Self, is that I do not seem to be differentiating myself from Dennett's position, for he would reply that what I call 'the Self' is actually an abstractum[25] which has been developed merely by my taking an intentional stance toward some complex system (i.e, the brain). In this case, the Self cannot be located at a concrete physical location, e.g., in the right hemisphere. Still, Dennett (1987) holds that we "really do" have desires and beliefs just the way we "really have" a center of gravity and the Earth has an Equator (53).

I am not so sure what this position comes to. It seems very natural to say that my beliefs, desires, intentions, etc. which I find within my Self *cause* me to act the way I do;

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[25] Other examples of abstracta are perfect circles, straight lines, centers of gravity or other useful constructs involved in the explanation of a specific natural phenomenon

yet, to say the Earth's equator *causes* something is a confusion. Clark (2001), recounting Rudder-Baker (1994), makes a similar complaint against Dennett:

> If beliefs are to have such causal efficacy they cannot be "merely stance-dependent," but must instead be real features of the world, irrespective of anyone's possible predictive strategies. One way out would be to treat causal efficacy as itself a stance-dependent feature. But there is no sign that this is Dennett's wish and his avowed realism about ordinary physical phenomena seem to point the other way. Rudder-Bakker thus accuses Dennett of widespread inconsistencies in his use of the idea of beliefs, etc. as stance-dependent features. (Clark 2001, 58)

More generally, it is very unclear what Dennett means by calling the mental class of abstracta "real." However, in Part Three of this project, I shall put forth what I call Individuation Theory. It will also state that the mind (and its associated properties like beliefs, desires, etc) is real, but it avoids the problems that plague Dennett's account.

The Self is that something that is easily lost in analysis when the vectored component of memories is ignored. Consciousness moves into personal identity when careful investigations of this vectored component are made. Common sense seems to indicate that our experiences of events occur in the very same order that we experience them occurring. For example, if I see a bird, a bee, and a tree, my seeing of the bird occurred before my seeing of the bee and the tree. But Dennett is not arguing with this *macro*scopic duration of our attention to psychological phenomena, but with the *micro*scopic duration.

When events are constricted to narrow time frames of a few hundred milliseconds, our presumption of this clean vectored order of subjective experience breaks down. Dennett would point out that even on the macro-level there is constant editorial revision at the duration between an event and a subjective remembrance of when that event occurs.

We tend to re-manufacture internally coherent, simplified renderings of what are taken to be the most important elements (Dennett and Kinsbourne 1997, 169). However, at the micro-event level, different attributes of our experienced events are extracted by different neuro-facilities at different rates. Further, we respond differently about our content of experience, depending upon the relative timing of the inputs to our experience and the latency between that input and our reporting of the experience.

Here is Dennett in a slogan: depending on *when* you ask delineates *what* you get. One might get any number of narratives, none of which is *the* stream of consciousness. Dennett writes, "Most important, the multiple drafts model avoids the tempting mistake of supposing that there must be a single narrative (the final or published draft) that is canonical--that represents the *actual* stream of consciousness of the subject whether or not the experimenter (or even a subject) can gain access to it" (Dennett and Kinsborne 1997, 144).

I must disagree here with Dennett and Kinsbourne. They are correct that looking for an actual thing, a final stream of consciousness, is not helpful. But the stream of consciousness must be taken as what a mind is disposed to report about its introspective states at any given time. Now people most likely cannot report everything they were thinking at some moment, for some things will slip away just by merit of their turning their attention to the act of reporting.[26] If we mean anything more than the disposition to report, then we run into the various problems of finding some magical theater, and

[26] I think this would stand as yet one more limit (in a pile of many) on what can be learned by introspective methods of psychological investigation.

Dennett has pointed out this is not helpful and, indeed, confusing. At any given time, the mind has an introspective unity, and this may or may not correlate with recurring information patterns moving around the brain during perception and experience. I need take no stand on this here. Although one may have access to that unity partially, and even inaccurately, as Dennett often loves to show, we regularly privilege what people report about themselves, which is why the stream of consciousness is best conceived as a person's disposition to account for his or her own unity of thinking over time.

Flanagan (1997c) admits that consciousness is not a sensitive detector of the "gappy" features of brain consciousness, but he does not see this as a threat to the objective stream-like character of consciousness. Flanagan notes that the evolutionary design of consciousness has not been adequately developed in neuroscience, and he reconsiders whether Dennett's discussions of cascading saccadic eye movements are some sort of threat to there being a stream of consciousness. "In the blind spots in our visual field," Flanagan writes,

> consciousness does not pick up all the information in the world. There are the visual blind spots, and there is much that we simply fail to consciously notice. But who would have thought otherwise? [. . .] The fact that there are things in the world we miss at each and every moment has no direct consequences for the stream-like quality of consciousness. We must be careful, as James says, not to infer gaps in the conscious stream from gaps in what we know about things in the world. (90)

Ideally, the collection of all propositions that the mind would acknowledge as true, the grand concatenation of all of these, just would be The Narrative, The Stream of Consciousness, or, as Dennett would hate to hear it, the True Version of conscious experience. We never get this completely, but it is always there in one dynamic form or another.

Up to now I have been discussing various essential features of consciousness, and trying to establish consciousness as some *one* thing against Dennett's Multiple Draft charges. I have found his complaints unconvincing. I now move to discuss whether consciousness might not be anything at all.

3.3.7.2 Challenges from "Zombies": It's Less Than One Thing

Dennett and Kinsbourne (1997) argue that an event is spread over the brain in space and, therefore, in time and that the various drafts of the event should not be labeled some as consciousness, some as not; for, this would be arbitrary. While I have given reasons to reject this, Ned Block (1997a) asks a slightly different, though nagging question. Worrying about the special, qualitative phenomenal feel of consciousness, he writes, "What if some of the brain representations of an event making up this spatio-temporal volume are phenomenally conscious whereas others are not?" (175)

Block goes on to note that it is *non*-arbitrary to label some events in the brain as conscious if there is something distinct about those brain events at the neuro-level that marks a difference between brain representations that are phenomenally conscious and those that are not. Block accuses Dennett and Kinsbourne as supposing that phenomenal consciousness just doesn't exist but complains they never give an argument to that effect. Block also points out that the spectrum of consciousness for these modules may not be purely phenomenal conscious or not, as there may be no definite answer as to when the module is actually phenomenally conscious or not (1997a, 175, 176).

Block's worries about phenomenal consciousness prompt consideration of a very controversial aspect of consciousness in general, one that often goes under the name *qualia*. By this is meant the distinctive feel of our experiences, the "what-it's-like" aspect.

In order to address this concern over phenomenal consciousness in the right hemisphere, I will first give a short, general survey about qualia. I will second, consider whether there might be (in principle) entities that are in every other way conscious like us, yet without phenomenal consciousness (qualia). My particular concern is that the right hemisphere has been suggested as possibly being an automaton by Nagel (1991)[27], and as such might be an instantiation of what philosophers of mind call a "Zombie." The more general worry is that while I have been advocating consciousness as a special type of higher-order thought, and have done this by cozying up to Lycan's internal scanner version, there is another side of the issue to be addressed: "what it's like" to be a mind in a certain state. If I hold that conscious mental states have a phenomenal feel to them, and that the right hemisphere has conscious mental states, then I must show that it's a least possible to account for qualia of a right hemisphere. If zombies have no conscious mental states, and it turns out that the right hemisphere is a zombie, then my overall position is

[27] This is not Nagle's own position, but only a worry on his part, for in complaining that the right hemisphere's activities are too elaborate to be regarded merely as a collection of unconscious automatic responses, he assumes without argument that the right hemisphere is "too intentionally directed and too psychologically intelligible" (Nagel 1991, 435). I am addressing the worry without making such a convenient assumption.

threatened. I now move to meet these concerns.

3.3.7.2.1 Consciousness and qualia

Operationalism's limits. An ineffective way to treat qualia is as operationalized behaviors. One simply lawfully correlates internal physical activities with verbal accounts of the subject, and then eliminates any alleged middle-entities, or "feels", as fictional. Bisiach (1997) finds this limiting, and tries to set the matter in a different light:

> Although I would hardly describe myself as having inside experience of the particles that constitute the complex physical system I am, I strongly oppose defining as "fictional" or "eliminable" the inside experience inherent in some states and processes of that system. This does not imply regarding that experience as a mysterious nonphysical accompaniment of those states and processes. That experience is *my* "point of view." That is the way it is. The bat, I presume has its own. Why on earth should they be "eliminated?" (237)

There is something it is like to have a point of view. Humans, and presumably other creatures with enough complexity (hence the reference to the bat), have certain inherent components to some of their conscious states. Bisiach describes his position in a first-person view, "*my* 'point of view.'" He is hardly a psychological introspectionist, but he believes it methodologically fruitful to grant a phenomenal experience to the other, for this presents "the only possibility we are given to learn *indirectly* about consciousness when we study the more empirical and scientific aspects oriented of brain lesions" (238).

There is good reason to appreciate Bisiach's distaste with a pure operationalism. Clinical and experimental data, collected from patients suffering from spatial and unilateral neglect and related orders, strongly suggest that conscious experience rests on mechanisms distributed over brain circuits, even if this mechanism of distribution is very poorly understood (Bisiach 1997, 250). Pure operational definitions--how the subject reports, or acts, in a given context, or some favored sum of such empirical measuring--give us "conflicting conclusions" when we refer to different operational definitions or when the corpus of empirical data varies (251). One result of this is that a general skeptical view of consciousness can arise.

Brains with qualia posit qualia to other brains. What is it, to take up Bisiach method, that I claim to be real of myself on the basis of my own first-person information? I, Brint, claim with certainty that I have qualia, and I want to attribute these to other human beings. Why do I do this? A little adjustment of Block (1978) is helpful here: "Since *I* know that *I am a brain-headed system,* and that *I* have qualia, *I* know that brain-headed systems can have qualia. So even though *I* have no theory of qualia that explains how this is *possible*, *I* have overwhelming reason to disregard whatever *prima facie* doubt there is about the qualia of brain-headed systems" (281).[28]

Nagel and Transcendentalism: Qualia can't be captured by physical facts. Nagel's pivotal article "What Is It Like to Be a Bat?" has offered much grist for lovers of qualia. Too much on White's (1997) view, who identifies Nagel as holding a transcendental theory of mind. Generally speaking, for a transcendentalist the feeling of "what it is like to be in pain" (or some other conscious state) is not captured by physical or functional descriptions. Being in pain is exclusively a first-person fact and cannot be reduced to third-person facts, no matter how intricate or rigorous the details of neuro-physiology are. As White claims, "For the transcendentalist, mention of the subject's

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[28] Quoted in Güzeldere 1997b, 40-41; each "we" changed to "I"

physical states brings us no closer to what the subject feels than does mention of the subject's functional states" (697).

I end up taking a position counter to Nagel's transcendentalism, for I claim that there is *at least in principle* some collection of third-person descriptions presumably mapping facts in the physical world that could give us an explanation of the qualitative character of experience.

Distinctions a la Ned Block. Earlier, I reviewed one of Pinker's senses of consciousness, namely in terms of consciousness having access to information. The "access-" / "phenomenal-" consciousness distinction is an important one. I also have already noted that Ned Block likewise (and much earlier than Pinker) draws a distinction between access consciousness and phenomenal consciousness (or "qualia"). In addition, Block also draws a related distinction when he lays out two different conceptions of the mind, the "computational" and the "biological."

The first conception, the computational, holds that all activities of the mind, including consciousness can be captured with notions of information processing, computation, and function in the system (Flanagan1997a, 360). Block points out that this often goes under the guise of functionalism, that the mind is just a local abstraction that allows for multiple realizations. According to the functionalist, there might be multiple realizations of how our mind gets implemented, just as there can be multiple realizations of how a computer is implemented.

The second conception, the biological, does not see multiple realization as a neutral matter for phenomenal consciousness or consciousness in general. If phenomenal consciousness and access consciousness are identical, but we have just not had the science to see it, then this would make the functionalist correct. But the biological advocates worry that the realization stuff does matter, and there could be, indeed probably would be, in this view, divergence between phenomenal consciousness and access consciousness.

Functionalist responses. The functionalist is going to claim that if one has the highest quality of access consciousness, then he or she would indeed have phenomenal consciousness. Thus, there is some argument that there could not be, for example, a blind sight person who had the highest quality access to information in his access consciousness and lacked phenomenal consciousness (Block 1997c, 386). Block worries that the possibility of there being one type of "Zombie" or another could get around this functionalist view. I now move to consider zombies.

3.3.7.2.2 Zombies

Among the several problems of consciousness is a specific one concerning the qualitative character of our experiences: How can there be something it is like to be a mere physical system? The problem also applies to the split-brain patient when we ask, "Is there something it is like to be a split-brain consciousness?" Why should one think a Sperry-isolated right hemisphere is conscious in the phenomenal sense? Would it make sense to call the Sperry-isolated, right hemisphere a zombie?

A 'zombie' is a class of "creatures which have information processing that is the same as ours but which have no phenomenal consciousness" (Block 1997c, 379). Zombies can also be parceled out based upon their "being mentally dead in one respect or another." These "different respects give rise to different zombies" (387).

When Thomas Nagel suggests that the right hemisphere might be an automaton (Nagel 1991, 435), he is apparently concerned that it functions as an information-processing device that, unless otherwise tied into the whole brain system, exists without phenomenal consciousness, which is tantamount to it being a zombie. There are two responses one could give here.

The first is that such a view is armchair cognitive science at its worst. Block's wave-off gives a nice summary of this:

> We know so little about the scientific nature of phenomenal consciousness and its function that we cannot judge whether the same function could be performed by an ersatz[29] phenomenal consciousness module--that is, whether an ersatz phenomenal consciousness module could inject its representations with ersatz conscious content that would affect information processing the same way as real conscious content. There is much of interest to be said about this idea and its relation to other ideas that have been mentioned in the literature, but I have other fish to fry, so I leave the matter for another time. (379)

More generally, since we know so little in cognitive science about how phenomenal consciousness might be explained, we should not too readily decide what is unexplainable.

The second response is that our deep ignorance of the scientific nature of qualia seduces us into thinking that we are conceiving something possible – in this case, zombies -- that is in fact not possible were all the data available.

I should now like to take a moment to discuss how a particular type of explanation operates in science and to show just how that type of explanation allows for zombie thought experiments to make trouble.

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[29] Meaning "substitute" or "synthetic." The word usually suggests inferior quality.

Generally, when we give explanations in science, we are reducing one set of phenomena to another. A standard example is reducing that otherwise clear, cold flowing substance called "water" to H_2O. So perhaps we can likewise reduce qualia to some brain state--for example, pain to c-fiber firings (or, more generally, qualia X = functional state F). In that case, we are seduced into thinking that the following two statements come under the same type of theoretic reduction:

1. Water = H_20

2. Pain = C-fiber firings

Of course this is not the case. Levine (1997) details how the theoretic explanations of 1 and 2 differ:

> If we consider the apparent contingency that attaches to (2), we notice that it works in both directions: it is equally conceivable that there should exist a pain without the firing of C-fibers, and the firing of C-fibers without pain. However, the apparent contingency of (1) only works in one direction. While it is conceivable that something other than H_2O should manifest the superficial macro properties of water, as Kripke suggests, it is not conceivable, I contend, that H_2O should fail to manifest these properties (assuming, of course, that we keep the rest of chemistry constant). This difference between the two cases reflects an important epistemological difference between the purported reductions of water to H_2O and pain to the firing of C-fibers: namely, that the chemical theory of water explains what needs to be explained, whereas a physicalist theory of qualia still "leaves something out." It is because the qualitative character itself is left unexplained by the physicalist or functionalist theory that it remains conceivable that a creature should occupy the relevant physical or functional state and yet not experience qualitative character. (548)

Zombies are just an instance in which we have conceived of something without the relevant quality of experience and yet with the relevant functional states.

We can grant that H_20 (and its interactions with other molecules) can explain the superficial macroproperties of water. The way we can tell this explanation has been accomplished is to see whether what we know about the macro-properties of water (its clearness, temperature, viscosity, for example) are (epistemologically) necessitated by what we know about the chemical structure of H_20, "that is, whether we can see why, given the facts cited in the reduction, things must be the way they seem on the surface" (549). The chemical theory, of which H_20 and its interactions are a part, accomplishes this, but functional theories *seemingly* do not. Absent and inverted qualia arguments also use this disanalogy as leverage against physical or functional accounts (549).

Qualia, however, has not been as conveniently explained by a functional state. Perhaps qualia *could* be explained by a functional state. In that case, we *would* find it as inconceivable that functional state F does not explain a capacity for some qualia capacity as we *do* find it inconceivable that H20 does not explain the macroproperties of water. Levine details what it would be like to have such a theory:

> No matter how rich the information processing or the neurophysiological story gets, it still seems quite coherent to imagine that all that should be going on without there being anything it's like to undergo the states in question. Yet, if the physical or functional story really explained the qualitative character, it would not be so clearly imaginable that the qualia should be missing. For we would say to ourselves something like the following: Suppose creature X satisfied functional (or physical) description F. I understand--from my functional (or physical) theory of consciousness--what it is about instantiating F that is responsible for its being a conscious experience. So how could X occupy a state with those very features and yet not be having a conscious experience? [. . .] The element of necessity is there[,] for it is clear that if citing the relevant underlying mechanisms really does explain how the psychological capacity in question is instantiated, then it would be inconceivable that some creature should possess these mechanisms and yet lack the capacity. If not, if we could conceive of a situation in which a creature possessed the relevant underlying mechanisms and yet didn't possess the capacity in question, then I would claim that we haven't adequately explained the presence of the capacity by reference to those mechanisms. For we are still left wondering what distinguishes the actual situation, in which the creature possesses the capacity, from those situations in which it (he or she) does not. (549-50)

Again, we do not have a functional theory of mind. Does this mean that Zombies can never be precluded?

One could insist that no amount of neurophysiological information can produce an explanation for qualia, sticking to one's guns that the conception of zombies *by definition* precludes their being brought under third-person accounts. As a point of logic, therefore, they cannot be precluded unless some internal contradictions were shown among the concepts making up a zombie (e.g., "information," "physical," "consciousness", etc.). I shall not take this route, so although there might not be any zombies in the actual world, they appear to remain ever-present conceptual threats to a complete physical or functional view of mind. However, such a conceptual threat can be minimized.

Consider just what one is conceiving about zombies. Zombies would not be scientifically detectable, nor explainable by properties of the physical world. Nor would they be logically necessary for scientific explanation, and they could not serve as empirical counterexamples to any experiments. Moreover, unlike the conceivability of "frictionless surfaces" or "idealized orbits", zombies do not advance empirical inquiry by simplifying models. Furthermore, it is important to note that what is (allegedly) conceivable need prove nothing about real situations, for what we can or cannot intuitively imagine does not preclude (or include) what might happen. Conceiving of X does not necessitate that X is possible.

A classic example of this was evident in Cantor and Russell's views on set theory. Van Cleve (1998) summarizes:

> Dare we assume that intuition is infallible? Standing in the way of this assumption is the apparent fact that what one person sees to be true or possible another may later show to be false or impossible. [....] Cantor supposedly saw that the fundamental axiom of his theory of sets – that for any predicate P there is a set whose members are just those things that satisfy P – was not only possible but true. But Russell later showed that this principle leads to contradiction. Since Russell's proof was itself based on intuition, we may say that the fundamental obstacle to assuming that all intuitions are true is that intuitions sometimes conflict (242).

