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Split brains and the unity of consciousness.

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SPLIT BRAINS AND THE UNITY OF CONSCIOUSNESS

A Thesis Presented

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INTRODUCTION

Descriptions of split-brain patients raise the question whether they each have one mind or two. Thomas Nagel, in "Brain-Bisection and the Unity of Consciousness," argues as though the determining factor in assessing this question were whether the patients were in ordinary or in experimental situations. But the difference between the one-mind view, and the two-minds view does not depend on the experimental situation per se; it depends upon whether or not the behavioral strategies used by patients in the experimental situation are permitted, and upon the explanation offered of these strategies. Because the difference between these views depends upon the explanation of strategies, the crux of the dispute is the relation held to obtain between a subject and the contents of his mind. If this relation is held to be one of direct access or introspection, then split-brain patients each have two minds. If strategies are described as passing information and afforded the status of mental events, then split-brain patients have one mind each.

Given an account of the mechanisms involved in strategies, and an account of the mind which embodies those mechanisms, the one-mind view is more plausible. An account of the mind relying on the possibility of parallel processes which can permit intelligent actions to proceed without

reflective attention and without permitting introspection, offers a more plausible alternative than that of the two-minds view. The two-minds view cannot account for the use of strategies as well as the parallel-process view of consciousness. Moreover, if the parallel process view is correct, the two-minds view must incorporate its major features anyway. As the two-minds view has serious conceptual difficulties of its own, and constitutes an addition, rather than an alternative to the parallel process view, it is unacceptable.

PHYSIOLOGICAL BACKGROUND

Research on patients with bisected brains, in which the commissures connecting the hemispheres were severed or are congenitally missing, is philosophically interesting because it raises a number of issues concerning the nature of consciousness, and the relation of mind to body. These questions arise in a distinctly physiological context. The philosophical issues obviously cannot be resolved by appealing to the facts in the case-histories of split-brain patients. The conceptual gap between the physical condition or observable behavior of the patient, and the attribution of consciousness, or the description of the mind prevent this sort of solution. Philosophical grounds for ascribing consciousness and philosophical descriptions of the mind are required.

The obvious question is why one would want to give a philosophical account so closely tied to neurological research. Descriptions of split-brain patients show that they appear to have multiple consciousness, at least under certain conditions; they lack behavioral features formerly assumed to be typical of persons possessing single, unified minds. It becomes crucially important to understand what these descriptions presume as conditions of consciousness and how it is experimentally demonstrated that these conditions are met. Researchers must establish that the right and left hemispheres

of the patient's brain demonstrate that they satisfy these sufficient conditions, as well as that they independently satisfy these conditions. Unsurprisingly, these contentions are difficult to establish. In the first place, it is difficult to establish whether certain functions of the cerebral hemispheres are performed independently of the lower brain and spinal cord. Unless this fact can be established, there is no reason to claim that the hemispheres are independently capable of consciousness. Secondly, most interesting candidates for sufficient conditions for consciousness are themselves capacities; the data on the functions of the hemispheres relies on the fact that under certain conditions, the patient is incapable of exercising those functions. Strong claims are made concerning the patient's capacities as evinced by failure to respond. These claims must be examined.

Descriptions of the sorts of behavior exemplified by split-brain patients manifesting disconnection syndromes, or loss of certain functions, must be examined. General accounts of disconnection syndromes center on the function of the great cerebral commissures, those fiber bundles connecting the hemispheres of the brain, notably the corpus callosum. Myers discovered that a cat with a sectioned corpus callosum could not perform tasks learned by manipulating one front paw, if the animal were forced to try to use the other front paw. This result followed only if sectioning had occurred prior to learning; cats which were sectioned

after learning could switch paws and perform the tasks easily. Myers and Sperry then performed other tests, attempting to establish that the function of the corpus callosum was to permit the transfer of information from one hemisphere to the other.

While the hemispheres of the cat's brain seem to duplicate each other, so that sectioning after learning leaves both sides capable of performing the learned tasks, this result does not follow in primates. In monkeys, some tasks learned before sectioning will be performed indiscriminately by either left or right limbs; other tasks appear to be limited to only one set of limbs. In neurological jargon, cats are said to "lay down engrams" (or memory traces) in both hemispheres of the brain, while monkeys sometimes lay down engrams on one side, and sometimes on both, depending on the task.

Humans have specialized functions in opposite hemispheres, though the evidence on whether these differences depend on the physiological structures of the hemispheres or develop only through use is inconclusive. This is an important point in contending theories of the possibility of multiple consciousness; critics of the two-minds view argue for innate differences in capabilities, while proponents of the two-minds view argue for the development of different capacities. Theories on this subject are closely related to studies of cerebral dominance, handedness, and speech capacity. In

humans, limb control, vision, and audition are controlled chiefly contralaterally: the left hemisphere of the brain controls the right side of the body, and vice-versa. The sense of smell is notably ipsilateral with the right hemisphere of the brain controlling the right side. Somesthetic sensation is predominantly contralateral, but crude information is given ipsilaterally. Finally, the muscles of the face and neck can be operated by both the right and left hemispheres of the brain.[1] The correlation of dominance and speech gives most people left-hemisphere speech centers. If severing the commissures effectively segregates the hemispheres of the brain, then one would expect that the right hemisphere would be effectively isolated from speech, while the left side of the body would be unable to perform tasks dependent upon the specialized capabilities of the right hemisphere of the brain.

These expectations appear to be fulfilled, at least during experimental situations where strategies were identified and prevented. Objects placed out of sight in the patient's left hand could not be verbally identified by the patient, and the subjects scored no better than chance if asked which of several objects they were holding. Presumably, the subjects did not know. But if they were permitted to use their left hand to point to a picture of the object (selected

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[1]The idioms expressing apparent independence of the left and right hemispheres enter early; all that is intended here is that information and movement is subject to bilateral control.

from a group) or a written word identifying the object held, the subjects were able to do this task correctly. On the other hand, spatial relations appear to be a special task of the right hemisphere of the brain. Although all of the patients were right-handed, none of the patients could copy simple geometric figures with the right hand, although they could do fairly well with the left.

On the basis of experiments such as these, experimenters concluded that it was utterly misleading to accept the verbal testimony as indicative of the knowledge possessed by the subjects. They concluded that the left hemisphere of the brain could not "speak" for the right, and they began to accord the "sides" of the patient's body independent status as experimental subjects. There are certain problems with this approach. In the first place, in some experimental situations, patients failed to manifest the expected separation of function, and the patients were capable of performing certain tasks which were theoretically impossible, given the experimenters' assumptions. Some of these tasks were traced to particular strategies used by the patients, though for other tasks the ability to integrate behavior could not be determined to be based on strategies. Secondly, two categories of cases in the split-brain literature failed to exhibit the expected disconnection syndromes. Subjects lacking the corpus callosum from birth tended to perform as normal subjects on the psychological tests devised for split-brain

patients. Various explanations are offered for these cases: either the subjects are described as having developed separate capabilities in the different hemispheres, or they are asserted to be relying upon alternate neurological pathways for the transfer of information. Other patients, notably those whose epilepsy was not cured by sectioning, also fail to exhibit disconnection syndromes. In most cases, these patients did not undergo the same psychological testing as the split-brain patients did; some experimenters thus attribute their failure to exhibit disconnection syndromes to undetected strategies, which were not prevented. Others, noting the similarities between the electrical activity postulated to account for learning and that involved in epileptic seizures, noting that the seizures were not prevented, suggested that the patients were using the same sort of pathways permitting seizures to pass information from one hemisphere to the other. At the very least, disconnection syndromes are not yet fully understood.