One is justified in conceiving something only if there are no outstanding defeaters for that conception. And by 'defeater' is meant "a reason for thinking a proposition false despite one's intuition of its truth" (243). Cantor would have an outstanding defeater once Russell's proof was available; thus, Cantor's conception about the fundamental axiom of set theory would be no longer justified were he to see Russell's proof.(243)

Drawing on van Cleve's example, the application for someone's conceiving that zombies are possible is straightforward. The advancement of cognitive science in explaining more and more functions of thought is a cumulative-case defeater for the position that physical or functional theories cannot explain consciousness. This is tantamount saying that the case for zombies grows weaker (for human conscious mental states, at least, which is all the right-hemisphere investigator need worry about) with each physical-to-conscious-mental-state correlation. As a practical matter the physical and behavioral aspects of other organisms are precisely the sorts of evidence that we use every day when we attribute consciousness to others. Since the conceivability of zombies is inconclusive for showing physical or functional explanations of consciousness to be impossible, I will maintain that otherwise acceptable empirical criterion for detecting the presence of consciousness in the right hemisphere are allowable.

3.4 Applying the Essentials: The Right Hemisphere

3.4.1 Introduction

In this section I am concerned with specifically addressing the subject of the consciousness of the right hemisphere by applying many of the essentials of consciousness that were identified in the previous section.

According to Corballis (1993), Eccles argues "that the right hemisphere in contrast with the left is a mere 'computer' comparable to the brains of lower animals. However, Zangwell is scornful of this claim describing this view as 'little more than a desperate rearguard action to save the existence and indivisibility of the soul'" (212).

Not taking such a computer-versus-soul dichotomy, I have instead argued that there is a range along the full spectrum of functionality for the brain. Consciousness can come in degrees. The detection of consciousness in the right hemisphere will certainly be no easier than the detection of this in an otherwise normal patient. Anesthesiologists, even with the help of EEG or median frequency machines, have been unable to identify a clear boundary between consciousness and unconsciousness. Consciousness is clearly more than the sum of behaviors normally attributed to a person who is said to be conscious. As an example of this, there have been focused accounts of patients under general anesthesia revealing that many times the patient appeared to be totally unconscious but was terrifyingly aware of the full surgical procedure being performed! (Güzeldere 1997b, 46).

At the very weakest, one must keep an open mind that the right hemisphere could be, analogically speaking, "along for the ride" with no way to influence events and no way to indicate its particular intentions about matters at hand. Yet we need not worry about the weak case, as there is much more evidence for consciousness of the right hemisphere than this.

3.4.2 Comparison to Armstrong's Truck Driver Degree of Consciousness

Degrees of consciousness have often been debated from a common example, first put forth by Armstrong:

> My own favorite is the case of the long-distance truck driver. It has the advantage that many people have experienced the phenomenon. After driving for long periods at night, it is possible to "come to" and realize that for some time past one has been driving without being aware of what one has been doing. The coming-to is an alarming experience. It is natural to describe what went on before one came to by saying that during that time one lacked consciousness. Yet it seems clear that, in the two senses of the word ["minimal" and "perceptual"] consciousness is present. There was mental activity, and as part of that mental activity, there was perception. That is to say, there was minimal consciousness and perceptual consciousness. If there is an inclination to doubt this, then consider the extraordinary sophistication of the activities successfully undertaken during the period of "unconsciousness." (1997, 723)

In Armstrong's case of the long-distance trucker, we have a mind that recognizes various things over the course of semi-conscious driving and that performs extraordinarily sophisticated activities: keeping the car on the road, steadying the accelerator, perhaps using the brake or clutch.

> Were not these acts purposeful? Above all, how is it possible to drive a car for kilometers along a road if one cannot perceive that road? One must be able to see where one is going, in order to adjust appropriately. It would have to be admitted, at the very least, that in such a case, eyes and brain have to be stimulated in just the same way as they are in ordinary cases of perception. (723).

Armstong's truck driver case is probably the most informative (otherwise normal) example of how a right hemisphere need maintain its own degraded ability to recognize objects in the experimental context.

In its awareness of objects in its visual space, the right hemisphere does recognize events that happen, and, similar to the truck driver case, these events are not always straightforwardly apparent to memory. Does the right hemisphere live solely in the present?

It turns out the evidence is against this position, since the right hemisphere can, after the fact, draw pictures of things it has selected (like a pipe), and since it can point to what was earlier grabbed under the experimental apparatus table. One cannot argue, therefore, that the right hemisphere was *either* unconscious as *or* only as conscious as the long-distance truck driver. The right hemisphere can identify more of its immediate past than either of these; the right hemisphere is, therefore, conscious to a more significant degree. In fact Armstrong notes that the truck driver lacks introspective consciousness, but, as I show, the right hemisphere does not have this lack.

I have considered modularism from both the perspectives of cognition and consciousness. I now move to consider what talk of modules within isolated hemispheres would come to in terms of consciousness.

3.4.3 Cartesian Modularism: Trivial And Left Prejudiced Versions

Short of being a Berkeley disciple, anyone familiar with the brain could agree upon a trivial version of Cartesian modularism, since I hold that the brain is the module of our body that maintains our consciousness. In this case Descartes' speculation about the pineal gland has been extended to the whole brain; it is the same idea, but the scale is different. Instead of a small collection of neurons that control the interaction between the brain and consciousness, we just invoke the whole system that does so. Of course, that is what makes this version of Cartesian modularism trivial; it does not account for some of the parts of the brain having nothing to do with consciousness, such as areas in the lower brain that merely monitor metabolic and respiratory system.

The most convenient place to draw a line for some special module (or set thereof) is at the left hemisphere. It has many of the analytic abilities we find so valuable for certain favored modes of reasoning. And it talks! Perhaps a political metaphor is called for: whoever controls the media controls the society--in this case the society of modules that count for being a self.

But such convenience is illusory. This is too rough a way of putting things. Even if the left hemisphere is sufficient for consciousness, it is not necessary. I have noted that some isolated right hemispheres can also talk, both of the Sperry-isolated variety and those left in place after a hemispherectomy. Van Gulick's caution is right: "Conscious states differ from unconscious ones in the processes that are involved, not in where they occur" (1997a, 181). Too many investigators have been taken in by the public relations of the left hemisphere during Sperry-type experiments, thinking that its relative dominance in communication makes it the locus of consciousness.

3.4.4 Hypnotic Analgesia and Right Hemisphere Patients

Block (1997c) notes that Rey (1983, 1988) and White (1987) have argued that some of our own subsystems, such as the two hemispheres of the brain, might themselves be separately phenomenally conscious. This would correlate with experimental data on patients who undergo hypnotic analgesia, the results of which can be compared favorably to the right hemisphere's consciousness.

Hypnotic analgesia is a procedure under which a patient's access to pain is blocked by hypnosis. Typically, the patient has his arm stuck in a swirling pool of cold water and is often asked to give a ranking of the pain. Naturally, after some time has passed, normal patients will increase their pain indications while the patients under hypnosis will not. A question arises: Are the persons conscious of the pain in the sense of phenomenal consciousness, but not conscious of the pain in the sense of access consciousness? That is, do they perhaps have the phenomenal experience of pain but are unable to access this experience in reason and action?

These subjects do have the psycho-physiological indications that normally accompany pain, such as an increase in blood pressure and heart rate. The comparison to split-brain patients, however, comes up when hidden observer techniques are applied in which the hypnotist tries to make contact with a "part" of the person who apparently knows about the pain (Block 1997c, 406). As Block writes, "The hidden observer often describes the pain as excruciating and also describes the time course of the pain in a way that fits the stimulation" (406).

The hidden observer attests to what I have earlier identified as phenomenal properties, in this case specifically, pain. There are two ways to think about this. The *first* way is that there are essentially different persons (strong sense) or perhaps just different consciousnesses (weaker sense), both of which are sharing some part of the body. The *second* way to think of this is that there is just one system, namely the person, who has some sort of disassociation problem.

On the first view, there are independently functioning modules that are not dominating the control behavior, but which the patient can report on under these specific hypnotic circumstances. On the second view, there is a disassociation, but a question immediately arises about how one could have a disassociation without there being independent modules reporting in. Put differently, what would it mean to say that there is a so-called executive system that is only partially active?

The first view is straightforwardly amenable to Lycan's position of internal scanning, so no additional analysis need be offered. The second view demands taking a position on a partially active executive system.

Let me render such a position now. A *partially active* executive system is a set of independently functioning modules that are not functionally equivalent to the otherwise normal computational structure for consciousness (whatever that happens to be). This is apparently the case under hypnosis. However, outside of hypnosis, the modules are once again functionally reorganized; the input and output channels for respective modules gain full information access to one another. This allows the proper computational state to re-instantiate and thus for consciousness to obtain once again in the patient. This is hardly a novel phenomenon, as the difference between sleeping and waking states likewise changes the functional organization of internal brain monitoring as, for instance, when our memories of dreams are only fragmentary and often only stay with us for short time after waking. The first view is preferable over the second view for the simple reason that radical surgical modification to the corpus callosum is at least as effective in re-routing and otherwise functionally reorganizing the input and output channels for respective modules as any hypnotic analgesia procedure would be.

In the Sperry-isolated right hemisphere of split-brain cases, we see the two major modules of the brain disconnected because of a corpus callosum cut and because of the experimental conditions. Certainly this counts as a radical functional reorganization of inputs and outputs. Yet the case for the right hemisphere being conscious is far stronger than in hypnotic and analgesia, for the right hemisphere has access to and is therefore able to guide parts of the body. It also has a memory for what it has done in the recent past. Furthermore, The less possibility there is for re-integration of modular access to mutual information flow, the more likely it is (or will be) that there are different persons or consciousnesses. Hypnotic analgesia does allow such reintegration–i.e., when the patient fully awakens. However, the surgical modification to the corpus callosum precludes *mere* disassociation in split-brain patients, since that modification does not allow for complete module re-integration to occur, much less so to occur under Sperry-type experimental conditions. Thus, under such conditions, most likely there are different persons or consciousnesses, and not just disassociation.

3.4.5 Handed Competition Indicates an Aware Consciousness

In Goldman's (1997) account of the referential aspects of consciousness, we can see that the right hemisphere clearly is conscious because it is aware of the objects that it points to in reference to the experimenter's interrogations. It is aware of where to point, and it is aware of the object it uses to accomplish pointing--the left hand.

Earlier in discussing block-stacking experiments, it was seen that split-brain patients can have competition between the two hands when stacking blocks. Since the limb movements were not random, and since they were regularly manipulating objects to complete a task, attributing consciousness to the right hemisphere is warranted. The right hemisphere has beliefs about where the blocks are, and it desires to change their configuration to that which the experimenter requests. Such an action is correctly understood as an action of an independently minded entity--more generally, of a functioning consciousness.

3.4.6 Nagel and Puccetti: The Same Error on Duality

Functional reorganization is a pivotal issue in analysis of the right hemisphere's consciousness. Nagel (1991) and Puccetti (1973) make the same error in their analysis of the information exchange among the hemisphere connections of a normal brain.

Nagel (1991) thinks that *if* there really are two minds in split-brain patients, then we should have concluded "on anatomical grounds that everyone has two minds," but we just do not notice it "except in these odd cases because most pairs of minds in a single body run in perfect parallel due to the direct communication between the hemispheres which provide their anatomical base" (438). Nagel does not think we have two parallel minds.

Puccetti, on the other hand, thinks that normal people *are indeed* composed of two distinct conscious entities and that the right hemisphere is aware of this from very early in life because of hearing speech emanating from a common body, speech that it has not generated.

In their particular views on duality of mind both writers erroneously assume that the neuro-net would be (Nagel) or already is (Puccetti) operating as functionally distinct, if respectively, the two hemispheres were found to be or are found to be independently conscious. Nagel thinks positing the right hemisphere as conscious would lead us to posit that we always were operating with functionally distinct minds. Puccetti thinks, as a matter of fact, that we always have been operating with functionally distinct minds and should, therefore, posit that each hemisphere (hence the right hemisphere) is conscious.

Both views fail because they have not recognized that the right hemisphere's independent consciousness is created by the experimental conditions. The functional separation is what *causes* an independent consciousness to come about in the right hemisphere. Braude (1991), in an aside from analyzing what researchers could hope to learn from MPD patients, has a similar view. He notes that the surgical procedure which leads to split-brain phenomena "is the clear analog to the trauma which leads to the development of alternate personalities" (142). Just as the alternate personality is formed by a contingent set of circumstances, so too is the second-mind of the split-brain patient formed by the circumstances of a Sperry-type experiment. I shall further address Braude below as I make a specific objection to Puccetti. I will then move to counter Nagel.

1. Contra Puccetti, the anatomical distribution of tasks is not a proper basis for claiming that humans always maintain a duality of mind, as when Puccetti claims, "even in the normal, cerebrally intact human being there must be two persons, though before the era of commissurotomy experiments we had no way of knowing this" (Puccetti,

351) On this view, humans have two independent, conscious hemispheres operating within their skull. There are two responses immediately available.

First, as Braude (1991) argues, appeals to split-brain experiments in arguments for the claim that the predissociative patient has two minds rests on a dubious assumption, what he calls the principle of "Compositional Reversibility" (CR). Although there are several version of CR, the most noncommittal rendering is that "predissociative functional divisions of the self are necessary for the occurrence of postdissociative functional divisions" (139). These divisions may be either (alleged) personality characteristics of the predissociative persons or (alleged) submerged token personalities. Braude gives several arguments why both of these interpretations fail due to their tacit reliance on CR, but one is especially germane for my purpose here. I analyze it as follows:

When people observe various forms of multiple personality, then they think they have uncovered an aspect of predissociative mental functioning. Or it might be that they have merely created the phenomena, and that there were no such pre-existing aspects within the predissociative patient. Now if they have uncovered an aspect of predissociative mental functioning, then they have either uncovered *types* of personality characteristics of the predissociative person (e.g. aggressive, angry, etc.) or they have uncovered submerged *token* personalities of the predissociative person (i.e., some distinct, predissociative component personality).

It is wrong that they have uncovered *types* of personality characteristics of the predissociative person, because this would commit one to an "absurdly inflated inventory of original personality components" (Braude 1991, 137). For any given type of personality component found in a dissociated persons, there would have to have already existed one of that type suited specifically to dealing with a traumatic event. But there are an unlimited genre of such events--murder of parents by a gun, by an axe, by poison, etc; "or murder of siblings, and another for in-laws, or next-door neighbors, or friends in St. Louis, and another for total strangers" (137), all of which would demand a likewise unlimited inventory of personality components, which is absurd.

Furthermore, it is wrong that they have uncovered submerged *token* personalities because things do not always divide or split into their historical components. A table or a board, for example, can be broken in half with an axe, "but it would be a mistake to conclude that the original object resulted initially from the uniting of those two halves" (Braude 1991). This would likewise be a mistake for assessing an initial number of predissociative token personalities.

Thus, overall in the case of MPDs, it is wrong to think that one has uncovered a predissociative mental functioning. Moreover, and relevant to our point, many observers of MPD have created the phenomena, when in fact there were no such pre-existing aspects within the predissociative patient.

This problem of creating the phenomena is applicable to Puccetti's views of split-brain patients as well. Just as it turns out that the functional divisions might result in genuinely new alters in MPD patients (as opposed to submerged personalities), so it might turn out that "a person can be made to have two minds, or that a person can be made to be two persons."(142). Braude then shows Puccetti's own entrapment by CR:

> Assuming it makes sense to attribute two minds to one person, why *not* say that both postoperative minds are new? Analogously, in cell division (or in slicing a flatworm), one gets two new cells (or worms), *neither* of which existed as such before. There is simply no problem of having to decide which of the two worms (or cells) is new. Puccetti quite obviously commits the same error as those who argued from the complexity of the postdissociative self to the complexity of the predissociative self [....] To show that cerebrally intact individuals have two minds, one must argue that two minds are required to explain the apparent disunities of normal mental phenomena. (1997, 723)

The tacit application of the fallacious CR principle is clear. Puccetti holds that pre-commissurotomy functional divisions of the self are necessary for the occurrence of post-commissurotomy functional divisions of the self. Yet Puccetti is tacitly operating with a revamped version of the token CR principle, and since the CR principle is a flawed, Puccetti's position is likewise flawed.

Second, although Puccetti would contend that the empirical data of split-brain experiments also supports his position, this corpus is up for grabs if another theory of identity can incorporate the data without remainder and yet avoid appeal to CR. In part three, Coherence of Identity, I will develop just such a theory.

2. Contra Nagel, the dichotomy or multiplicity of consciousness comes about only because a separation of neuro-processing occurs without adequate information exchange among all or a sufficient number of modules. Normally, the corpus collasum[30] functions as the unifying element that allows but a single mind within humans. It functions to unify the brain's entire neuro-network.[31] In unifying that neuro-network, it unifies consciousness.

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[30] Along with the other minor collasal structures mentioned in the discussion of brain anatomy.

[31] This is loosely stated, since lower brain functions (within, for example, the Medulla Oblongata, Pons, etc.) and cerebellum functions do not appear to be functionally linked by

(Nagel also resists the view that one can actually count the number of minds within a patient during a Sperry-type experiment. I shall address this later.)

Exactly how much information exchange must occur for there to be a unified consciousness seems in principle to be an empirical matter. However, even apart from the intractable technical difficulties, the ethics of cutting one neuro-pathway away at a time to systematically explore such an exchange would be horrendously out of bounds. Still, perhaps a non-evasive, controlled shutdown of the pathway would be possible--somewhat akin to the way a complete, single hemisphere can be anesthetized by a Wada procedure, in which a patient has a full recovery after the procedure. If individual neurons could be selectively and combinatorically anesthetized, perhaps then the relationship between information exchange and the creation of a second consciousness could be rigorously, safely, and ethically investigated.

3.4.7 Phase-Lock Argument

Finally, we can argue that the right hemisphere is conscious based upon continuing, phased-locked unity of its modules. Since the right hemisphere is not disconnected from the phased pulses of the thalamus, the modules within the right hemisphere maintain their ability to synchronize communication. Thus, they correlate information within and between the different subsystems--recall the 40 Hz waves that underlie the visual system--that are still operant in that hemisphere. This synchronization, or something along the lines of phase-locked synchronization, seems very promising for explaining what binds together the separate modules needed for producing consciousness.

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this apparatus.

The right hemisphere still has this type of synchronization; hence, one is as justified to claim it conscious as one would otherwise be when such synchronization is present in a normal, fully connected brain.

3.4.8 Rosenthal: Creature Consciousness vs. State Consciousness

The right hemisphere is not in a coma, nor is it in REM sleep or somehow oblivious to its perceptual engagement with the world. It hears sounds; it sees information under the test conditions. Here, then, it can be said that the right hemisphere has at least "creature consciousness" as David Rosenthal puts it. But this doesn't seem to be the mystery in split-brain cases. Instead, the question is, does the right hemisphere possess "state consciousness"? (Rosenthal suggests such terminology.) Here, I am asking about types of mental states. Perhaps I am asking about computational states, or those hidden influences that can (allegedly) be brought out by psychoanalysis, and whether the right hemisphere has phenomenological awareness of these state conscious aspects. It is here, in state consciousness, that inquiry must be made.

3.4.9 Lycan: Inner-Sense Theory of Consciousness

As I noted earlier, Lycan's theory holds that conscious awareness is the successful operation of an internal scanner. This internal scanner outputs what he calls second-order representations of first-order psychological states. By first-order states, Lycan merely means the sensory properties that represent features of physical objects. According to him, for example, a color presented in a visual perception is the represented color of a physical object. The second-order states are what results when internal attentional mechanisms are directed at such first-order (or other lower-order) psychological states. Ultimately, these monitors are not subject to Dennett's charge of Cartesian materialism, which is the view that there is a physically realized spatial or temporal turnstile in the brain where all of the integrations come together to exhibit something to consciousness.

The brain is a distributive mechanism, as was seen in the first part of this investigation into split-brain patients. The internal monitoring system, therefore, can monitor different components of brain processes. In the case of the split-brain patient, this internal monitoring occurs in the right hemisphere. There is, indeed, an attention mechanism that is directed to bond the representational subsystem and stages of the right hemisphere. The mechanism allows the right hemisphere to point to objects in its environment, gives recollection of what it pointed to under the conditions of the experiment, and generally functions as an internal monitor would be expected to function in the inner-sense theory as Lycan lays it out.

Lycan's position on the inner-sense theory conveniently explains why it is that the right hemisphere is able to operate as a consciousness. These internal monitors are distributed among the parallel processing of the brain and, although we split the neuro-connections along the corpus callosum, the distributed nature of internal monitoring is still able to coordinate the functioning subset of subordinate homunculi, in this case subordinate modules, of an overall self. The system need not be the *same* single, special place where it all comes together, even if there is *some* functional place where it comes together as a coordinated, functioning subset.

3.4.10 Memory Vector Argument

Lulled in the countless chambers of the brain, our thoughts are linked by many a hidden chain; awake but one, and in, what myriads rise!
-- Alexander Pope

I earlier discussed Dennett's Multiple Drafts view on stream of consciousness. I argued that a memory vector approach was necessary to account for a self, and that the stream of consciousness must be identified by what a mind is disposed to report about its introspective states at any given time. While the right hemisphere cannot speak, it can report, can answer yes or no questions based upon propositions representative of its own introspective dispositions. Hence, one could ask thumbs-up or thumbs-down questions of the right hemisphere: Did you choose the shovel? Did you indicate thus-and-such? Have you recently seen a snow scene? Have you recently seen either word A or word B?--where words such as "stairway" or "keychain" were represented to the right hemisphere. Since the right hemisphere can give an aided report of the memory vector of its introspective states, again there is justification to think that it qualifies as conscious and maintains a stream of consciousness as it has been understood in prior discussions.

3.4.11 Right Hemisphere's Ability at Introspection

Does the right hemisphere have the ability to perform introspection? Answering this would require first that, under the conditions of a Sperry-type experiment, the right hemisphere be given a choice among options: let it look at what *it* chooses. Later in the experiment, the right hemisphere could be instructed to remember what was seen and to indicate so by pointing. Finally, the right hemisphere could be asked, "A moment ago, you were trying to recall something. Point to what you were trying to recall."[32] Here, then, one would expect the right hemisphere to point to an object--say, a pipe.

Note how at that moment we would not merely be asking what the right hemisphere earlier *saw* in the experiment. Instead, we were asking what the right hemisphere earlier *remembered* seeing; we are asking it to remember what was earlier recalled. Therefore, if the right hemisphere can perform this task, can perform second-order recall, we have good evidence of introspection, for it has used content as the vehicle of spontaneous conceptualization in self-description.

3.4.12 Establishing Consciousness for the Right Hemisphere: Local vs. Extended View

There are two options one might take in establishing whether the right hemisphere is conscious. The first option might be to look at the brain's information structures and processes over time (neuro-firings and seritonin exchange, for example) and determine if one can correlate those data with behaviors in the course of an experiment where such behaviors were as good as some otherwise known standard--for example, if they are as good as an eleven-year-old would perform. If such a correlation can be made, then the right hemisphere would correctly be dubbed conscious. Call this the *local view*.

The second option might be to claim that the consciousness of the right hemisphere is such that there is an essential (i.e., empirically unfalsified) relation between

[32] This is somewhat misleading as stated, for in Sperry-type experiments, the patient is informed what task is to be followed before hand, and then behaviors are noted while the Sperry-type experimental conditions obtain. There is no direct "asking" of the right hemisphere. A nonverbal pointing procedure is almost always used for communicating with the hemispheres individually; thus, a similar procedure would have to be in place for requesting and subsequently noting right hemisphere recall.

the right hemisphere's being in given neural states at a certain time *and* the right hemisphere's social environment beyond the skull. Call this the *extended view*. Here, then, we would say that even if we had several right hemisphere patients that had, per impossible, the exact neural activity occurring over a given time within the skull of a patient, some might be judged as conscious and some might not be, for there might be differences among third parties for when a person is considered conscious. In this case, we would be moving beyond the local view, where the consciousness of patient X is exclusively tied to certain structures and processes within the brain. In the extended view, any other individual, patient Y, even if an operational duplicate of X, need not be called *conscious*.

3.4.13 Social Component and Right-Hemisphere-Only Patients

The local view appears easiest, at least if there were some uncontroversial standard of comparison of which quantitative measures could be applied. Fool's gold is not gold, however, even if everyone in town says it is and uses it as a monetary unit of exchange. But unlike for consciousness, there are uncontroversial quantitative measures for noting the difference between the two; hence, each kind of material can be readily identified. Differences abound on what consciousness is and the criterion for detecting it.

We do not have a rigorous physics of mind nor even a software model that can adequately mimic a human mind's information flow. Thus neither natural science nor studies in information structure currently allow us to give a local explanation of why human minds arise as they do from brains. Perhaps they will; but not at the moment. So, unlike such devices which can distinguish fool's gold vs. natural gold, we must rely on some other device for distinguishing consciousness from "fake" consciousness.

Given this situation, therefore, one cannot totally ignore the social component for identifying consciousness. After all, the patient's life is not suddenly considered lost by the experimenter or others present in the room when the conditions of a Sperry-type experiment obtain. When the right hemisphere is doing its Sperry-type experiment activities, or, perhaps when, in surgery, the left hemisphere is put to sleep and inquiries are routinely made of the right hemisphere about what is being held in the left hand, everyone around the patient recognizes who the patient is and behaves as if there has been no sudden change of social connection. Glover (1988) has alluded to a similar situation in his work on the "I." Patients who have had their left hemisphere removed are indeed recognized in their social fabric when they return from the procedure. Whether this social connection is sufficient for holding them to be the same *persons* (as opposed to their being conscious) is an issue that is addressed later. But their social fabric must be counted as evidence toward their being conscious. Overall, then, I favor the extended view over the local view. Patients under Sperry-type experimental set-ups and even hemispherectomy patients are communicated to and are given standard social interaction behaviors by third parties when in the presence of these patients. I have already taken a position on worries about zombies–that they are inconclusive for showing physical or functional explanations of consciousness to be impossible--but I now can make a bit stronger claim: that social behaviors preclude the right hemisphere being accounted a mere automaton. The right hemisphere is conscious.

3.4.14 Qualia and the Right Hemisphere

I noted earlier from Block that some believe the realization of "stuff" does matter, and that a functionalist view of the mind, and in this case, of the right hemisphere, might not be a neutral matter in terms of qualia. In a slogan: Not just structure, but also stuff! However, I find this view unconvincing, for if there were some difference that would result in different qualia for systems that were made of different stuff, then there would have to be some causal component; something, someplace, would have to cause the qualia in the two cases to be different. If there were such a component, then a different information structure, a different functional configuration, would obtain. A difference in qualia, therefore, would be a difference in function (or subfunctional component) of mind. Here is a counter slogan: Stuff that matters, matters causally!

One might worry that while the causal structure could be the same, any difference in qualia could yet be explained merely in terms of differences of material stuff. However, far before appealing to differences in material stuff, one who makes such an argument is lead to take an unwise position on causal influences.

1. Suppose **a** has material configuration **X**. Suppose **b** has material configuration **Y**.

2. Now let **X** cause event **E1**, and **Y** cause event **E2**; furthermore, stipulate it turns out that **E1** and **E2** have the same type of causal structure

3. Moreover, stipulate that qualia **Q1** is "what it's like two seconds after taking a bite of an orange, and qualia **Q2** is "what it's like two seconds after taking a bite of a dill pickle."

On my view, it should be the case that **Q1** differs not from **Q2**, since they have the same type of original casual influences from **E1** and **E2**, and since two things with the same type of causal influences will have the same type of effects.

However, per the worry, **Q1** does differ from **Q2**. One might seek here to blame the "stuff", the material configuration of **a** and **b** (1), but one must first move back through issues of causal influence (2). So one denies either that **Q1** and **Q2** have the same type of casual influences or that two things with the same type of causal influences will have the same types of effects . Now by stipulation in (3) one cannot deny **Q1** and **Q2** have the same type of original casual influences; so, one is forced to deny that two things with the same type of original causal influences will have the same types of effects. This means one accepts the following as possible: two things could have the same type of causal influences, and yet have different effects.

Yet even if this is possible, which I doubt, we regularly observe correlations between like causal influences and like effects. Since qualia are not well understood, and since brain investigation is only at its genesis, it seems unwarranted, even *ad hoc*, to hold that causal influences can be the same in the face of differences of effect regarding qualia.

Another worry also presents itself. Sometimes the strength of argument for qualia is based upon these mysterious phenomena not being epistemically accessible. One can know all the third-person facts, but not know what it is like. But the Wada procedure seems to give us one way to close this gap, for one can recall "what it is like" after recovery or even "what it is like" as the procedure takes hold and during its height. While one cannot become a Bat, anyone with two hemispheres can become a split-brain patient and introspect before, during, and after the Wada-procedure event. Hence, any qualia arguments against knowing what it's like to be a conscious right hemisphere loses its bite. The Wada patient will positively indicate holding objects after the fact. Once again, the right hemisphere is best accounted as conscious.

In summary, I have shown that worries over qualia in regards to issues of causation and third-person accessibility do not impede my overall project's goal of showing the right-hemisphere to be conscious. I would like to make a short observation about the status of the right hemisphere as regarding lawful regularities of its behaviors under Sperry-type experimental conditions.

3.4.15 Right Hemisphere and Rational Regularities

Georges Rey (1997) points out that although psychology is not a fully developed science with fully developed laws, it does loosely have a set of laws that could be known as rational regularities. He describes these regularities as

> a creature's states whereby they instantiate the steps of inductive, deductive, and practical reasoning. So far, the best explanation of such remarkable capacities seems to be one that postulates mental processes in the animals whereby they are able to perform at least rudimentary inductions and deductions, and are able to base their behavior upon some one or other form of practical reasoning. (463)

I have been arguing that the right hemisphere exhibits such rational regularities and far more than on just a rudimentary level. Again, we see that the pointing and communicating behaviors of the right hemisphere under Sperry-type experimental conditions are at least equal to that of a young child. Certainly the mental acuities of a young child are testable, so the right-hemisphere's abilities should likewise be testable. Thus, I now move to discuss a modified version of the Turing Test which I think can accomplish this task.

3.5 The Identification of a Person: A Modified Turing Test

> *I tend to view animals, especially furry animals, as conscious--not plants, not inanimate crystals, not computers. This might be called "the cuddly-ness criterion."*
>
> -- *Carl Pribram*

3.5.1 Introduction

This section considers the determination of some criterion for counting how many consciousnesses there are in a patient. Perry (1976) explains that there are two uses of the word *criterion* in discussions of personal identity. One concerns the unity relations between simultaneous events or, perhaps, nonsimultaneous person-stages. But the other is more true to the root meaning behind the word, which is "way of knowing" (11). This is the sense in which the word is used for this project. Perry summarizes:

> We might discover that person-stages are stages of the same person not by observing directly that the unity relation holds between them, but by inferring this from the holding of another relation between them. That other relation would be our evidence for the unity relation's holding. Now some philosophers believe that there can be such evidence which has a privileged status, which is somehow "conceptually guaranteed" to be, if not infallible, at least reliable, and use the word "criterion" for such evidence. (11)

It was noted earlier that one cannot totally ignore the social component of consciousness for determining number of persons within a patient. I now argue that a modified form of the Turing Test can be constructed that leverages this social component into a legitimate criterion, in Perry's second sense of the word, for identifying a consciousness. In as much as a person is a consciousness over time, this modified test can also be used as a criterion for counting persons. Before that, however, I shall discuss how counting consciousnesses is possible.

3.5.2 Understanding Versus Counting

One might worry that since we really have little idea of what consciousness is, we cannot have much hope for identifying how many consciousnesses there happen to be in a split-brain patient. But in reply, one does not have to understand the essence of the phenomenon in order to count or identify that phenomenon. For example, in the 1600s, one may have taken a very thin wire and attached it to a kite and flown that kite on a dark, stormy night. Every time electricity hit the kite, the crazy experimenter would certainly be able to count painful instances of electricity without being able to understand exactly what electricity is. Likewise, one can be optimistic about counting consciousnesses even if we cannot exactly identify what consciousness is. And this is what one can reasonably expect out of a properly modified Turing Test.

Even if we have come to some agreement on the idea of consciousness, there is yet a deeper worry. The very idea of counting consciousness (and subsequently persons) has met with resistance from Thomas Nagel in his pivotal article, "Brain Bisection and the Unity of Consciousness" (1991). He holds that "the idea of a *single* person, a single subject of experience and action" (432) is in difficulties, and that this difficulty has emerged because of a too optimistic stance in seeking a physiological understanding of the mind. Furthermore, he holds that "the idea of the unity of a person" is one "whose validity may be called into question with the help of recent discoveries about the functional duality of the cerebral cortex"(433).

Nagel's argument can be summarized as follows: If we are to understand whether there are *one or two* minds in split brain patients, then we must already have "some idea what an ordinary person is *one* of" (435). Moreover, split-brain patients show us that we do not have an idea of what an ordinary persons is. Thus, understanding just how many minds these split-brain patients have eludes us.

Clearly his conclusion is incompatible with my whole project. I will proceed by showing Nagel's argument for the second premiss is flawed. My conclusion will be that our ordinary concept of a person as somehow *one* is consistent with the data we observe of split-brain patients under Sperry-type conditions, and that we do in fact have access to procedures which allow us to count persons.

Nagel suggests that there are five ways to interpret the experimental data with a view toward attributing a mind to the patients under observation. He argues "that each of these interpretations is unacceptable for one reason or another" (435). The fifth of these interpretations – namely, that split-brain patients "have one normal mind most of the time, while the hemispheres are functioning in parallel, but two minds are elicited by the experimental situations which yield the interesting results" (435) – is the position taken in my overall project, and is the sole one I need to address. It turns out that Nagel's three reasons for finding this interpretation unacceptable are wanting.

First, Nagel holds that "in fact it [a Sperry-type experimental situation] produces no anatomical changes [in the patient] and merely elicits a noteworthy set of symptoms" (438). This is not right. To the contrary, any change in neural synapse configuration or in neural-chemical exchanges is a change in anatomy, since it is a physical change in the micro-structure of the brain. Moreover, concurrent visual reflex action, and more generally, proprioceptive awareness, for examples, result in neural-chemical exchange, and probably[33] even minor synapse re-configuration. Thus, against Nagel's claim, there is change in anatomy after all.

Second, Nagle claims that "there is nothing about the experimental situation that might be expected to produce a fundamental internal change in the patient" (438). But there are now good empirical reasons to think this claim wrong. Synapse connection and neuro-chemical flow jointly control information flow among the various modules and brain pathways. Such information flow leads one to expect, for it is often correlated with, changes in thought patterns of the patient. The hemisphere isolation by means of various Sperry-experimental set-ups modifies synapse connections and rates of neuro-chemical flow . Thus we have every expectation to think that fundamental internal changes in the patient are occurring after all. Nagel can hardly be blamed for his position on this matter, however, for non-invasive brain scanning procedures were unavailable and the results of what parts of the brain correlate with what sensory information modalities were unknown to him at the time of his analysis.

Finally, Nagel asserts the following:

> During the time of the experiments the patient is functioning largely as if he were a single individual: in his posture, in the following instructions about where to focus his eyes, in the whole range of trivial behavior control involved in situating himself in relation to the experimenter and the experimental apparatus. The two halves of his brain cooperate completely except in regard to those very special inputs that reach them separately and differently (438).

Nagel has not appreciated that proprioceptive movement is controlled by areas lower in the brain, areas which have not been split by Sperry-type experimental conditions, but

[33] These reflexes can be sped up by training, which means more (and/or more efficient) synapse pathways have been formed.

which are still mutually accessible to both upper hemispheres. Because of this, Nagel is incorrect in thinking that the hemispheres "cooperate completely" in regards to proprioceptive activity, since this system, now considered a part of the haptic, or touch system, normally functions automatically – that is, without conscious guidance (Azar 2002).

What actually happens is this: Signals from vestibular hair cells that serve as mechano-receptors within the inner ear are "passed along the vestibular nerve, part of cranial nerve VIII" (NAN 2002) Although a few axons[34] do project directly to the cerebellum, it turns out most of these neurons synapse in the vestibular nuclei of the medulla. Furthermore, neurons of the vestibular nuclei project to the spinal cord, cerebellum, medulla and pons -- again, all areas lower in the brain. This vestibulo system is also present in ocular reflex action, for it "helps maintain a steady retinal image if the head suddenly moves as in walking, or running, or orienting to a stimulus. You can see the effect of the vestibulo-ocular reflex, by suddenly moving the head with an external force. While looking at a distant object, notice how the world 'jumps' when you hit yourself up on the side of the head!" (NAN 2002)

Since this posturing and behavioral control (regarding the patient's relation to the experimental apparatus) is an automatic response, the two hemispheres, therefore, do not "cooperate completely"in their proprioception. In fact, neither hemisphere monitors this any more than a normal person, which is to say rarely if ever at the conscious level.

[34] The axon is the generally longer part of the nerve fiber that generally conducts impulses away from the cell body of a neuron.

Overall, then, Nagel's reasoning does not show that the fifth interpretation of the experimental data (whereby two minds are elicited by the experimental situation) is unacceptable. Therefore, his more threatening position that there is no number of minds to

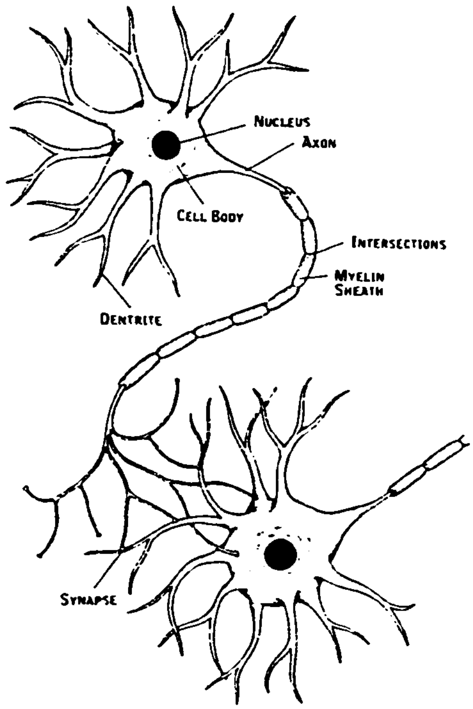

Figure 8 Sketch of nerve cell showing axon and other features (Restak 1995, 38)

be counted in split-brain patients is undermined. We may proceed, therefore, unimpeded in constructing a criterion for counting minds in split-brain patients. That criterion shall be a modified Turing test.