After giving accounts of the behavior of split-brain patients in normal and experimental situations, taken to indicate either single or multiple consciousness, I will consider a possible account of the behavioral integration displayed in these situations. The most interesting explanations attempt to reveal strategies used to pass information from one hemisphere to the other, where prevention of these strategies causes a loss of integrated behavior of certain kinds.

Briefly, I contend that consciousness is identified by Nagel and by others, with acting in a functionally integrated manner. What it is, which is functionally integrated, varies in descriptions of split-brain patients. Nagel, for example, refers to the integration of stimuli, as well as to the integration of overt behavior. Other accounts of consciousness describe behavioral routines as displaying functional integration as overt behavior, and refer to the intentions behind such integration. The lack of unanimity, or even consistency, in descriptions of what is integrated, and how it is integrated leads to a confusion of mental and physical events, as well as to a confusion of introspection and integration.

SPLIT-BRAIN PATIENTS' BEHAVIOR AND STRATEGIES

The most obvious fact concerning split-brain patients' behavior is their ability to perform simple and even complex tasks easily, without apparent confusion, or loss of coordination. Their ability to perform most tasks after the severance of the commissures is comparable to their level of performance prior to the operation; this ability requires an explanation. Apparently, either the tasks were ones which the patients had "overlearned" and could do almost automatically, or the patient could watch himself performing the task, and so coordinate his activities. Norman Geschwind writes in Disconnexion Syndromes in Animals and Man (p. 624):

> We were perplexed by this at first, but then realized that as long as each hemisphere had learned its task such bimanual activities could be carried out. In our case, a command to tie the shoelaces would thus have been conveyed to the left hemisphere; the right hand would then move to begin the task. But the visual regions of the right hemisphere would thus receive visual stimulation and proceed to do its share of the task. Presumably, a more careful analysis of the latencies with which each hand began to do its task, would have helped prove this mechanism.

Geschwind suggests that it is the ability to watch one side performing the tasks which leads to coordinated activity.

There were two patients who failed to perform normally even under normal conditions, at least on occasion.

Geschwind[2] cites Kurt Goldstein's description of a patient with a sectioned corpus callosum:

> I have pointed out the presence in my patient of a feeling of strangeness in relation to movements of the left hand which she described with such curious expressions (she would say that someone was moving her hand and that she wasn't doing it herself) that she was regarded at first as a paranoiac. (p. 638)

Sperry and Myer's first patient also tended to experience what are described as conflicts between the right and the left hand. Sperry writes, "The patient and his wife used to refer to the 'sinister left hand' that sometimes tried to push the wife away aggressively at the same time that the hemisphere of the right hand was trying to get her to come and help him with something."[3] This same patient is further described by Gazzaniga (in The Bisected Brain, p. 107):

> Once he grabbed his wife with his left hand and shook her violently, while with his right trying to come to his wife's aid in bringing the left belligerent hand under control. Once, while I was playing horseshoes with the patient in the backyard, he happened to pick up an axe leaning against the house with his left hand. Because it was entirely likely that the aggressive right hemisphere might be in control, I discreetly left the scene--not wanting to be the victim for the test-case of which half-brain does society punish or execute.

It is possible that these patients had difficulty in coordinating their movements, or in coordinating their emotions and their movements because of other types of brain damage.

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[2]Norman Geschwind, "Disconnexion Syndromes in Animals and Man"(in Brain 88, 1965), p. 638.

[3]R. W. Sperry, "Brain Bisection and the Mechanisms of Consciousness" (in Eccles, ed., Brain and Conscious Experience), p. 304.

This factor has been offered in explanation of the behavior of Sperry's patient. The interesting factor in the explanations of the experience of these patients lies in the coupling of their behavior with their subjective experience of their behavior as unintegrated; only Goldstein's patient experienced this disintegration.

In considering the results of the test-situations, one finds the use of strategies to be an important factor in producing integrated behavior. When the subject was prevented from using strategies to pass information "around the split," disruption of some functions resulted. The disrupted functions varied, depending upon the nature of the experiment; behavior routines which were not being tested concurrently did not evince disruption. Gazzaniga[4] describes several types of strategy, such as target information crossover, eye divergence, emotional cross-cuing, ipsilateral somatosensory "leakage," and perhaps most interesting, cooperative strategies. A few examples of various of these strategies follow.

Monkeys confounded researchers' expectations with their ability to retrieve objects using the ipsilateral hand and eye (when the use of either opposing hand and eye were prevented). By examining slow-motion films of the monkeys' actions, researchers identified the strategy of target information crossover. Although without the slow-motion film, the

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[4]Michael Gazzaniga, The Bisected Brain, Chapter 6.

monkeys appeared to simply reach out and grasp the object, they were in fact using visual information to orient the head, neck, and shoulders toward the object, and then using this postural information to guide their reach. Some monkeys were discovered to have had their eyes shut when they reached to retrieve the object. Experiments were then done, in which the monkeys' heads were restrained; the monkeys proved unable to retrieve objects under these conditions.

It was anticipated that subjects with sectioned commissures would be unable to make visual-visual comparisons involving the use of both eyes. Most subjects proved unable to do so. But some patients could tell whether a line was continuous or discontinuous, even when the discontinuity occurred at the break in their visual fields. The patients were using eye divergence to discover the difference. Using the facial muscles of one "side" to control both eyes, the patient would place the fixation points of <u>both</u> eyes at the height of the line perceptible to that side; the subject then waited to find whether the other "side" would raise or lower the fixation point. The change, if there was one, was perceptible; this strategy was repeated, with greater and greater refinement, until the lack of further response indicated to the subject whether the lines were continuous or discontinuous.

Cooperative strategies offer a refinement of feedback strategies such as eye divergence: they offer more information

to the sides. Trevarthen[5] reported that one monkey with a split-brain was consistently able to make visual-visual comparisons across hemispheres in one experiment; the monkey was able to identify the larger of two circles in different visual fields. After extensive testing, Trevarthen[6] conceded the possibility that the visual mechanism involved in the discrimination was sub-cortical, and thus unaffected by the split. Gazzaniga[7] proposed an alternative explanation. The monkey had devised a strategem, rather like calculating the odds in playing blackjack against an opponent. In Trevarthen's experiment, five circles of various sizes were used, and after several trials, each "side" had become familiar with their relative sizes. (For convenience, I will refer to the largest as 1, and so on.) Each side was to respond immediately if it recognized the larger circle, by pressing a button on that side.

Because each side knew the relative sizes of the circles, each would respond immediately if it saw 1. Similarly, each side responded immediately if it saw 5, by pressing the button for the opposite side. And all the other possibilities were decided through the use of response latencies. If one side had 2, it waited for the other's response; observing

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[5]C. B. Trevarthen, cited by Gazzaniga, ibid., p. 102.

[6]Ibid., p. 102.

[7]Ibid., pp. 102-103.

that the other side did not respond immediately (as it must to have 1), the side with 2 would indicate that as the larger circle. If 4 was shown in combination with 3, the side recognizing 4 hesitates; if the other side does not press the opposite button indicating it recognizes 5, the side with 4 presses the opposite button to indicate that it has the smaller circle. To test whether this strategy was indeed being used, the number of circles to be discriminated among was increased to ten; the subjects were unable to respond correctly. This result was consistent with the finding the subjects could not make visual-visual color comparisons.