3.5.3 What Is the Turing Test?

The origin of the Turing Test actually flows out of what A. N. Turing called 'The Imitation Game.' It seems that everyone tells his or her own slightly different version of the Turing Test, even Turing himself. The outlines are pretty clear, however. The Turing Test is a special application of behaviors for identifying some candidate system as a genuine thinker (no matter what its internal construction). Clark (2001) gives a pithy summary:

> Turing proposed a test [. . .] that involved a human interrogator trying to spot (from verbal responses) whether a hidden conversant was a human or a machine. Any system capable of fooling the interrogator in ongoing, open-ended conversation, Turing proposed, should be counted as an intelligent agent. Sustained, top-level verbal behavior, if this is right, is a sufficient test for the presence of real intelligence. (21)

In its original form, Turing had a game in which an interrogator was to determine over conversation via teletype whether he was talking to a man or a woman. Sitting in yet two other, separate rooms were a man and a woman with their own teletype machines who were returning answers. The man was allowed to give any answer in order to deceive the interrogator while the woman was advised to tell the truth. After setting up this scenario, Turing suggested a change in players: "We now ask the question, 'What will happen when a machine takes the part of [one of the humans] in this game?' Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman? These questions replace our original, 'Can machines think?'" (Turing 1950, 434).

The idea here is for the human interrogator to determine which of the other two players is a computer and which is a human. (See Diagram.) The interrogator is permitted to ask any question, and the computer is permitted to give any answer necessary to fool the interrogator. This procedure is repeated with people of various backgrounds occupying the position of both interrogator and answerer. "If the number of successful identifications of the computer is not significantly greater than the 'guessing frequency' of

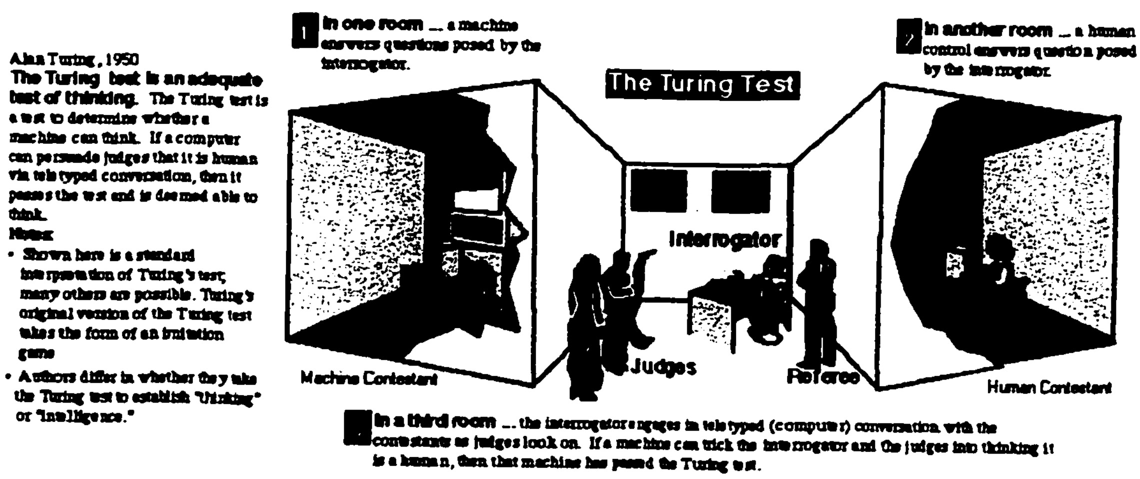

Figure 9 A standard setup for a turing test. (Adapted from Macrovu 2002)

fifty percent, it is to be concluded that the computer can think" (Copeland 1993, 38).

Could a modified Turning Test be constructed for identifying consciousness in isolated hemispheres? What would a Turing Test look like that presents the hemispheres to an unbiased observer--i.e., to one not already aware that a hemispherectomy patient or Sperry-isolated, single hemisphere is at the other end of an exchange of communication?

3.5.4 A Hypothetical Modified Turing Test Setup

Constructing a Turing test for a Sperry-isolated left hemisphere would be somewhat of a standard exercise. The left hemisphere can talk, thus a voice-to-text translator would be useful to carry the otherwise traditional input-to-output communication route via teletype. Interviewing the left hemisphere in a Turing test context would be very similar to interviewing a person with a particular set of mental handicaps. Both interrogators and control subjects (i.e., otherwise normal humans) would assume their traditional roles. But since the issue of the left hemisphere being conscious is not nearly as controversial as the right hemisphere being conscious, the set-up developed from here out will have the conditions of a Sperry-isolated right hemisphere in the forefront.

Consistent with the traditional test, there are no unusual objectives. A modified Turing Test is still considered a special application of behaviors for identifying some candidate system as a genuine thinking person. The internal construction is not supposed to be at issue, and it isn't – or, it is far less an issue when using half a brain as a conversant than when using a computer. (This shall be discussed in a bit more detail later in the section.)

There would have to be some modifications, however. A human interrogator will not be able to judge whether a right hemisphere is conscious based upon verbal responses originating from the test subject, as Turing first proposed, for the right hemisphere rarely is able to speak. So any right hemisphere which is able to convince an interrogator in open-ended conversation (mediated thru teletype, or similar device) will have to rely on some system of selection cues to indicate its responses.

But the right hemisphere is hardly without any communication resources. It is well known that under Sperry-type conditions, the right hemisphere can receive instructions and answer queries. The interrogators would have to be informed on what was conceptually thinkable by an isolated hemisphere, but would introduce no undue bias into the test, since, to use a parallel example, very young children are often tested within conceptual boundaries, and the results of their mental acuity are correlated with pre-understood expectations. Therefore, comparable procedural boundaries for the interrogators who participate in the modified Turing test could be arranged after both the abilities and the limits of Sperry-isolated right hemispheres were identified for implementation into the set-up.

This attention to conceptual limits might very well demand that there are different sets of control subjects for comparison of different abilities. For example, if the right hemisphere functions only as well as a two-year-old in line drawing skills, then only two-year-olds should be in the control group for the performance of that particular modality. On the other hand, if the modality of evaluation moves to facial recognition, and the abilities of a right hemisphere operate at a full adult level of cognitive maturity, then adults should be immediately rotated into the control group. This could be done in real time if the set-up and information exchange routing between hemispheres, control subjects, and interrogators was planned with sufficient care.

Even with the known conceptual boundaries in place, interrogators still have very wide latitude to communicate with Sperry-isolated right hemispheres. Questions of a Yes or No nature could be asked of objects and situations. Digital pads could relay drawings of objects, for example, in ways similar to the methods that Sperry himself used. He would often flash two different figures to the isolated hemispheres. When "the subject is asked to draw what he saw using the left hand out of sight, he regularly reproduces the figure seen on the left half of the field" (Sperry 1967, 58). Interrogators in the modified Turing test would be able to make a full range of requests of the right hemisphere (and other subjects, of course, all being behind the veil of the test set-up) so as to compare its drawings to other subjects in the testing context. After all, it is desirable that this modified Turing test be able to evaluate the widest possible behavioral modalities.

In the end, and consistent with the traditional Turing test, the idea here is for the human interrogator to determine which among the players is a Sperry-isolated hemisphere and which is an otherwise normal human. The interrogator is permitted to ask any question and the right hemisphere is permitted to give any answer if feels appropriate in order to convince the interrogator of it being conscious. This procedure is repeated with people of various backgrounds occupying the position of both interrogator and answerer. If the number of unsuccessful attributions of consciousness to the right hemisphere is not significantly greater than the guessing frequency of fifty percent, it is to be concluded that the Sperry-isolated hemisphere is indeed a person.

3.5.5 Objections and Replies to Use of the Turing Test

Although several different objections can be brought against the Turing Test, each can be resolved when this modified version is applied to the right hemisphere.

First, one charge against the standard Turing Test is that the dissimilarities between computers and humans are too great to apply the Turing Test as a criterion for consciousness. For example, Descartes gave two reasons why a human replica would fail to pass for an actual human being. For one, it would be incapable of the creative use of language that even the "men of lowest grade of intellect" enjoy. For another reason, as a mechanical device, it could do only what it was constructed to do and would not have the flexibility to respond intelligently to new or unanticipated situations (Corballis 1993, 8). Yet another reason for complaint of dissimilarity is the difference between simulated thought and actual thought. And there is a whole line of discussion regarding Searle's thought experiment of the Chinese Room, which is often invoked in complaint.

In reply, the dissimilarities disappear when the object of the test is a right hemisphere. Clearly this standard Chinese Room objection to the Turing Test--that these hemispheres are only simulated minds--will not do. The split-brain patient stands clear of the charge of having non-organic hardware, for at the other end of the communication line is actual brain matter operating within a functioning human being. Potential language acquisition and intelligent response under experimental conditions also leave Descartes' objections unmotivated.

Second, the Turing Test is limited just like any other criterion that is based upon empirical evidence: it can never completely establish its case, and its data surely do not constitute what is a mind. There are two replies to be made here.

1. The Turing Test does not pretend to be an operationalist definition of mind. No logical and conceptual links have been set up between some concept being defined and certain operations; and, certainly, no satisfaction of the operations is alleged to provide

necessary and sufficient conditions for the application of some concept, in this case what is "conscious." Moor (2001) further exonerates Turing of this charge of operationalism:

> First, Turing never says he is giving an operational definition nor does he discuss operational definitions in his article. Second, Turing clearly doesn't take his test to be a necessary condition for intelligence, for he admits that a machine might have intelligence but not imitate well. After he raises the question, "May not machines carry out something which ought to be described as thinking but which is very different from what a man does?", he replies, "This objection is a very strong one, but at least we can say that if, nevertheless, a machine can be constructed to play the imitation game satisfactorily, we need not be troubled by this objection" (Turing 1950, 435). Third, though Turing is focused on the sufficiency of the Turing Test and not its necessity, he never says the sufficiency is a matter of logic, conceptual, or definitional certainty. There is no evidence for understanding Turing as giving an operational definition nor is there any need to do so. (82)

Likewise, the modified version of the Turing Test does not allege to operationalize consciousness, merely to justify that consciousness is present in a right hemisphere.

2. Both the standard and modified Turing Test help set boundaries for determining if there are any counter-example types of behaviors of what is under consideration for being a "minded" being. If it turns out there is no appreciable empirical distinction that can be drawn between by a human inquirer and the object of his or her inquiry, whether that object be the right hemisphere of a split-brain human, or even (someday) a machine, then a conservative stance is called for. Innocence, a pivotal value in Western thought, has always been given the benefit of a doubt in its various justice systems; likewise should consciousness, the highest property of minded, biological systems, be given the benefit of a doubt in various epistemic criteria.

Third, the Turing Test is sometimes accused of essentially being the classical "analogy of other minds" position dressed up for contemporary tastes. The interrogator cannot get into the mind of the other, so whatever is going on there--teletype behaviors be damned--the conclusion that the other players are conscious cannot be maintained. Several different replies are possible at this point, but the complaint hinges on knowing what it's "really" like and identifying some other mind's mental states as being of the same type as my mental states. Let me address these in turn.

1. Granted, when applied to a right-hemisphere patient, a modified Turing Test cannot give us the what it is like--the qualia of being a one hemisphere entity. Indeed, even under the conditions of the split-brain experiments, the patient normally cannot introspectively tell us what it is like any more than we can introspectively tell one another what it is like to have raw feels. (Keep in mind, however, the Wada procedure exception to this noted earlier; even without surgery, non-split-brain patients can come to know what it's like.) The right-hemisphere's position in terms of expressing qualia via the Turing test is no worse than otherwise normal people trying to express qualia to one another.

The Turing Test gives us an insight into our own third-person approaches to consciousness. We generally make observations about other beings that we take uncontroversially to be conscious. What the Turing Test does is put a criterion on the table, so to speak, showing us at least one set of sufficient criteria that we intuitively use to identify conscious entities.

The Turing Test does not tell us what consciousness is ontologically. Neither is it a necessary criterion for us to detect consciousness, for people were making claims about what was and was not conscious long before the existence of Turing. Even given these caveats, it is still an attractive method; it gives us warrant (see next point) for classifying things as conscious or not.

2. We have earlier noted that the Turing Test is not an operational definition of mind, nor in its modified form, of consciousness over time (i.e., of personhood.) It is merely a rigorous test that, if a machine so passes, allows us to attribute mindedness to the machine, now with good inductive grounds. Moor (2001) explains, "We would not have certainty in such a judgment and we might revise our judgment in light of new evidence, but we would have sufficiently good evidence to infer that the machine was intelligent" (82). Likewise, there is evidence for its application toward establishing consciousness in the right hemisphere. Perhaps in interaction with a broad set of human interrogators, the warrant for thinking that the right hemisphere is conscious will be negligible, even countermanded. But that is the nature of inductive testing. If a cross-section of people, themselves minded beings, find insufficient or no reason to account the right hemisphere as being conscious over time, then a new analysis of just what to make of the right hemisphere's state of mind (or not) is called for. But such testing has not been initiated, much less has a "nay" position been established. And even now, with but the *prima facia* evidence we do have of the right hemisphere's consciousness over the course of a Sperry-experiment, some scientists feel compelled to label the right hemisphere as an independent mind with its own consciousness.

Fourth, since the Turing Test applies to machines, which are composed of merely non-organic, non-thinking human artifacts, it is only by design that a very complex conglomeration of such devices fools us. Such devices do not enter into social relationships by their own initiative--"No mind if by design." Some of the objections in Searle (1980) expressed within his Chinese Room argument carry this idea. In reply, Georges Rey (1997) notes that our ordinary notion of consciousness can give us contradictory intuitions when it is applied or described from a bottom-up view as opposed to a top-down view. If one imagines first a non-biological machine and then a program that would implement its various mental abilities, we are disinclined to regard it as conscious. This would be the bottom-up view. In contrast, if we discover that close friends or we ourselves are just machines, we would reach the opposite verdict, thinking that they are conscious after all, even though they are machines. In this case, we would be proceeding from a top-down view of consciousness (478).

3.5.6 Conclusions

Let me summarize on this modified Turing test. Perhaps it is an understatement to note that we are not in a position scientifically to reduce consciousness to mere neurological activity, to mere "meat machines" as it is sometimes crassly put. Maybe we *are not* in said position because we *cannot* be. The very fact of reduction in science normally carves off the subjective experience and excludes those experiences, by definition, from what count as the "real" phenomena. As Searle (1997b) fairly notes, "Where the phenomena that interest us most are the subjective experiences themselves, there is no way to carve anything off" (456). The idea of modifying a Turing Test is merely to identify when we encounter a consciousness. Clearly the right hemisphere is not composed of human artifacts, even if it does have something like design behind it–that is, if the idea of surgical intervention is stretched unduly far as a way of "redesigning" brain structure. Yet such a debate on where design begins is moot. In the end, there is no need to produce or justify a reductive explanation for consciousness nor even to take a stand on the nature of mind (more properly, consciousness) at all--other than that there is such a thing to be found occasionally in the world.[35] The modified version of a Turing Test seeks only to establish that the right hemisphere is indeed conscious. It seeks only to lay out controlled conditions for when an identification of consciousness is warranted, and it does this by appreciating the social interaction that commonly occurs when minds otherwise confront one another under various circumstances.

[35] An Eliminative Materialist would cry foul at this point, but I shall let this pass without redress.

4 COHERENCE OF IDENTITY

Without the ego the episodes of a life can seem like a heap of stones.
-- John Glover

4.1 Introduction

4.1.1 "Person": A Tentative Definition

While this project is generally concerned with the split-brain phenomenon, it is also more particularly concerned with what it is to be a person--that is, what is it to be "an intelligent being, that has reason and reflection, and can consider itself as itself, the same thinking thing in different times and places; which it does only by that consciousness, which is . . . essential to it" (Locke 1979, 335). It is widely acknowledged that by "consciousness" Locke actually meant "memory" (Noonan 1991, 54). But Locke's definition can be usefully hijacked by reloading the term not only with its legitimate passenger, memory, but with Lycan's new passenger, higher-order monitoring. On this modified position, then, one may loosely and yet accurately speak of a person as a consciousness over time.

Although Locke's prose is pleasing, the worry about personhood is deeper than producing a tidy definition that includes all of the favored essentials. Definitions can vary, depending upon the arena of discourse. Philosophy might approach the issue in one way, science in another. Ultimately, however, it is desirable that the different approaches agree, or at least that they be consistent with one another so that one may speak of a coherence of personal identity. It is disconcerting when both philosophy and science force one to abandon common sense notions of the self. But radical positions are not necessarily wrong positions, so the merits of some of the newer views of mind must be carefully considered.

4.1.2 Sketching the Issues

Three issues seem important for analyzing split-brain patients and their functions as persons under Sperry-type experimental conditions: identification of a person, individuation of a person, and the inward perspective of a person. Although I shall be especially concerned only with that last two of these, I will nevertheless offer a quick sketch of all of them in what immediately follows below.

First, there is the identification of a person. Typically persons have consciousness of the self. To claim, "A self is someone," is a trivial claim. Yet to claim, "A self is some one," in the numerical sense, some unity--that is not at all a trivial claim. But what gives the self its unity, and can this unity be compromised and there still be a self? Who gets to make the claim that "this is a self, but that is not"? And just what is a "self"? Is it only a body? Is it a "mind" as distinct from a body? Certainly a person may believe, for example, that his unity consists in having the same body, or the same memory, or some such "essential." This is natural enough, for such beliefs are pervasive. But philosophers and scientists have offered arguments contrary to such beliefs, and one is often in the position of having to choose between existentially strong intuitions and empirically well-grounded arguments. This problem is suggestive of first-person versus third-person perspectives on personal identity.

Second, there is individuation of a person. Perhaps considerations of being a person do not demand the unity that has been naturally assumed. Neurological investigations and psychological studies challenge any easy assumption of unity. Earlier, it was noted that the brain can be divided, either physically (e.g., by surgery) or artificially (by a Wada procedure). The surprising result of such a division is what appears *prima facie* to be a division in consciousness, or if not a division in consciousness, then a doubling or even a creation of consciousness. The options of dividing, doubling, or creating consciousness are really at issue in viewing the mind as a potential emporium. If the brain can be divided into 2 cognitively functional modules, perhaps it can be further modularized into yielding 3, 4 or n number of cognitively functional modules; thus, perhaps consciousness can be divided (our doubled or created) so as to yield 3, 4 or n consciousnesses. But divided into what--fragmented persons or new persons, or perhaps into something merely resembling persons? Again, these are issues to be explored, and at least tentative explanations can be made.

Finally, there is the inward perspective. It is often surprising for one to come to understand that "the self I am, is not the self I was." But it is even more radical for one to misunderstand or be outright *wrong* about the boundaries of one's own inward perspective. In two ways, one's belief about one's own unity could be wrong. First, this admission could simply mean the weaker, "I've changed." Events happen, and persons find themselves with different dispositions and characteristics. For example, one might have had a disposition to retreat from spiders, but then got over it. Or one might have been a loving person, but after a military stint become uncharacteristically cruel. These are interesting and surprising psychological changes. But a second, stronger and more troublesome admission is "I am not the person I thought I was; in fact, I'm separate and distinct from the person whom I thought I was." With either admission, the issue of memory and its role in personal identity becomes paramount.

4.2 The Individuation of a Person

"She's not me." "I'm not her."

- Sara and Rebecca, age 10 and identical twins, upon being asked how they tell themselves apart.

4.2.1 Introduction

Whatever other problems split-brain patients present to a philosophical account of mind and personhood, two classic questions of personal identity immediately arise. First, what are the criteria for the numerical distinctness of persons who have the same general description? Rorty (1976) reports that this is sometimes known as the "problem of individuation" (2). Second, there is a concern over individual identification: "what sorts of characteristics identify a person as essentially the person she is, such that if those characteristics were changed, she would be a significantly different person, though she might still be differentiated and re-identified as the same?" (2). In the investigation of split-brain patients, the first problem, that of individuation, is of primary importance for my project (although one cannot separate the second problem, that of identification, from any analysis.)

The main thesis of my project has been that the right hemisphere of the brain has its own, independent conscious states over the course of Sperry-type experimental conditions. I would now like to defend an ancillary thesis as well–namely, that under Sperry-type experimental conditions the right hemisphere is a person. This reasoning for this is as follows: (1) Anything that has conscious mental states over time has a unity of consciousness. (2) That thing which is identified as having a unity of conscious is a subject of mentality. Moreover, (3) since a person just is a subject of unified consciousness over time, and (4) since the right hemisphere has now been shown to have conscious mental states; this is why, in the end, it must also be accounted a person.

Premiss (1) merely acknowledges the temporal component of the Sperry-type experimental conditions, for there is a significant duration of time under which the right-hemisphere independently operates. Premiss (3) is a commonly held definition of person, while premiss (4) is what has been defended thus far in the project. This leaves (2) as the key premiss needing defense. In order to defend (2), I must show how we can speak meaningfully of a single subject of mentality (that being the patient who sits down to begin a Sperry-type experiment) initially fissioning into two subjects of mentality and then subsequently re-fusing back into a single subject of mentality. To this end, I offer up a theoretical structure which allows us to discuss the fissioning and re-fusing of some subject of mentality over the course of a Sperry-type experiment, and thus allows me to affirm (2) in support of my overall goal of accounting the right hemisphere as a person.

An Investigation of split-brain phenomena will present its own set of puzzles regarding how the personal identity of the split-brain patient should be interpreted given the phenomena observed under Sperry-type experiments. How convenient it would be if there were some theoretical apparatus available with both a controlling concept and a subsequent theoretical structure developed from this concept that would illuminate how a single mind fissions and subsequently re-fuses over the course of Sperry-type experiments.

In this section I argue that there is indeed such a structure available, which I dub 'Individuation Theory.' Yet I can make a case for such a structure only after I have first framed 'Knot Theory' and 'Hole Theory' within an even more general structure called 'Disturbance Theory'. To this end, I first briefly identify Disturbance Theory. Next I sketch out a short history and application of Knot Theory, and subsequently relate it to Hole Theory. I next formally reinterpret the semantics of Hole Theory to yield Individuation Theory. Such a reinterpretation is desirable because the original brain-mind relationship is difficult to understand, but Individuation Theory draws on the detailed theoretical structure of Hole Theory, and thus makes inferences about the brain-mind relationship much more efficient than they would be if we reasoned about them only as raw phenomenon.[36]

4.2.2 Disturbances

It turns out that Knot Theory and Hole Theory, or rather their primitive objects--i.e., "knots" and "holes"--can fall under a more general and related notion, namely that of a "disturbance." Toomas Karmo (1977) introduced the notion of a disturbance as an object or entity found in some other object, "not in the sense in which a letter may be found in an envelope, or a biscuit in a tin, but in the sense in which a knot may be in a rope, a wrinkle in a carpet, a hole in a perennial order, or a bulge in a cylinder" (147). Moreover, knots and holes can be directly perceived as related, for the crossed structure of a knot serves as a host to holes.

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[36] This schema for noting the desirability of Individuation theory was suggested to me by (Swoyer 2002).

4.2.3 Knot Theory

Sailors, weavers, fisherman, surgeons, mountain climbers, not to mention Boy Scouts--all of these, whether for earning money, saving lives, or just saving face at a campout, are playing with the encarnalized entities of Knot Theory. Knots appear cross-culturally, both as aesthetic items in artwork and as parts of religious ceremonies and, obviously, as practical appliances for keeping things connected in the world.

There are hundreds of diverse types of knots, and mathematicians, for recreational, and more recently, for professional and practical purposes, have been concerned with doing mathematical research on these common structures. Mathematical research uses the basic rules of logic and a host of tools to assemble *a priori* components in order to describe an otherwise obscure structure. "Occasionally the fog lifts just enough to reveal unsuspected links between disparate elements" (Peterson 1992). Only a decade ago, few mathematicians would have guessed that the study of knots would join together several areas of mathematical research. But recent studies in Knot Theory have connected various mathematical specialties, showing domain specific problems to be different facets of a more general problem.

Given the length of tenure for other ideas in mathematics, Knot Theory is relatively young. The genesis for the systematic study of knots came more than a century ago when chemist William Thompson (who became known as Lord Kelvin) became dissatisfied with the then current theory that atoms were hard spheres held together by mysterious forces. Instead, he imagined "atoms as minute, donut-shaped vortices of swirling fluid embedded in a pervasive space-filling medium called the ether" (Peterson 1992). He further speculated that these vortices were bound together by forming tiny knots. Later, a Scottish chemist, Peter Tait, began cataloging knots and ultimately created a crude table where he classified each knot by the number of times its strands crossed. Tate and some of his associates spent a number of years on the project, and in the end they were responsible for giving birth to a new field of mathematical relationships (Skerrett 1994).

From a formal mathematical standpoint, knots are "one dimensional curves sitting in three-dimensional space that begin and end at the same point and never intersect themselves" (Skerrett 1994). Linked rings such as the Olympic insignia are considered knots. Shoestrings, bowties, and large balls of string, however, are not knots under this technical definition. As De Witt Sumners, a Florida State mathematician explains, "if a knotted string has loose ends, it's really not a knot, since you can always slide a free end around and eventually, if you have the time and patience, get back to a nice, untangled line" (Skerrett 1994).

The key of Knot Theory is finding a classification system sufficient to differentiate each and every knot by using a single label. Knots are difficult to classify because a single knot can be twisted and rearranged into what appears to be a different shape, yet by extended rules of topology classification, it remains essentially the same. Mathematicians have proposed different methods for knot characterization--for example, imagining them as tubes in tight configurations that give a distinct ratio of volume to surface area. University of Iowa mathematician Jonathan K. Simon explains that "such methods potentially offer a practical approach to knot classification" and "lead us to understand and predict how different knot types behave in real physical situations" (Peterson 1996).

It turns out that knots turn up across all manner of different areas in mathematics. Developments in Knot Theory have provided valuable insights to chemistry, physics, and biology and have allowed researchers to form deep connections between problems of characterizing knots and problems within otherwise disparate areas of mathematics and science.

Thanks to these newly recognized connections, Knot Theory is now emerging as a powerful tool for solving a broad array of problems. "It explains how tightly coiled DNA manages to replicate inside cells. It is helping to find the very structure of [quantum] space. Knot theory is aiding the search for effect antibacterial and anticancer drugs, and it may make computer networks more reliable and efficient" (Skerrett 1994). Furthermore, it is expected that the applications will continue to expand even further as the theory becomes more intricate and the knot theorists turn their attention to other real-world problems. This is considered quite an exciting turn out for a branch of mathematics that was once relegated to and derided as "recreational doodling for terminally bored topologists" (Skerrett 1994). Mathematician Albert Thaler writes, "it is so satisfying to see all this mathematics that we've had sitting on the shelf for 25 or 50 years now being put to use in a stunning variety of disciplines" (Skerrett 1994).

Sometimes the applications of Knot Theory come about when physicists find direct connections and similar problems between descriptions of physical phenomena in comparison with the structures of Knot Theory. The most exciting developments are in quantum mechanics and in molecular biology.

In 1984, Vaughn E. R. Jones at the University of California, Berkeley, found a connection between Knot Theory and mathematical techniques that undergird quantum mechanics. His particular breakthrough came when he discovered a powerful new method for labeling knots. "Much to everyone's surprise, his startling new approach shared equations with quantum physics and statistical mechanics, the study of systems with a massive number of components" (Skerrett 1994). Lewis Kaufmann, a mathematician from the University of Illinois at Chicago, who is widely credited with exploring the connection between Knot Theory and the physical sciences, writes that "the discovery that Jones made linking statistical mechanics and knot invariants [formulas that describe knots] immediately got people wondering how close this relationship was and where else it might lead" (Skerrett 1994). Two other physicists, Carlo Rovelli and Lee Smolin, were doing work on the fabric of space and noticed that a new translation of Einstein's equations bore an uncanny resemblance to equations drawn from Knot Theory. Rovelli suggested building the new translation's equations with different knot polynomial equations that described specific types of knots. This went some way toward unifying a theory of quantum gravity with general relativity and quantum mechanics (Skerrett 1994).

Another application of Knot Theory is in molecular biology. Lipkin notes that "within the watery world of living cells DNA molecules do a torturous dance. First the chainlike strands wind themselves into helices. Then they bend and twist again, folding into gnarled supercoils" (Lipkin 1994) Many are familiar with the structure that resembles a tangled braid, but in fact the DNA supercoil has been interpreted as a type of knot that ties itself up according "to rules governing its geometry and electrical forces acting on it from the liquid surroundings" (1994). The loops and links of the DNA chain pose serious problems for the enzymes that copy DNA and manipulate its genetic information. Also, it is currently thought that Knot Theory will provide the crucial topological analysis for understanding these enzymes. Summers believes that Knot Theory "lets you decide the enzymes' reaction mechanism" (Skerrett 1994). Avner Friedman speaks to many mathematicians' optimism when he writes, "Knot Theory is really the next chapter of the DNA story" (Skerrett 1994).

While Knot Theory has been reinvigorated by practical application, this should not imply that practical concerns are always tantamount. John Sullivan and associates at the University of Minnesota's Geometry Center want to know "what happens when you distribute a negative charge evenly around the computer drawn knot. 'I can't imagine what practical use this might have,' he says. 'But mathematicians have great faith that if you find something that exhibits really interesting patterns, it will eventually have some application.'" (Skerrett 1994). Perhaps Hole Theory, a corollary system to Knot Theory started out just as an exercise in noting interesting patterns.

I have spent time discussing knot theory because it is a structure that has found many applications across a wide range of sciences for describing features we encounter in the world. Since Hole Theory is a corollary system to Knot Theory, this warrants us to think it likewise would describe certain features we encounter in the word. Indeed, it does. I now move to discuss Hole Theory, which will offer its formal structure as a base for reinterpretation into Individuation Theory.

4.2.4 Hole Theory

Currently the most extended and rigorous treatment of holes is found in Roberto Casati and Achille Varzi's *Holes and Other Superficialities* (1995). A few months before beginning this joint project, Casati was making a presentation on perception in Geneva. During the meetings there, holes were sometimes mentioned as problematic objects of perception. At the same time Varzi was "struggling with truth-value gaps and other harassing semantic nonentities, and was starting to develop a hyper-realistic attitude towards them" (Casati and Varzi, ix). Soon enough, Casati and Varzi met during a lecture on the logic of ordinary objects, where holes and other immaterial objects were accounted as troublesome entities. At this point they decided it would be "natural to join our efforts and face this neglected side of reality once and for all"(ix).

People's naive reasoning about space and things that occupy space involves reasoning about holes and holed objects. People avoid holes when walking, place things in and through holes, quantify them by measurement. They enlarge holes, fill them up, and compare them with one another. "What exactly holes are, or even whether such dubious entities do indeed exist, these are of course questions one eventually needs to address in order to make good sense of such forms of reasoning" (Varzi 1996, 1).

In the poem or poem-like philosophy of Parmenides, he writes "There is" as his first sentence, and in the same line of that poem a second existential sentence--namely, "There is no not-being" (Cleve 1973, 528). Typically this has been rendered, "There is no nothing." So when one considers holes, it would not do to say they are made of nothing or that they are token instances of nothing. If one is unwilling to accept as meaningful utterances that "holes are token instances of nothing," then the burden is on anyone who would step up to identify just what holes are.

Casati and Varzi "argue that to say that there are holes is not a mere *facon de parler* [manner of speaking]." Nor are holes properties, but a special type of particular called *superficial particulars*:

> They are dependent particulars: they cannot exist alone; they need a host at the surface of which they find a place to be. They are not abstractions but individuals,

> although they are not made of anything but space. [. . .] They are immaterial bodies, located at the surfaces of their hosts and provided with some very primitive properties. (6)

The conceptual framework of holes allows its described elements to have, within limits, a mereological structure. Holes can move, fuse into one another, and even split. Holes "can be causally responsible for, or causally subject to, several different phenomena." Holes also can be born, develop, and even die. As a pithy but paradoxical sounding synopsis of their whole project, Casati and Varzi claim, "A hole is there where something isn't" (7). At first encounter, one gains a feeling in the face of such talk similar to what Aristotle apparently felt when considering Parmenides' philosophy--"But, obviously, to think in this way in real life verges on insanity" (Cleve 1973, 524).

While not quite insanity, there is good reason to see why their position creates dismay for the traditional card-carrying materialists. One of the chapters in Casati and Varzi's *Holes* is titled "Immaterial Bodies," which is just what holes are. Holes are either outright immaterial bodies (cavities) or else pairs of immaterial bodies (hollows and perforating tunnels). They are "made of space only, without having to be identical to any region of space, and they live an intrinsically parasitic life" (37).

Casati and Varzi come to this position because two earlier theories of holes show themselves to be inadequate upon careful scrutiny. The first of the two earlier theories holds that holes are superficial parts of their hosts. But this position is dismissed because, as Willem (1995) summarizes, "it is too reductive and ties a hole too closely to its host, for the hole would then share too many properties with the surface of the host" (316). After all, surfaces are two-dimensional geometrical abstractions (gained through perspective), but yet still "parts of the objects of which they [surfaces] are boundaries"

(Casati and Varzi 1995, 11-12). Willem continues his summary of the second theory and its problems:

> Theory 2, defended by Stephanie and David Lewis, is that holes should be identified with hole-linings. Casati and Varzi spend rather more time dismissing this theory, since it has been ably defended in the literature. They review the objections to which the Lewises' reply, but put the heaviest emphasis on the fact that [such a] theory would require a radical change in the meaning of certain predicates, e.g. "surrounds" would mean is identical with, "inside" would turn out to be ambiguous, particularly when what is inside one hole is another hole, and "enlarge" would sometimes have to mean make smaller. Finally, since hole-linings are themselves only potential parts of their hosts, we have a far fuzzier conception of their identity criteria than we have of the identity criteria of holes, which are often highly salient. (316)

In light of these problems, Casati and Varzi conclude that in as much as one lacks "complete clarity about the onto-logical status of potential parts," one ought to "avoid ontological commitment to them, and the whole project of explaining away holes by reference to hole-linings becomes at least suspicious" (30).

Frank Jackson offers a more radical alternative by proposing "not to identify holes with hole-linings, but to avoid all reference to holes by translating all hole statements into statements about hole-surrounds" (Willem 1995, 316). It turns out, however, that the hole-surrounds position falls prey to the same problems as the hole-linings position.

In the end, Casati and Varzi dub holes *ontologically parasitic entities*. While holes have an ontological dependence on their hosts, holes are nevertheless real entities. In a separate discussion (Varzi 1996), holes are distinguished from the purely conceptual (*de dicto*) dependence. Consider the sentence, "Every sister has a sibling." While there cannot exists sisters without siblings, it is false to say "of any sister that *she* could not have existed as an only child." Holes, in contrast, "cannot exist except as a hole *in* something, so it suffers from a form of truly *de re* dependence" (3). Because of this ontological dependence, there are no holes *simpliciter*; holehood is a relational property (3).

As a relational property, we can lay out a binary relation to express this primitive intuition of a hole being a parasitic entity: "Hxy" will stand for "*x* is a hole in (or through) *y*." From this notation, Casati and Varzi are able to lay down axioms to describe the constraints of host-hole relationships.

4.2.5 Reinterpreting a Formal System of Disturbances

As noted, the controlling concept of a "knot" and the theoretical structure that has been built around that controlling concept has illuminated how objects behave in the physical world. A theoretical apparatus already available was later found to be quite helpful in explaining interactions that had hitherto puzzled scientists. The case for the controlling concept of "hole" need be no different.

Hole Theory is a much more intricate calculus than propositional logic calculus, but it has the essential four components of an axiomatic system. There are *formal notions of vocabulary* along with *definitions* and *axioms* that allow *theorems* to be inferred.[37]

The most significant consequence of strict formalization is not a consequence that follows from the syntactical structure of a calculus with its various shuffling of variables and operations; rather, it is from the possibility of an interpretation. As a rule, a number of interpretations can be offered for a given calculus; moreover, there are often a number of interpretations for a formal calculus that can lead to applications in completely different areas of discourse. This was noted for several scientific applications using Knot Theory. Not surprisingly, the calculi of Hole Theory offer the same opportunity.

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[37] Those unfamiliar with axiom systems may consult Appendix A for a short review.

Since holes are types of disturbances, and since minds can be taken, *pro tempore*, as types of disturbances, it seems a natural move to reinterpret the formal system of holes with the semantic terms of mind. Varzi (1996) writes that "countenancing holes calls for some explicit theory (i.e. set of principles) about these entities--their identity conditions, their part-whole relations, their patterns of interaction with the environment" (2). Anyone concerned with personal identity faces the same problems when countenancing minds.

What is required of an interpretation is that there be a group of terms of the theory that can be given ordinary language meanings that can then be reliably applied independently of the theory. The only demand is that any relevant relations among the meanings of these terms, or among the meanings of the special (non-ordinary) terms of the theory, or between meanings of special terms and ordinary terms, be expressed explicitly as meaning postulates or axioms of the theory. It does not matter that some of these ordinary terms are more or less theoretical terms of ordinary language in the sense that they have meanings that are not given purely ostensively--after all, one does not point to a mind. There is no obligation to reduce all the terms of every formal system to terms that can be explained ostensively. On that position, what would speculative metaphysics be? Where would Number Theory develop? Whatever else we learned from cliché logical positivism, the answers clearly are not "nothing" and "nowhere".