All of the strategies employed have common features: they are all performed in situations in which the subjects (both sides) understand the task to be performed, and are able to structure the situation with their bodies by using response latencies. They structure the situations using latencies, in such a way that failure to respond is significant to the side lacking direct information. There are serious limitations on the amount of information that can be transferred in this way. First, the situation must be somehow defined so that the required action is either obvious to both sides, or so that if one side "initiates" an action, the other can grasp what is required of it. How this structuring is done is not obvious; it is a very fundamental problem, because much of the vaunted "independence" of the hemispheres rides on explication of the initiation of action by the

hemispheres, or the claim that the hemispheres observe each other. Secondly, the mode of information transfer must admit the lack of response to count as significant, constituting a form of feedback; this indicates whether more information is required, or whether there is sufficient information for "overt" action using that information. Finally, the subject must be free either to react or not to react, if the lack of response of one side is to constitute an informative response. Preventing strategies requires the control of these factors; either the experimental situation is made more complex, and thus unamenable to structuring, or the subject is restrained so that the lack of response is no longer informative. In essence, the experimental restrictions serve to saturate the subject's medium of communication, or to block it altogether.

INTEGRATED BEHAVIOR, INTROSPECTION, AND STRATEGIES

Confusion concerning whether each split-brain patient has one mind or two is a consequence of the confusion of two models of consciousness. One model relies upon verbal mediation, and is necessarily serial; introspection and the concept of a stream of consciousness are commonly assimilated to this model. The second model relies upon parallel processes, and incorporates verbal mediation as one of these processes; other activities proceed concurrently. On this latter interpretation not all of our behavior can be introspected concurrently. The unity of consciousness on this model does not require the ability to perceive the relations among experiences. A crucial feature of this model is thus the way in which these parallel processes are conceived as unified subjective experience. Although the parallel model is given as a description of the consciousness of normal persons, it can be adapted to serve as a description of the experience of split-brain patients. The primary virtue of this adaptation is that it rids us of the temptation to equip split-brain patients with mental processes which are both parallel and introspectible.

On the single string, serial model of consciousness, action is mediated solely by verbal intervention. The input

system sees the object and names it; a verbal mediator, using the name of the object, names an appropriate action, which is then executed by the output system. There are several obvious difficulties with this model, as a description of consciousness. First, it fails even as a model of perception. Studies of perceptual difficulties, as well as of language difficulties, have demonstrated that the inability to name an object does not preclude the ability to recognize it, or to demonstrate that recognition through the use of the object. But the major failing of this model lies in the requirement for a central executive which controls all the activities of the system. This model is manifestly false, as there are forms of intelligent action, such as complicated sensorimotor routines, which do not require an arch-controller. Much of our ordinary behavior consists of these routines; once learned, they no longer require conscious attention. Finally, some of our actions may depend upon conditional responses which are attuned to certain "thresholds" on gradients of sensory input; any attempt to give a verbal account of these processes is doomed to failure. Verbal mediation cannot be a prerequisite of all conscious action.

If verbal mediation is not a prerequisite of all conscious action, it is inappropriate to regard verbalizable knowledge as a paradigm of all knowledge. If verbalizability is not a necessary condition of knowledge, then we need some other account. This account is given explicitly in the

refutation of conscious action as necessarily verbalizable; it is the ability to use the object. Michael Arbib[8] suggests, "We normally ignore the linguistic level and instead explore the idea that the 'meaning' of an input for an organism resides in the interactions that are appropriate with the object it represents, which actions depend not only on what an object is, but on where it is." In short, meaning is use, and is therefore necessarily context-dependent.

A parallel system incorporates a verbal mediator, which receives information from the input system and which may send instructions to a non-verbal sensori-motor center to "designate" an action. The significant difference between the serial and parallel models is that the sensori-motor center can operate without the intervention of the verbal system, in "designating" an action to be performed by the output system. These actions may be quite complicated, and involve very sophisticated routines. The sensori-motor center is certainly capable of intelligent action, as Arbib describes it. Briefly, to be capable of intelligent action is to be capable of perceiving "features of a situation beyond 'raw sensation.'"[9] He gives as features of intelligent action: the possession of a modifiable model of the world, in terms of the potentiality of interaction with its features; flexibility and generality

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[8]Michael Arbib, The Metaphorical Brain, p. 166.

[9]Ibid., pp. 93-94.

in these interactions; the ability to plan. D. M. MacKay suggests that intelligent action "makes use of the correlations and regularities observable, to improve the strategy of control of adaptive action."[10]

The possibility that the sensori-motor center may operate independently of the verbal mediator is very important; it makes the parallel system an anarchic one. The parallel model lacks a central executive, and some explanation must be given of the organism's ability to act in an integrated manner. For example, there is nothing to preclude the possibility that the verbal mediator may order one action, while the sensori-motor system is engaging in ordering a wholly incompatible action. Somehow there must be a priority system which can choose among competing possible courses of action; this priority system determines which segment has the more important information, and gives control of the organism to that segment, though presumably only for the duration of that action. Warren McCullough[11] describes this as the problem of redundancy of potential command, and formulated a principle for its resolution. Roughly, the principle is that the <u>situation</u> in which the organism finds itself designates the action of the organism, in conjunction with

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[10] D. M. MacKay, "Cerebral Organization and the Conscious Control of Action" (in Eccles, ed., <u>Brain and Conscious Experience</u>), p. 429.

[11] McCullough, cited in Arbib, op. cit., pp. 17-18.

the organism's goals. McCullough offered as illustration the strategy employed by the United States Navy in World War II in assigning command in battle; the first ship to sight the enemy assumed command, whether or not it was the flagship in which command of the fleet normally resided. Thus, the redundancy of potential command is resolved because the situation chooses the "actor."

The interest of the parallel model lies in the possibility of assimilating the account of the consciousness exemplified by split-brain patients to a model of consciousness applicable to normal people. The ability of split-brain patients to use strategies to integrate their behavior, in contexts where both hemispheres share goals and can use contextual information to grasp the significance of the other side's response, is then merely an instance falling under McCullough's principle; the hemispheres of the split-brain patient's brain can be accommodated as parallel processes. There are major questions which are not answered, however; the simple expedient of pointing out that split-brain patients' observable behavior approximates that of normal patients, does not answer whether or not split-brain patients' experience is markedly different from that of normal subjects. The most important question concerns the relation of the principle preventing conflict of action, to our subjective experience.

The key point here lies in the fallacy of the passive perceiver. The belief in a serial, introspectible

consciousness is conditioned by the belief that objects simply are "out there," and impress themselves upon us by means of our senses. We simply see them. The idea that we have direct access to our senses simply reinforces this view. But perception itself is action oriented; we notice things for a purpose.[12] Things exist as sets of features whose further discrimination depends upon our assessment of their use in the light of potential actions. The ability to resolve the redundancy of potential command is thus a condition of our discrimination of objects; it determines what we perceive. The ability to resolve parallel processes into non-conflicting actions makes our subjective experience possible. We attend to all kinds of sensory events proceeding at once around us, but because we transform them into objects only in the context of our own goals and can finally only introspect the results of the organization of those goals (and not the process), we recognize a series of perceptions. The unity of consciousness on this view refers, not to the ability to experience (in any introspectible sense) the relations of experience, but to the unity of the organizing system, choosing

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[12]Unless, of course, we have the additional time and interest to note things for their own sake. But it is a mistake to assume that all of our noticing is of this sort; not all, or even most, of our perceptions are garnered in this "aimless" fashion. The ability to perceive sense-data disinterestedly, although they may be "meaningless" themselves, and to remember them later, poses a very difficult problem for any theory of perception, but particularly for this one. The difficulty with appealing to the "goals of the organism" lies in giving an explanation of memory which can account for the ability to store and later locate apparently useless information in contexts where it has meaning.

from among various possible actions. The integration condition is a necessary condition of introspectible consciousness, but integration cannot be introspected.