However, since it is human beings who are being investigated here, it is reasonable to suppose that at least some terms, ultimately, must be related to terms that are ostensive in the sense that they can be interpreted according to semantic rules of the sort that allow us to interpret "brain," "body," and "connected" as objects of everyday experience. This supposition, however, is certainly not necessary to an understanding of formal systems, or of the activity of analyzing personal identity. Indeed, to insist on it would be distracting and would draw attention away from simpler and more relevant matters, such as: How is such and such a theoretical term, say "mind," related to other terms, say "encarnalizes," in the formal system? How are these related to the terms of ordinary discourse, such as "body" and "brain"? The later question may be asked quite independently of whether those terms of ordinary discourse to which it refers are relatively ostensive ones or relatively theoretical ones.

One of the key advantages of the formal approach is that the same calculus can be part of a number of systems; the form can be separated from the content, and the form common to two distinct systems of similar structure can be treated as a thing in itself and studied independently. Such a study is generally what applied mathematics leverages from pure mathematics in order to predict and explain events in the world. At some level, then, perhaps this is the same leverage a philosophy of individuation is applying to a particular calculus of disturbances, to Hole Theory. If so, it works just fine, for the purposes of speaking of a subject of mentality.

4.2.6 Individuation Theory

Consider yet again the lessons gained from Knot Theory. There, one looked for common notions evidenced among common structures of knots. These notions were then axiomatized for application to another area. Knots, being special disturbances, yielded fruitful insights for applications in physics, chemistry, and biology.

The notion of a disturbance was earlier noted as connoting an object or entity found in some other object, not in the sense of one object spatially within another, but in the sense of an object located 'through-in' another, to coin an odd preposition. The examples of disturbances hitherto under consideration have been "a knot is in a rope" and "a hole in a doughnut." But there is yet another fruitful application for the notion of disturbance: "a mind in a brain." By producing a formalized structure that can account for this last kind of disturbance, one can skirt an otherwise troublesome dichotomy that has arisen in discussions of personal identity.

Shoemaker (2000) identifies two traditionally opposed ways of understanding personal identity. The old way, that of determining "whether identity of a person over time requires identity of substance, has a musty smell to it" (478). It has been kicked around since the time of Descartes, and later with Butler and Reid, and even before that, if one considers the prevalence of the term in medieval discussions of the soul. The more contemporary way takes a view in opposition. Locke, for example, denies that the identity of a person over an interval of time requires the same substance that thinks within the person throughout that interval. And Hume thinks that talk of any substance at all is misguided, "unless our 'perceptions' themselves count as substances" (Cooney 2000, 479). Parfit is the most well known contemporary example of this latter camp.

As Casati and Varzi spoke of holes, one may likewise speak of minds. Minds are not objects just in a manner of speaking, but they are a special type of particular, a "superficial particular." Like their cousin "disturbances," they do not exist alone, but need a host, a brain, at which they find their place of being. Some brain encarnalizes a mind; a mind is located "in" or "through" (thus, "through-in") a brain. It is common to say that a mind is in a brain. Minds are not abstractions, yet, as types of disturbances, they are immaterial bodies encarnalized in brains, but immaterial bodies with identifiable properties nonetheless. When they are understood as superficial particulars, one then has a way of individuating minds, and this allows one to skirt the troublesome dichotomy that Shoemaker outlines.

The advantages of both ways of understanding personal identity are retained while the disadvantages are avoided. On the one hand, one may talk of individuating minds by attending to their ontological, mereological, and topological relationships to brains. On the other hand, one may avoid the radical reductionism often inherent in such discussions about mind by pointing out how there can be a parasitic but nevertheless real superficial entity that over time is sustained as a metaphysical complement to the brain.

Ultimately, it can be seen that the members of the metaphysical class *minds* are subject, albeit in a constrained way, to a mereological structure. Moreover, it also can be seen that just as does their cousin disturbances, holes, minds too "can move, fuse into one another, split. They can be causally responsible for, or casually subject to, several diferent phenomena. They can be born, develop, die" (Casati and Varzi 1995, 7), which is just what is happening to a split-brain patient under the conditions of a Sperry-type experiment.

So, just as for their most basic relation Casati and Varzi claimed that "{holes} {are located in/through} {hosts}," one may likewise lay down a reinterpretation for yet another type of disturbance: "{minds} {are encarnalized by/through/in} {brains}." This allows a full axiomatic system of Individuation Theory to be formed. (This system with some supporting commentary is presented in Appendix B.)

4.2.7 Conclusions

Framed as an axiomatic system, Individuation Theory is supposed to help us in organizing our thoughts by allowing us to see the full implications of the intuitive positions we happen to hold about persons and minds. Furthermore, in my project's specific investigation into split-brain patients, Individuation Theory shows that some of our commonly held notions about the mind entail that split brain/split-mind phenomena are something that we should expect to see. While one might initially suspect that these phenomena are so far out as to be unaddressable by our common notions, Individuation Theory has predictive value in showing us that this is not the case after all. The mind (along with associated mental properties) is "real" when viewed as a superficial particular, and real in the sense that otherwise more familiar disturbances such as holes and knots are real. At the very least, holes and knots (and other types of superficial particulars) can have causal effects on the world, while mathematical points, perfect circles, equators and the like–things Dennett dubs abstracta–do not seem to have this ability. Furthermore superficial particulars can be given a concrete physical location. Dennett's abstracta cannot. Hence, when we understand the mind as a dynamic convoluted three-dimensional superficial particular, Individuation Theory handles complaints that Dennett's fuzzy version of realism cannot, and is to be preferred at least on this basis.

Apart from whatever else can be said about Individuation Theory, it still commits me to the thesis that human beings are wholly physical entities; whereby, humans are best described in terms of a specially partitioned set of properties. The first set of properties are those associated with the language of the natural sciences (especially physics). The second set of properties are associated with the language of psychology (cf. beliefs, desires, consciousness, intention, etc). My desire to talk of immaterial bodies as encarnalized through-in material structures makes me a property dualist. Now there are several types of property dualists, but a broad distinction can be drawn in terms of weak and strong versions.

A 'weak' property dualist holds that there is a dualism of theories rather than a dualism of ontology or metaphysics. Cunningham (2000) summarizes:

> If mental properties are emergent in the same sense that color, solidity, and the properties of water are emergent, then they can be completely accounted for by physical theories. They are a special, complex version of physical properties, and their difference is captured by theories at a higher level of generalization than theories about atoms or electrons or neutrons. On this interpretation, 'mental' properties still belong within the framework of the natural physical world and might be seen on analogy with economic properties or aesthetic properties. [...] The Dualism is really a dualism of *theories* rather than a dualism of ontology or metaphysics [...] (34)

A 'strong' property dualist holds that mental properties are something nonphysical, a set of metaphysically unique properties which are, in Chalmers (1996) words, "fundamentally new features of the world" (125).

So on the one hand, I can say that I am a weak property dualist, since I hold that these special entities, these superficial particulars are a very nice way of talking about the dynamic information structure that constitutes our mind. On the other hand, I am tempted to say more than how this is just a nice, organized way of talking. For example, in talking about one type of "disturbance", I really do think there are holes, that they are real, sometimes even dynamic patterns in the world. So are knots, and perhaps a host of other disturbances. Yet since we do not have a very good handle on disturbances yet, and since minds are taken here as a type of disturbance, it is, therefore, hardly surprising that we do not have a good handle on just what a mind is. In light of this, I have presented

Individuation Theory as something better than what has been currently available.

4.3 Spectrums of Individuation: From Blindsight to Multiple Personality Disorder

4.3.1 Introduction

Several points in Individuation Theory would indicate that there can be more than one mind in a single brain. Ontology theorem 1.3 (see Appendix B) indicates that minds do not encarnalize one another, although they can have minds as proper parts. This is investigated with some detail in the Mereology component. As is generally indicated there, minds can have parts and can bear part-whole relations to one another. Of course, if minds can have proper parts, the exact relations between minds and mind parts, and also between minds and brain/brain parts must be outlined. This is among the most important roles of the basic axioms of the Mereological component.

Since several of the Mereological Axioms entail theorems (e.g., 2.1, 2.6) that would allow multiple minds in a single brain, a brain of which could be formed under different mereological conditions (e.g., T2.9, 2.10), it is appropriate to discuss multiple personality (or "Dissociative Identity Disorder"), fugues, and other such phenomena in regards to split-brain patients. To this end, the controversy over multiple personality disorder is first discussed. Then other phenomena that introduce similar worries about individuation are addressed--namely, blindsight, doubling, emotive disparities, separation of consciousness, and, finally, multiple personality

4.3.2 Professional Controversy over MPD

Multiple personality Disorder (MPD) is currently a controversial area in psychology. That this is the case can be seen in the very history of classification for the (alleged) disorder. Psychiatrists and psychologists use the *Diagnostic & Statistical Manual of Mental Disorders* (DSM) to provide a framework for labeling various psychological disorders. The International Code of Diseases (ICD), an international classification of all medically accepted diseases and disorders, also uses its terminology.

Originally, MPD was a subsection of "Hysterical Dissociative Disorder" and did not have its own diagnostic code number. But in the third edition of DSM, enough mental health workers were recognizing MPD in their clinical practices often enough to legitimate giving MPD a diagnostic code number and some defined characteristics. As Dennett summarizes the third edition's claims:

> The accolade of "official diagnosis" was granted in 1980, with an entry in the clinician's handbook, DSM-III: 'Multiple Personality. 1. The existence within an individual of two or more distinct personalities, each of which is dominant at a particular time. 2. The personality that is dominant at any particular time determines the individual's behavior. 3. Each individual personality is complex and integrated with its own unique behavior patterns and social relationships.' Typically there is said to exist a "host" personality, and several alternative personalities or "alters." Usually, though not always, these personalities call themselves by different names. They may talk with different accents, dress by choice in different clothes, frequent different locales. (Humphrey, N., and D. C. Dennett. 1989)

Eventually a backlash began against this stance. There had always been worry that such a disease was, only a "candidate phenomena" (Humphrey, N., and D. C. Dennett. 1989) and not a real psychological disorder. When the committee of experts met to decide what disorders should or should not be listed in DSM IV (and subsequently in ICD-10), there was internal debate between treatment therapists and academy researchers. Ralph Allison (2001) offers some political analysis of the debate:

> The teachers could not agree that MPD could be an accurate label for anyone. The treaters on the committee did not know how to explain that in practice, if not in theory, their patients acted as if they had other personalities. The teachers decided that the patients had the major mental problem of believing that they had more than

> one personality. The goal of therapy should not be integrating the various personalities, but getting the patients over their false belief (delusion) that they had other personalities at all [....] So the patients still had a problem, but it was redefined as a different problem than the one their therapists were treating them for. Instead of therapists trying to integrate "alters" into an original personality, they should now focus their attention on the patients "delusion" that they did not have a single identity.

It finally turned out that the International Code of Diseases, edition 9, did not accept DSM IV as the official sub-section on Mental Disorders, but merely listed Dissociative Identity Disorder as a synonym for MPD. Allison makes the ironic observation, "So, in the world outside the USA, MPD still exists. Only in the USA have all multiples been told they have a false belief that they have alters running their bodies."

As MPD is a controversial claim about brains and minds, it is best to first introduce phenomena that are not so significant but which present similar issues for individuation. Perhaps then some rather conservative observations about multiple minds within certain patients with mental illness can yield informative analysis for some split-brain phenomena.

4.3.3 Blindsight

The blindsight phenomenon allows people to perform tasks they claim they cannot see. Indeed, this appears to be the case. For example, a person may have a brain lesion that does not allow him or her to consciously process visual input. If one were to say to such a person, "Please stick an envelope in a horizontal or vertical slot," this person would honestly reply that he or she could not see the slot from his or her angle of observation. But when one tells the blindsight person to merely "guess" when placing the envelope, he or she will perform the task accurately, or at least above the rate of chance.

This raises a question: why do we presume there is still one patient under these conditions? It seems that one could make a move analogous to split-brain phenomena and say that there is another person there, with a very rudimentary mind that can actually perceive what is going on. It just happens that one person and another person do not know they co-exist together. So we have a very simple mental entity that can do simple tasks, but the brain of the original patient is not aware of this other simple entity. Somehow we think that in the blindsight case there is a failure of a single patient to perform a task becauase of brain damage. But we do not think that in the split-brain case there is just one patient, or at least we are highly tempted to think there are two patients. Yet, why are there alleged to be two patients in split-brain cases while only one in blindsight cases?

Perhaps in the split-brain case the empirical feedback is sufficient, for we can actually query the hemispheres on what they just saw or did. They can either draw pictures or report orally. But in blindsight cases, when we query the patient on what has occurred, we get only a single, albeit inaccurate, response (or professed ignorance of any response). If split-brain patients did not give us feedback upon query, we might not be so quick to presume double consciousness. In both blindsight and split-brain cases, the patient gives verbal reports that do not accurately describe what the body of the patent is actually doing. But verbal reports are not enough, when only the left hemisphere controls speaking. So we rely on other means, such as facial or written signals, either using unspoken behaviors, or drawings or waving of hands for agreement or disagreement. The right hemisphere will in fact do these sorts of things when disagreeing with the verbal reports of the left hemisphere, as two examples show:

> [1] If a concealed object is placed in the left hand and the person is asked to guess what it is, wrong guesses will elicit an annoyed frown, since the right hemisphere, which received the tactile information, also hears the answers. If the speaking hemisphere should guess correctly, the result is a smile. [2] A smell fed to the right

> nostril (which stimulates the right hemisphere) will elicit a verbal denial that the subject smells anything, but if asked to point with the left hand at a corresponding object he will succeed in picking out e.g. a clove of garlic, protesting all the while that he smells absolutely nothing, so how can he possibly point to what he smells. If the smell is an unpleasant one like that of rotten eggs, these denials will be accompanied by wrinklings of the nose and mouth, and guttural exclamations of disgust. (Nagel 1991, 434)

The blindsight cases are considered one person, because there are not intra-body communications that would otherwise indicate such disagreement, but in split-brain patients, we do have such intra-body communication disagreements, thus counting as further evidence for their being two streams of consciousness within these patients while they are under Sperry-type conditions.

4.3.4 Doubling

Doubling is the development of a "barrier" where a person can substantially isolate two incompatible modes of life. For example, one might be a Nazi doctor or government-funded torturer in the afternoon, but a loving father in the evening. How can these dichotomous forms of life coexist in one person? Unlike multiple personality patients, these people do not have compartmentalized amnesia, but simply do not dwell upon their professional self when living as a "ordinary self" (Glover 1988, 23).

4.3.5 Emotional Dichotomy

In the case of split-brain patients who, on the one hand, do not have cognitive access between hemispheres, yet on the other hand do have emotional access between hemispheres, one is left with the problem of determining whether this is two people or one person, even if one ignores how the patient performs on standard perceptual tests (such as when the patient merely manipulates objects or recovers pieces of words). If two beings were to share the exact same emotional state--that is, they share a state that obtains from the exact same stimulus--this might stand alone as evidence that the patient is one person. Parallels to this might be seen in multiple personality patients where some subset of the personalities is angered at the same event that the patient has had to endure. Standard cases of fission would not be able to address this problem of emotions. The two fission subjects, although they would be experiencing the same type of emotion, would not be experiencing the same token emotion. They would be perceiving some given event (the one that caused the emotion in question) from slightly different perspectives, e.g., one subject would be standing slightly to the left the other to the right. But in the case of the split-brain patient, we have both hemispheres experiencing the same token emotion. Perceptual input to the hemispheres is shared before transfer. (Probably by means of the interior commissure.)

4.3.6 Multiple Personality

Earlier, in part two, we argued that the corpus callosum normally functions as the unifying element of a single mind within humans and is sufficient for unifying the entire brain's network activity, thus unifying consciousness. This is still true even in multiple personality subjects, for subjects do not suddenly lose their ability to recognize that a face is present, to add, or to sort geometric shapes when a new personality phases in. Any separation of consciousness is discrete along a timeline and not simultaneous as in a Sperry-type experiment.

What arguments are there that claim there is no such thing as multiple personality? Perhaps the following is an example: an actor can certainly behave like he is four or five different people, although he still knows none of the personas are actually who he is. An actor seems analogous to the multiple personality case. Knowing that one has multiple personalities precludes one from actually being a multiple personality.

This is a critical empirical question. How many people *know* that they are multiples apart from being told by an external source? Can one autonomously discover that he or she is a multiple or must it be revealed by an outside observer? So then the first issue is knowing (or not) that one is multiple. I suspect that genuine multiples do not know they are so just from a first-person perspective, but must build up a collection of third-person cues to this hypothesis.

Another issue: can multiples voluntarily switch their personalities even after being informed of their being a multiple? True multiples involuntarily switch back and forth. They cannot actively control the process, or at least the original person cannot control the process, for if they could, they would be no different than professional actors who "forget themselves", as it were, within a role.[38] But it seems to be the case that other non-original persons within the body can "hand-off" to other non-original persons within the patient.

I think analogous claims can be made regarding split-brain patients. Under the conditions of Sperry-type experiments, the patients do not seem to recognize that there is a parallel consciousness operating within the same body. One difference between the split-brain patient and the multiple personality patient is that in the split-brain patient there is no "original person", since both hemispheres stay conscious during the Sperry-induced circumstances. One does not have the luxury of using a chronological criterion to identify

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[38] One caveat here is that sufferers of MPD might be able to initiate a switch by voluntarily placing themselves in the kind of situations that bring on high enough levels of stress to cause a shift to another alter. This would a passive type of control.

some original person. In contrast, it is common in sexual abuse cases to identify the original person as the one present at the impetus of the abusive act.

Of course one might be tempted to assume that the left hemisphere is the original person, since it is the one that maintains linguistic ability and uses it to communicate to the researcher. But this would be using an arbitrary criterion to determine the original person. One could just as well use facial identification abilities, which is normally a strength of the right hemisphere.

4.4 The Inward Perspective

4.4.1 Memory

> *"Following the surgery, each hemisphere also has thereafter its own separate chain of memories that are rendered inaccessible to the recall processes of the other."*
>
> *- (R. W. Sperry 1967)*

4.4.1.1 Introduction

Traditional uses of memory in analysis of personal identity seem to lean on a misclassification of this faculty. I first review a typical classification of memory, show where this fails, and present a more useful description of one key component of memory. Second, I apply this component to an analysis of self-identity in animals and then of personal identity in right-hemisphere patients. Finally, I end by modifying a Lockean view of memory as essential for personal identity and apply that to a description of the right hemisphere's personal identity.

4.4.1.2 The Identity and Classification of Memory

In order for a thinking thing to consider itself as itself in different times and places, it must have a *memory*, a way of retaining and retrieving its past experiences. When experiences influence subsequent behavior, a person is said to be *remembering* something. So, too, is the operation of memory essential for learning. As Squire notes, "Learning is the process of acquiring new information while memory refers to the persistence of learning in a state that can be revealed at a later time" (Gazzaniga, Ivry, and Mangun 1998, 247) Memory is the outcome of learning. Practice results in a cumulative effect on memory leading to skillful performance. The ordered behavior of a thinking thing requires memory, and remembering is a prerequisite to reasoning, for the ability to solve a problem demands that one recognize a problem exists, and this means depending on memory.

Memory is also the crucial element in personal identity. John Locke's view, for example, was especially committed to memory alone as being the essential element for identity of persons over time. Yet as Noonan (1991) points out, our notion of memory is very wide:

> I can be said to remember my 7 times table, or that Columbus sailed the ocean blue in 1492, or that I am due to take my son to a football match next Saturday. This is factual memory, retention of previously acquired knowledge. I can also be said to remember how to pilot a plane or to do a handstand. This is retention of previously acquired abilities. But there is also the memory of events witnessed or participated in, typically reported in the form: "I remember X's F-ing' (as opposed to the typical report of factual memory: "I remember that x F-ed'), and, as a special case of such event-memory, there is the memory of one's own experiences and actions, which one will report in first-person memory claims. (11)

While important for its caution against memory as a singular faculty, Noonan's taxonomy of memory is not as helpful as it might appear. Under which of these classifications would the short-term or, better, "buffer memories" for the various sense modalities fall? It is unclear.

4.4.1.3 Buffered Memory for Sense Modalities and Introspection

Consider, for example, the visual memory system. While the auditory system maintains a sensory memory bandwidth of about 10 seconds, this is far longer than visual memory, and most likely because listeners must maintain enough information to understand a speaker who articulates to them a complex sentence (Gazzaniga, Ivry, and Mangun 1998, 254). Consider the case of reading standard English texts. When doing so, the eyes move from right to left, dropping a line as the page progresses. When one learns to read, one has a factual memory that the eyes move from left to right and drop a line. Eventually, however, this becomes an automatic action. Thus, one retains a fact about reading, develops and retains an ability to move the eyes appropriately, and then comes to ignore the factual and ability component only to find that the relevant eye movements have been retained by an event memory. As any elementary school teacher will attest, this movement from learning to read to auto-action reading does not happen all at once, nor sometimes, as in the case of dyslexia, in a consistent fashion. Noonan's taxonomy of discrete memory types, therefore, seems more a convenient way of talking about memory than an accurate description of how a brain's underlying control structures come to produce memory.

As noted, the auditory system and the visual system have different bandwidths. One might then begin to worry about the bandwidth of personal identity. It seems easy enough to ask oneself what one thought a few seconds ago, but it is far more difficult to ask what was on one's mind 20, 30, or 40 seconds ago. There can be introspective memory as well. One can recall, "A moment ago I was wondering whether I went to the store yesterday or the day before, but now I'm playing tennis." Just as in the sensory memory case, experiments can be set up to ask what persons remember hearing or seeing, one can likewise reasonably posit that there would be neural substructures that support the memory of immediate introspective actions of consciousness, so these, too, would have some bandwidth detectable by empirical procedures. From such a presence of bandwidth, limits would likewise be noted concerning just how many introspective acts could be maintained in what might be dubbed buffered introspective memory.

4.4.1.4 Self-Image in Animals and Humans

Ned Block (1997c) defines self-consciousness as the possession of the concept of the self and the ability to use this concept in thinking about one's self (389). By invoking the phrase "one's self," Block is actually moving within the discourse of personal identity and not speaking of just consciousness proper (as was analyzed earlier in part two). Although he speaks of experiments on animal consciousness, there is a tacit demand for positing a buffered introspective memory.

As he reports, some of the experiments on animal self-consciousness involve placing animals in front of mirrors with an ear painted with a florescent spot. Higher primates are known to show interest and recognition when they see themselves in mirrors. Other animals treat mirror images as strangers. Chimpanzees between the ages of 7 and 15 will try to clean the spot off, as babies will under similar conditions after about the last half of their second year (Block 1997c, 389).

Animals that are bothered by the mirror presentation must keep a particular view of themselves in consciousness over time. When this body-image memory is inconsistent with what is seen, the observed behaviors are not surprising. What is important to take away here is that there is indeed a continuity of memory of the self. In this case there is an immediately buffered introspective memory of what the self should look like in contrast to what the self does look like. Occasionally, humans are caught in a very unpleasing and more amplified contrast between these two poles when, for example, someone wakes up after a number of years of being in a coma and looks into a mirror.

4.4.1.5 Longer-Term Memory

The relation of a buffered introspective memory would have similar functional interactions with a longer-term introspective memory just as buffered sense modality memory has functional interactions with longer-term memory. In fact, Francis Crick and Christoph Koch (1997) argue that long-term episodic memory is not essential for consciousness since there are patients with brain damage who, while they cannot lay down new episodic memories, nevertheless appear in all other relevant aspects to be fully conscious (279).

Long-term episodic memory is a pivotal issue when we move to discuss whether the right hemisphere is a person or not. It appears as if one has the ideas of a mental natural kind called a *self*, and that there is one of these special kinds present (or not) within the split-brain patient. At first glance, it might appear that the left hemisphere has a self, but the right hemisphere does not, since the right hemisphere does not command the longer-term introspective abilities of the left hemisphere. But there is no monadic, independent essential self, only a question of longer- or shorter-term buffered introspective memory bandwidth. The idea of a hemisphere's personal identity, therefore, is a merely a question of degree--namely, the degree of introspective bandwidth and, of course, any additional information that has been transferred from this buffered introspective information into longer-term memory. Since it is not the case that all buffered data gets passed-on to longer-term memory, one can rule out what is called 'psychological connectedness' as essential to personal identity just on the basis of what is known about retention alone, and without recourse to a separate argument of retrieval.

4.4.1.6 A Neo-Lockean Position Using Newer Memory Models

As a general claim, memory for skills and procedures, semantic memory, perceptual presentations sensory registration. and working memory can all be shown by cognitive theory and neuroscientific evidence to be separate but interacting parts of the brain. The brain indeed has multiple cognitive and neuro-systems that support these different aspects of memory (Gazzaniga, Ivry, and Mangun 1998, 287).

Locke holds that personal identity is tied to memory, so one must carefully consider which among the various distinctions of memory are relevant to maintaining personal identity. Unfortunately, this has not been done, and Locke's position comes off as much weaker than it actually is. But if Locke's position is reconsidered in light of contemporary research into memory, such as by noting the presence of a buffered introspective memory, some of the key questions of personal identity can be addressed anew.

When, one may ask, is personal identity compromised? A specific example: How much amnesia, whether retrograde or anterograde, [39] actually distinguishes a new or different personal identity? Memory is not equally distributed throughout the brain, but various substructures "form systems that support and enable rather specific memory

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[39] 'Anterograde' amnesia - Inability to remember ongoing events *after* the incidence of trauma or the onset of the disease that caused the amnesia. 'Retrograde' amnesia - Inability to remember events that occurred *before* the incidence of trauma or the onset of the disease that caused the amnesia. (Adapted from Stedman's Medical Dictionary, 27th ed.)

processes" (Gazzaniga, Ivry, and Mangun 1998, 288). One of the more important distinctions is drawn between declarative and procedural memory:

> *Procedural memory* in humans is related to the knowledge of rules of action and procedures, which can become quite automatic with repetition. When one studies a learning curve of some task, we can see that performance is improved (either by less errors or quicker responses, or by a combination of both) with the number of repetitions of that task. Having a lot or little "practice" with certain task is procedural knowledge. Nonassociative learning and most classical conditionings produce procedural memory. *Declarative memory* involves explicit information about facts. To remember one's telephone number, or the names of the parts of the neuron, does not require a set of rules or procedures, it is explicit and involves associations with other events. To put it colloquially, declarative memory is what we know consciously, and procedural memory is what we perform unconsciously. [....]Although this division of memory seems arbitrary at first, it is very useful in neuroscience since each type of memory probably has different types of neural substrates. For instance, the hippocampus and temporal cortex seem to be involved in the formation of declarative memory, but not of procedural memory. Whereas certain nuclei of the cerebellum and spinal chord seem to be necessary for procedural memories to form, but do not intervene in declarative memory. Due to this anatomical organization, declarative memory is said to be controlled by higher brain mechanisms, while procedural memory appears to depend on lower regions and systems.(Gutierrez and Ormsby 2002)

Here then suggests another way of engaging the Lockean view of memory with more modern distinctions. As regarding how memory contributes to what precisely forms our personal identity, would the reference be to declarative memory or procedural memory? Again, studies on people with amnesia reveal that they do not lose all of their memory. Even if such patients lose (or lose access to) large stores of explicit memory, they do not lose the memory of how to use a fork, how to sit down or stand, and so forth. If one were going to quantify the information that we have in memory, declarative memory would seemingly have far less information about the world than procedural memory. But it is difficult to see how one could quantify memories into discrete natural kinds, for there seems to be overlap and cooperation among various types of memory in performing actions.

This, of course, leads one to ask the question, 'just how much (even on a duly modified memory criterion) would be required, were clear quantification procedures available for memory, to maintain one's personal identity?' It turns out this is yet another personal identity question with a musty smell to it. There is merely the degree of active and transferred information from the introspective buffer, just as there is from sensory modality buffers.

4.4.1.7 Pointing, Memory and the Right Hemisphere's Personal Identity

While the left hemisphere as the advantage of speech, I would like to note just how important the mere act of pointing is for evidencing that the right hemisphere is a person. Pointing (or making 'deictic gestures') "is defined as drawing another party's attention to an out-of-reach object by locating the object in space for the other party" (deWall 2001). Now all through Sperry experiments, and at the request of the experimenter, the right hemisphere both locates various objects and indicates options And as deWall further notes, "there is no point to pointing unless you understand that the other hasn't seen what you have seen, which involves realizing that not everyone has the same information" (DeWall 2001). Thus, the right hemisphere seems to have access to the procedural memories of how to use pointing to communicate. Furthermore, there is a recognition of the presence of another in the room, that this other party has desires, and that these desires are about a set of information that may or may not be available to the right hemisphere. This shows an operant declarative memory, for the hemisphere has stored and retrieved the fact the moderator is in the room, making requests; that requests are generally , followed, etc.

This pointing ability could be further leveraged to show that and how the right-hemisphere maintains an image of itself. Consider two hypothetical experiments. A set of placards could be flashed (using standard Sperry-type procedures) where each placard is a different face. In one experiment, the right hemisphere could be asked to point out which face is its own. In another related experiment, the right hemisphere could be asked to point out which bodies in the room (among patient, moderator, and others who serve as control bodies) are bodies which carry the faces seen up on the placard. Since the right hemisphere is known to be superior in face recognition, the results of these experiments would be telling for establishing that the right hemisphere maintains an implicit memory template of yet one more component of personal identity.

4.4.2 Self, Ego, and "I"

> *"The Self which is reflexively referred to is synthesized in that very act of reflexive self-reference"*
>
> *- (Nozick 1981)*
>
> *"Any fixed categorization of the Self is a big goof."*
>
> *- (Ginsberg 1963)*

4.4.2.1 Introduction

This section addresses issues of personal identity that loosely concern the Self, the Ego, and the first-person inward consideration of the subject as a subject– an "I". I am less concerned to argue a position here as to show how varying notions of Self, Ego, and "I" play out regarding the status of the right-hemisphere. Toward the end of this section I explain why these notions clarify little as regards the status of the right hemisphere's consciousness of itself over time.

4.4.2.2 Brain Versus Metaphysical Ego

Traditionally it has been thought that the "I" refers to what Glover (1988) calls a metaphysical ego, a paradigm example being what Descartes had in mind when he discussed the self. But investigations into the brain eroded this view. Glover notes, "There is a lot we do not yet know about the brain, but compared to its potential explanatory power, that of the metaphysical ego looks dim" (97).

4.4.2.3 The Self's Considered Parts

Descartes held that "when I consider the mind, or myself in so far as I am merely a thinking thing, I am unable to distinguish any parts within myself. I understand myself to be something quite single and complete" (Cottingham, Stoothoff, and Murdoch 1985, 59). Perhaps Descartes was unable to conceptualize himself as having parts, but it does not seem outright inconceivable. Cannot a person imagine the self in *temporal* parts? It would seem so. For example, upon reading a lengthy diary at the end of one's life, a person might find that he or she cannot understand the mindset he or she was in at 21 now that he or she is 91. It is *as if*, and perhaps *as so*, he or she is a different person. He or she might ponder, "I know that it should be me; I can remember times after being 21 and times before being 21, but for that year of my life, I cannot understand why anyone would think that way of things, much less that I did." Here, the 91-year-old literally has a part, in the sense of *temporal segment*, which he or she distinguishes within the self. Descartes apparently thought being unable to imagine consciousness divided into parts meant that consciousness cannot be divided into parts, but considerations of *temporal parts* of the self is evidence to the contrary.

4.4.2.4 A Hemisphere's External Part

Suppose under the conditions of a split-brain experiment, the patient is told, "There are now two of you." Now, if speaking to the left hemisphere, one might say, "Do you realize that at this moment there is someone who has had all the experiences you have had, who you have depended upon for your whole life, and that someone is now independent from you? That person is like a less-intelligent, dim-witted version of yourself." How would the left hemisphere take this? Would it deny that there could be such a person? Might it act surprised that it still felt so complete even without having this other person available? Perhaps the context is such that the left hemisphere does not need the other person for its current activities. It will, therefore, not be disconcerted under the condition of the experiment. The left hemisphere might see things differently if the right hemisphere remained split off for hours or days on end, for it would recognize an otherwise unexplainable, severe limitation on its abilities.

Glover (1988) uses the phrase "structural beliefs" to describe beliefs about beliefs. For example, one might have the belief that evidence and experiment should be used to establish the truth of some position. (This is why science is so valuable.) Suppose someone were to deny this. Here, there would be a difference in the structure of beliefs concerning evidence and experiment (156). Analogously, the left hemisphere might have a structure of belief that it is independent and that there is no second person that lends (or has lent) it any support. This is why confabulation seems so interesting in the split-brain patient. There appears to be an underlying structure of belief that I am the same person I was moments ago. Would it be possible to convince the left hemisphere that indeed this structural belief is false? Perhaps it would be just as difficult as convincing the post-fugue state person (who has lived a separate life for years) that s/he had a life which s/he currently does not remember. And whether the person is within the fugue or external to it in his or her "normal track" life, trying to convince the person of the predicament might be too fantastic for the person to ever really believe, even if he or she sees the incontrovertible evidence. He or she might claim, "Even if it's true, I can't make sense of it." It would not be hard to see the left hemisphere giving a similar response.

One could try the same tactic with the right hemisphere, although it is far less verbal, and on a practical level one could not expect to get very far, given its conceptual limitations. It would most often be akin to convincing a 2- or 3-year-old of something beyond its level of comprehension. Recall, however, that patients abilities vary widely.

Glover (1988) holds that unity of consciousness is required for being a single person. He is, however, open to unity of consciousness as being a question of degree. This would give a pragmatic twist to how he might handle the analysis of split-brain patients: a requirement for a certain unity of consciousness is merely that "it may be less misleading to think of split-brain patients as two people. He admits, however, that he is wary of being too rigid, for "in the case of temporary brief divisions, it may raise fewer problems to think of one person than of two" (61). But Glover does suggest some conceptual distinctions that can be developed for giving more than just pragmatic help. He notes that the logic of identity is an all-or-nothing affair, but the logic of survival is a matter of degree (102).

Here is how this conceptual distinction might be developed. One's survival is cashed-out in terms of whether one's plans will be carried out, whether a survivor will be influenced by the memories of the past, and so on. There are so-called links that are preserved, with links apparently being close family resemblances of sets of attributes of persons as these persons come and go over time. In split-brain cases, perhaps this question is not how many *persons* there are under the conditions of the experiment, but how many *survivors* there are under the conditions of the experiment. *Person* seems too close to the idea of an *ego*, and talking in terms of an ego forces one to frame the issue in terms of identity. In the *long* run, an ego is a person where a survivor is a token of that person; thus, one might talk of the split-brain patients as still having one ego.

Yet one could take a *short*-run view. Here, one is tempted to view the ego as the token survivor of a person, for it is hard to relinquish that there is this moment-by-moment presence of an ego. Granted, one can incorporate talk about a metaphysical ego if a survivor is viewed as distinct from a person. Still, perhaps the whole issue of an ego is a confusion, so one should really commit only to speaking of a survivor. Medical technology's discoveries about the human brain would allow survivor talk to be far less problematic than ego. Talk of a metaphysical ego no longer comes as natural as it did when a Cartesian view of human beings seemed so common sensical.

The application of this way of speaking does help somewhat in dealing with the right hemisphere. A new survivor comes into being, but not a new person. The right hemisphere is the same person, yet an independent survivor emerges when the patient is placed under Sperry-type conditions.

Ultimately, it is unclear whether distinguishing a token survivor from a person further clarifies the status of the right hemisphere's consciousness of itself over time. This may be because adequate empirical criterion for distinguishing the notions of Self, Ego, and "I" have not been forthcoming, and because common intuitions regarding these three terms are just too vague to allow us to leverage fine distinctions.

4.4.2.5 James as Closing Word: The Continuity of What Precedes

Finally, William James noted that within each personal consciousness, thought is essentially continuous. James describes it as without breach, crack, or division. He does admit that there can be interruptions and time gaps in thought. But even where there are time gaps, consciousness feels as if it belongs together with the consciousness that preceded it; that is, there is this awareness where the consciousness now is another part of the same self (James 1997, 74).

So, in the quest to defend the right hemisphere as a person, one very important element of consciousness is seen as here--this feeling as if it belongs with what preceded. For under the conditions of Sperry-type experiments, the right hemisphere recognizes that it has not been torn from the room or thrown into unknown circumstances while the experiment proceeds. Furthermore, all of the behaviors of the body that are controlled by the right hemisphere indicate no panic or confusion. Indeed, this is a further surprising fact about the Sperry-type experiments, for one might expect that the changes from one moment to another within the qualia of its consciousness would throw one or the other hemisphere awry. But as is seen by the examiners, the left hemisphere is only very occasionally aggravated, and the right hemisphere is as serene as if nothing special has happened at all. Perhaps it is this very serenity of response that has lured some investigators into arguing that it is not conscious, but this is quite the wrong way to see this behavior. That very serenity is a sign of the otherwise continuous and natural feeling of being connected with what has preceded.

5 CONCLUSION

In this paper I have tried to defend that the two hemispheres exhibit consciousness and personhood while the patient operates under the conditions of a Sperry-type experiment. I have been particularly concerned to show this to be the case for the right hemisphere. To that effect, I have argued that the right hemisphere has functionally distinct modules of cognition and sentience of the sort detailed by our most current theories in cognitive science. Moreover, practically all of the behavioral outputs for all modes of communication available to the right hemisphere (keeping in mind that speech is not one of these modes) are best explained by there being a superset of modules that maintain a degree of consciousness under Sperry-type experimental conditions. Such consciousness was outlined in terms of higher order monitoring relations between modules.

I further defended an ancillary thesis that under said conditions the right hemisphere is a person. I argued that anything that has conscious mental states over time has a unity of consciousness; furthermore, that which is identified as having a unity of conscious is a subject of mentality. But since I defined a person just as a subject of unified consciousness over time, and since the right hemisphere was shown by the main thesis to have conscious mental states, I was able to conclude it must also be accounted a person. My argument would likewise apply to the left hemisphere. In addition to this, I argued that we can speak meaningfully of a single subject of mentality initially fissioning into two subjects of mentality and then subsequently re-fusing back into a single subject of mentality without sacrificing our standard views of how our minds are related to our brains. To effect such an argument, I offered up Individuation Theory as a theoretical structure which could more reasonably account for Split-brain phenomena than any of the currently available contenders.