In order for the integration of sense-data to be introspectibly conscious, the sense-data themselves must be introspectibly conscious and their relations empirically discoverable. If their relations are empirically discoverable, then it must be possible to observe that these relations do not obtain and to be conscious that they do not. There is, however, a logical impossibility in assuming that one and the same subject can perceive his perceptions as isolated in his consciousness; if he perceives them, they are necessarily his but if they are not his, he cannot perceive them to lack relationships, simply because he cannot perceive them. The observation of the mind by itself is logically impossible. Without consciousness, of introspectible consciousness, portions of the brain may reciprocally monitor one another; portions of the mind, however, are inherently absurd.

The fallacy of confusing the two conditions lies in the attempt to demonstrate that the split-brain patient perceives objects independently, in this introspectible way. It is when perception is taken to be a passive process, enabling us to see exactly what we observe consciously so that we seem to have "direct access" to our perceptions, that we are tempted to hold the view that split-brain patients have two streams of consciousness, two introspectible minds, or two

selves (with attendant self-consciousness). This view is illusory. Either we must be content with a perfectly mechanical process which passively registers the presence of objects, or we assimilate the behavior of the "sides" of split-brain patients to the parallel processes described. It is unclear how one would make the transition from a passive perceiver-object namer to a conscious agent; if we account for the inability of the left hemisphere to describe what is happening on the right, the ability of the right hemisphere to identify objects independently of the left's is not an argument for its independent self-consciousness. The claim that the right hemisphere is self-conscious because it perceives objects, requires the use of a model of active perception.

But this claim cannot be substantiated, for it requires its own hierarchy of perception; it requires that there be a mechanism for the resolution of redundancy of potential command which is independent of the left hemisphere. The difficulty with this requirement is that it takes independent priority systems to set goals, one for the left hemisphere and one for the right; it is extremely difficult to prove that this is possible. The difficulty lies in structuring an experiment which could prove this volitional independence. Only one experiment had been addressed specifically to this issue.[13] A monkey was allowed to choose with one hand between red or green grapes, where the green grapes were treated with

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[13]Gazzaniga, op. cit., p. 144.

quinine; offered a choice with the other hand between untreated red and green grapes, the monkey did not hesitate to eat the green ones. The defect in Gazzaniga's experiment, as he realized, lies in demonstrating that the monkey did not simply adopt a conditional experiment. Finally, the claim that hemispheres act independently in other experimental situations is dubious at best; it rests on the premise that because the data of the experimental situation were restricted perceptually to one hemisphere, the purpose of the experiment (e.g., to match words with pictures) was restricted to that hemisphere.[14] Finally, taking such structured evidence as indicative of purpose is at best misleading; it seems more plausible to argue that the purpose is that of the experimenter.

My intention here has been to demonstrate that if we assume the right hemisphere to be an utterly passive perceiver, then there is no temptation to consider it conscious; a machine which names objects is only more sophisticated than a machine which reads numbers off checks, and there is no need to consider either of them conscious. If we abandon a passive model of perception, and attempt to give an account of consciousness in terms of the ability to discriminate features as significant in the light of some purpose, then

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[14]Indeed, if this were so, it would be difficult to reconcile Thomas Nagel's claim that the right hemisphere follows instructions with Gazzaniga's observation that there is no evidence that the right hemisphere understands verbs at all.

it becomes increasingly harder to justify attributing independent consciousness to the hemispheres, because it becomes increasingly difficult to discern what could cause subjectively important differences in significance. Any differences in the experimental subject's perceptions in experiments are features of the experiments, and not of his consciousness.

The crux of this argument is whether subjects occasionally manifest conflicting modes of behavior, and whether they are subjectively aware of them. For this, there is only Goldstein's "paranoiac" patient, and Sperry's patient whose left hand occasionally got out of control. Goldstein's patient described her hand as moving without her, while Sperry's patient complained of tingling on occasion when it moved, in the months following surgery.

Integrated behavior is thus a condition of consciousness which appears to <u>preclude</u> the possibility of multiple consciousness in any introspectible, or self-conscious sense; parallel intelligent behavior, however, is not limited to split-brain patients.