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APPENDIX A

A glance at formal systems. A formal system consists of two parts: a calculus (a syntax), and an interpretation (a semantic).[40] Although semantic systems can be given a formal interpretation, it is generally the case, even in a strict formal system, that the interpretation is treated more or less casually and informally. However, the interpretation is typically what provides the connection between the syntactical structure of the calculus and the real world. Thus, the interpretation is of the greatest importance in attempting to understand the connection, for instance between geometry and physical space; or, for the purposes herein, between personal individuation and the phenomena one encounters in dealing with human beings, whether split-brain patients or otherwise normal subjects.

The calculus of a formal system consists of the part of the formal system that can be dealt with by syntax alone. Although the calculus is quite literally (and purposely) meaningless without an accompanying interpretation, it is generally much easier to describe the syntax than the semantics, and probably for this reason the calculi of formal systems have received more attention than their interpretations.

Propositional logic is a well-known and accessible formal system. Like other calculi, it can be broken down into four parts: vocabulary, formation rules, axioms, and rules of inference. Each of these are discussed in turn, although not rigorously. The idea is to give just enough flavor of a simpler formal calculus to appreciate what a

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[40]Concerning my position here on formal systems and interpretations, I have benefitted greatly from Henry Kyburg's *Philosophy of Science: A Formal Approach (New York: Macmillan, 1968).*

reinterpretation of Hole Theory to Individuation Theory offers for explaining some key split-brain phenomena.

The vocabulary of a formal system consists of all those signs that are used in writing the statements of the system, except those signs that are introduced explicitly by definition. There are the signs that stand for sentences, A, B, C, D . . . , and there are signs that stand for logical constants, ~,v,&, ->, <->, which stand for the natural language intuitions (or something close to them) of "not," "or," "and," "only if," and "if and only if," respectively. One can also define other symbols in terms of combinations of these symbols. For example, one might define a special type of "or" relation that allows only one of two sentences to be true but not both of them. Thus, while "A v B" would not do the job, we could define "A * B" as "(A v B) & ~(A & B)" so as to have a convenient way of talking about this special type of relation. One can even define definitions in terms of definitions, e.g., "A # C" as "(A * B) & (B * C). Here, definitions have been grouped into the vocabulary, but Copi (1973) gives a reminder that "the use of defined terms is, from the point of view of logic, a matter of convenience only. Theoretically, every proposition that contains defined terms can be translated into one that contains only undefined ones by replacing each occurrence of the defined term by the sequence of undefined terms which was used to define it" (154-55). Essentially it is less clumsy to manipulate "A * B" than "(A v B) & ~(A & B)", and facts like this capture the whole point of using definitions.

The formation rules tell us how to construct the meaningful or well-formed expressions of the object language (that is, of the calculus) whose syntax we are describing. Here, one would specify that the signs that stand for sentences count as well-formed (i.e., allowable) formulas, as would combinations of these along with the logical constants. Thus, "A", "~A", A & B", or even "(A & B) v A" would all be considered well-formed formula. The other logical constants would follow a similar pattern. Any and only expressions that follow these rules of combination from the vocabulary are allowed.

The axioms of any system consist of a set of statements in the object language of that system. Syntactically, they are an arbitrary set of statements; semantically, they are generally a set of statements assumed to be true, from which (pragmatically) important statements of the system can be deduced. Generally, they are taken to be the most obvious or at least the immediately graspable of relationships within a formal calculus. In the propositional calculus, rules such as (A v A) -> A, or (A v B) -> (B v A) have an intuitive veracity that is felt by competent speakers of English. For example, "If you're human or you're human, then you're human." Or again, "If you're an animal or you're warm-blooded, then you're warm-blooded or you're an animal."

Finally, the rules of inference allow deductions constructed by means of chaining together immediate, logically cogent connections that have ultimately been drawn from the axioms and the vocabulary. For example, one might make a "meta-statement about how well-formed statements in the calculus operate. A meta-statement such as "From well-formed formulas of the form X and (X -> Y), Y may be inferred" would be one among rules of inference. It is essential that the rules of inference never allow a resulting formula (or theorem) and its negation (e.g., "x & ~x") to be derivable from the axioms of the calculus; that is, one wants the calculus to be free from contradiction.

APPENDIX B.
INDIVIDUATION THEORY

Interpretive Mapping:

The reinterpretation of Hole Theory as Individuation Theory uses the following schema:

Hole	Mind
"Walls"	Boundaries
Hosts	
Verb form	... encarnalizes ...
Noun form	Brains (or Brain structures)
... is located at ...	... is encarnalized through-in ...
Surface	structure

1. Ontology

The main thesis is that a mind is an immaterial body encarnalized through-in the structure (or some structure) of a material object. The ontological basis is concerned with the general dependence of a mind on its brain.

Notation

N1.1 Hxy = x is a mind in (i.e., through-in) y.

This is our primitive relation. We need a binary relation to express the basic intuition that minds are dependent entities. A mind is always encarnalized through-in some object.

Definition

D1.1. Hx =df. $\exists y Hxy$

We write 'Hx' for "x is a mind". Since every mind is ontologically dependent on its brain, being a mind is defined as being a mind in (i.e. through-in) something.

Basic Axiom

A1.1 $Hxy \rightarrow \sim Hy$.

The brain of a mind is not a mind.

Some Theorems

T1.1 $Hxy \rightarrow \sim Hyx$.

Being a mind in (through-in) is an asymmetric relation: a mind cannot encarnalize its own brain.

T1.2 $\sim Hxx$

Being a mind in (or through-in) is an irreflexive relation: a mind cannot encarnalize itself.

T1.3 $Hx \rightarrow \sim\exists yHyx$

Minds do not have minds; they cannot encarnalize one another (though they can have minds as proper parts).

T1.4 $\exists xHx \rightarrow \exists x\sim Hx$

Minds cannot be the only things around. [[Comment: A denial of Berkeley's position, thus allowing for physicalism.]

2. Mereology

As immaterial bodies, minds have parts and can bear part-whole relations to one another (though not to their brains). The main principles concerning these relations can be formulated within the framework of classical extensional mereology supplemented with some specific axioms on the behavior of the ontological relation H.

Notation

N2.1 $x \leq y$ = x is a part of y.

This is one of many possible mereological primitives: a reflexive, anti-symmetric, transitive relation (i.e., a partial ordering), according to classical mereology.

Definitions

D2.1 $x < y =df.\ x \leq y \wedge \sim x = y$.

'$x < y$' means "x is a proper part of y"; i.e., x is a part of y other than y itself. This is a transitive and asymmetric (hence irreflexive) relation.

D2.2 $x \circ y =df.\ \exists z(z \leq x \wedge z \leq y)$.

'$x \circ y$' means "x overlaps y"; i.e., x and y have some parts in common. This is a reflexive and symmetric (but not transitive) relation.

D2.3 $\sum xAx =\text{df. } \iota zAy(y \circ z \leftrightarrow \exists w(Aw \wedge y \circ w))$.

'$\sum xAx$' stands for "the fusion of all x such that Ax." The existence of such an object is always assumed in classical mereology, provided there is some x such that Ax. We do not assume it unless otherwise specified.

D2.4 $x \sqcup y =\text{df. } \sum w(w \leq x \vee w \leq y)$

'$x \sqcup y$' stands for "the union of x and y," i.e., the smallest thing whose parts are either parts of x or parts of y. This is an idempotent, commutative, distributive operation.

D2.5 $x \sqcap y =\text{df. } \sum w(w \leq x \wedge w \leq y)$.

'$x \sqcap y$' stands for "the intersection of x and y," i.e., the largest thing whose parts are both parts of x and parts of y. This too is an idempotent, commutative, distributive operation, though one that is defined only if $x \circ y$.

D2.6 $x - y =\text{df. } \sum w(w \leq x \wedge \sim w \circ y)$.

'$x - y$' stands for "the difference of x and y," i.e., the largest thing contained in x that has no part in common with y.

D2.7 $x \trianglelefteq y =\text{df. } Hx \wedge x \leq y$.

'$x \trianglelefteq y$' means "x is a mind-part of y," i.e., a mind that is a part of y. This is a partial ordering, like $\leq$; it applies only when y is itself a (part of a) mind.

D.28 $x \prec y =\text{df. } x \trianglelefteq y \wedge \sim x = y$

'$x \prec y$' means 'x is a proper mind-part of y," i.e., a mind that is a proper part of y. This is a transitive, asymmetric, irreflexive relation, like <.

Basic Axioms

A2.1 $Hxy \rightarrow \sim x \circ y$.

No mind overlaps its own brain (though the sum of a mind and its brain may be a legitimate brain for different minds: e.g. the sum of a human y and its mind x – if such a sum exists – will not be a brain of x, but it will be a brain of a mind that may be hidden inside y). [[Comment: a multiple personality claim: allows hidden minds where a mind and brain can sponsor other minds.]]

A2.2 $Hxy \wedge Hxz \rightarrow \exists w(w < y \sqcap z \wedge Hxw)$.

Any two brain structures of a mind have a common proper part that entirely encarnates the mind.

A2.3 $[Hxy \vee Hzy] \rightarrow \forall w(w \preceq x \sqcup z \rightarrow Hwy)$

Any brain of a mind entirely encarnates all common mind-parts of any sum involving that mind.

A2.4 $Hxy \wedge y \leq z \rightarrow x \circ z \vee Hxz$

Any object [e.g. the central nervous system] that includes the brain of a mind is a brain of that mind, unless its parts also include parts of that very mind.

A2.5 $Hxy \wedge Hzw \wedge x \circ z \rightarrow y \circ w$

Overlapping minds have overlapping brain structures. (However, two minds may well occupy the same region, or part of the same region, without sharing any common parts. Minds are immaterial, and can penetrate one another; mereological overlapping is not implied by spatial co-localization.) [[Comment: Allows multiple personality to obtain]]

A2.6 $Hx \rightarrow \exists z(z < x)$

No mind is atomic (though minds need not have proper mind-parts; otherwise every mind would correspond to a collection of infinitely many, gradually submerged minds

Some Theorems

T2.1 $Hxy \rightarrow \sim x \leq y$

Minds are not parts of their brains (although the brain of a mind may have different minds as parts) {A2.1}.

T2.2 $Hxy \rightarrow \sim x \preceq y$.

Minds are not mind-parts of their brains (although they can be mind-parts of parts of minds) {A2.1}

T2.3 $Hxy \rightarrow \sim y \leq x$.

The brain of a mind is not part of it. {A2.1}

T2.4 $Hxy \wedge y \leq z \rightarrow \sim Hz$

The brain of a mind is not part of any mind. {A1.1 + A2.4 - A2.5}. This is a generalization of the ontological axiom (A1.1) and of the thesis that a mind cannot encarnalize anything (T1.3).

T2.5 $Hxy \wedge Hxz \rightarrow y \circ z$.

Any two brain structures of the same mind are overlapping; i.e., a mind cannot have two discrete brains {A2.2}. [[Comment: 'the networked theorem' Affirms a brain as single, networked device]]

T2.6 $Hxy \rightarrow \exists z(z < y \wedge \sim Hxz)$.

Not every part of a mind's brain is a brain of the mind (though [one of these parts] could encarnalize a different mind) {A2.2}.

T2.7 $Hxy \rightarrow \exists z(z < y \wedge Hxz)$.

Encarnalizing a mind is having some proper part that entirely encarnates the mind {A2.2}.

T2.8 $Hxy \rightarrow \forall z(z < x \rightarrow Hzy)$.

Encarnalizing a mind is encarnalizing any proper parts of the mind that are minds themselves {A2.3}. (Note that the same does not hold relative to <.)

T2.9 $Hxy \wedge Hxz \rightarrow Hx(y \sqcup z)$.

The union of any two brains which happen to encarnalize a mind is itself a brain of that mind {A2.1 + A2.4}.

T2.10 $Hxy \wedge Hxz \rightarrow Hx(y \sqcap z)$.

The intersection of any two brains which happen to encarnalize a mind is itself a brain of that mind {A2.1 + A2.2 +A2.4} [[comment: T2.9 and T2.10 state that there are different ways to tie a brain network together to form a new mind.]]

T2.11 $Hxy \wedge Hxz \rightarrow \sim Hx(y - z)$.

The difference of two brain structures of a mind is not itself a brain of that mind {A2.2}

$T2.12\ Hxy \rightarrow \forall z(\sim x \circ z \rightarrow Hx(y \sqcup z))$.

A mind in an object is also a mind in any mereological sum including that object, provided the sum does not include any parts of the mind itself {A2.4}.

$T2.13\ Hxy \rightarrow \exists z(\sim x \circ z \wedge Hx(y \sqcap z))$.

A mind in an object is also a mind in some mereological product involving that object, provided the product does not include any parts of the mind itself {A2.2}.

$T2.14\ Hxy \rightarrow \forall z \sim Hx(z - y)$.

The difference between an object and the brain of a mind is not a brain of that mind {A2.2}.

$T2.15\ \sim H(\sum z.z = z)$.

If the universal individual exists, it surely isn't a mind {A1.1 + A2.1}.

$T2.16\ \sim H(\sum z.z \neq z)$.

The null individual (if it exists) cannot be a mind {A2.6}.

$T2.17\ \sim \exists z.z < y \rightarrow \sim \exists xHxy$

Atoms are mindless {A2.2}.

$T2.18\ Hx \rightarrow Hx(\sum zHxz)$.

The fusion of all brain structures of a mind is a brain of that mind {A2.1 + A2.4}.

3. Topology

Notation

Topology constitutes in many ways a natural next step after mereology, although various mereological notions could formally be defined in terms of topological ones. Particularly in a theory of minds, topological notions are important to account for the fact that every mind is encarnalized through-in some structure of its brain as well as for taxonomic purposes.

N3.1 $x \subset y$ = x is connected with y.

This is a reflexive and symmetric relation capturing the intuitive notion of touching or being co-localized at some point. We take it to satisfy the clause that what is connected with a part is also connected with the whole, so that $x \leq y$ implies $\forall z(z \subset x \rightarrow z \subset y)$.

Definitions

D3.1 $Cx =df. \forall y \forall z(x = y \sqcup z \rightarrow y \subset z)$.

'Cx' means "x is (self-) connected"; i.e., x does not consist of two or more disconnected parts.

D3.2 $hx =df. \sum y(Hxy \wedge Cy)$.

'hx' stands for "the principal brain of x," i.e., x's maximally connected brain (a notion that we take to be defined only when x is a mind). We may intuitively regard this as *the* brain of the mind, every other brain structure being either a topologically scattered mereological aggregate including the principal brain or a potential part of this latter (see above *ad* A2.2).

D3.3 $x \rtimes\!\ltimes y =df. x \subset y \wedge \sim x \circ y$.

'$x \rtimes\!\ltimes y$' means "x is externally connected with y"; i.e., x is connected with y but does not overlap it. This is an irreflexive and symmetric relation.

D3.4 $x \lhd y =df. x \leq y \wedge \forall z(z \rtimes\!\ltimes x \rightarrow \sim z \rtimes\!\ltimes y)$.

'$x \lhd y$' means "x is an interior part of y"; i.e., x is a part of y that is externally connected only with things that are not so connected with y itself. This is a transitive relation included in $\leq$ and closed under both $\sqcup$ and $\sqcap$.

D3.5 $x \ll y =df. x \leq y \wedge \sim\exists z.z \lhd x$.

'$x \ll y$' means "x is a superficial part of y"; i.e., x is a part of y that has not interior parts of its own (or, intuitively, that only overlaps those parts of y that are externally connected with the geometric complement of y). This too is a transitive relation closed under $\sqcup$ and $\sqcap$.

D3.6 $Sxy =df. x \ll y \wedge Cx \wedge \forall z(z \ll y \wedge Cz \rightarrow (z \subset x \rightarrow z \leq x))$.

'Sxy' means "x is a structure of y"; i.e., x is a maximally connected superficial part of y.

Basic Axioms

A3.1 $Hx \rightarrow Cx$.

Minds are self-connected; i.e., there is no scattered mind.

A3.2 $Hxy \rightarrow x \subset y$.

Minds are connected with their [respective] brains.

A3.3 $Hx \rightarrow \exists y(Hxy \wedge Cy)$.

Every mind has some self-connected brain.

A3.4 $Hx \wedge y < x \rightarrow \exists z(z \rangle\langle x \wedge \sim z \rangle\langle y)$.

No mind can have a proper mind-part that is externally connected with exactly the same things as the mind itself.

Some Theorems

T3.1 $Hxy \rightarrow x \rangle\langle y$

Minds are only externally connected with their brains; i.e., a mind and its brain touch each other, but have no parts in common {A2.1 + A3.2}.

T3.2 $Hxy \rightarrow \exists z(z \ll y \wedge x \subset z)$.

Every mind is connected with some superficial part of its brain structures {A2.1 + A3.2}. (Minds are superficial entities; they go hand in hand with structures.)

T3.3 $Hxy \rightarrow \forall z(z \lhd y \rightarrow \sim x \subset z)$.

No mind is connected with any interior parts of its brain structure {A2.1 + A3.2}. (Making a mind is transforming interior parts of an object into superficial ones.)

T3.4 $Hxy \wedge z \leq x \rightarrow z \rangle\langle y$

The mind-parts of a mind are all externally connected with the brain of that mind, i.e., they are all encarnalized along the "boundaries" of that mind. {a2.1 + A2.3 + A3.2}.

T3.5 $Hxy \wedge z \leq x \wedge w \leq y \rightarrow (z \rangle\langle w \rightarrow x \rangle\langle w)$.

A mind is externally connected with every part of its brain that is so connected with some mind-part of that mind {A2.1 + A3.2}

T3.6 $Hxy \wedge z \leq x \wedge Hzw \rightarrow x \subset w$

A mind is sure to be connected (externally or not) with the brain structures of its own mind-parts {A2.1 + A3.2}.

T3.7 $Hx \wedge Hy \rightarrow (Hx \sqcup y \rightarrow x \subset y)$.

Only minds that are connected with each other can join to form a mind {A3.1}. [[comment: multiple personality reintegration]]

T3.8 $Hxy \rightarrow \exists z(z < y \wedge Hxz \wedge Cz)$.

Encarnalizing a mind is having some proper self-connected part that entirely encarnates the mind {A2.2 + A3.3}.

T3.9 $Hxy \wedge Hxz \rightarrow y \subset z$.

Any two brain structures of a mind are connected with each other {A2.2 + A3.3}.

T3.10 $Hxy \wedge Hxz \rightarrow \sim y \rtimes z$

Two brain structures of a mind cannot be externally connected {A2.2 + A3.3}.

T3.11 $Hxy \,\&\, Hxz \rightarrow \exists w(w \leq y \sqcap z \,\&\, Hxz \wedge Cz)$.

Any two brain structures of a mind have a common self-connected part that entirely encarnates the mind {A2.2 + A3.3}

T3.12 $Hx \rightarrow Chx$

Principal brain structures are always sure to be self-connected {A2.1 + A2.2 + A2.4 + A3.3}. [[comment: 'principal' defined earlier in D3.2]]

T3.13 $Hx \rightarrow Hxhx$

Every mind is a mind in its principal brain {A2.1 +A2.2 + A2.4 +A3.3}

T3.14 $Hx \wedge z \leq x \rightarrow hx = hz$

The principal brain of a mind is also the principal brain of any mind-parts of that mind {A2.3 + A3.3}