INTEGRATED BEHAVIOR AND INTROSPECTION

Researchers describing the results of split-brain experiments tend to offer alternative grounds for ascribing single or multiple consciousness to each of their subjects; on the one hand, they cite the ability to act in a functionally integrated manner, and on the other, they rely on the ability to demonstrate awareness through testimony. The experimental data cited by researchers in support of the contention that split-brain patients exemplify integrated behavior is used to claim that the behavior is more than simply intelligent. But no clear case is made for the contention that this behavior does demonstrate that split-brain patients do have parallel, introspectible consciousness which cannot be assimilated to a parallel model. The two models of consciousness are confused in descriptions offered of the mental states of split-brain patients. The claim that split-brain patients are multiply conscious appears to be either relatively trivial and true, or interesting and false.

Norman Geschwind writes in Disconnexion Syndromes in Animals and Man (p. 635):

> If the ability to give a verbal account is a prerequisite of consciousness, then only the left hemisphere was conscious; if the ability to respond in a highly organized manner, and use the results of past experiences constitutes consciousness, then he has multiple consciousness.

Sperry states in "Brain Bisection and the Mechanisms of Consciousness" (p. 303 of Brain and Conscious Experience):

> Everything that we have seen so far indicates that the surgery left these people with two separate minds, that is, two separate spheres of consciousness. What is experienced in the right hemisphere seems to be entirely outside the realm of awareness of the left hemisphere. This mental division has been established with regard to perception, cognition, volition, learning, and memory . . .

Sperry is here referring to the responses of subjects in experimental situations; later, he adds, "The presence of conscious apprehension in a hemisphere is hardly demonstrable in the absence of some mode of expression. If speech and writing are excluded, as they are in the minor hemisphere or in other kinds of brain damage, more devious testing procedures are required." Finally, when pressed in discussion as to whether the experimental results justify the attribution of multiple consciousness in split-brain patients, Sperry states, "I can only go back to the statement that someone made here yesterday--namely, that we tend to infer consciousness by analogy; in people, we accept it, and in objects, we don't" (p. 311).

Thomas Nagel addresses himself to the question of multiple consciousness. In "Brain-Bisection and the Unity of Consciousness," he writes:

> There may be other grounds for the ascription of conscious mental states that are sufficient even without verbalization. And in fact, what the right hemisphere can do on its own is too elaborate, too intentionally directed, and too psychologically intelligible to be regarded merely as a collection of unconscious automatic responses . . . it is able to respond to complex visual and auditory stimuli, including language, and it can control the performance of discriminatory and manipulative tasks.

Nagel concludes here ". . . the right hemisphere displays enough awareness of what it is doing to justify the attribution of conscious control in the absence of verbal testimony." Nagel does not conclude that the subjects do have multiple consciousness, because Nagel offers other grounds for the attribution of consciousness. Later, Nagel offers an account of the unity of consciousness.

Nagel's account of the unity of consciousness differs from the account offered in the description of the parallel-process model of consciousness. The unity of consciousness on that account concerned the integration of the parallel processes through the resolution of redundancy of potential command; the unity is unity of goals. Nagel's account offers "some assumptions about the unity of consciousness that are basic to our understanding of another individual as a person." He writes:

> We assume that a single mind has sufficiently immediate access to its conscious states so that, for elements of experience or other mental events occurring simultaneously or in close temporal proximity, the mind which is their subject can also experience the simpler relations among them if it attends to the matter. . . . The experiences of a single person are thought to take place in an experientially connected domain, so that relations among experiences can be substantially captured in the experience of those relations.

Nagel notes that in experimental situations, split-brain patients flagrantly fail to meet these conditions. He also points out that both hemispheres of a split-brain patient's mind are remarkably well-integrated. There are two major

ambiguities in Nagel's account; one is "elements of experience or other mental events," while the other concerns what it is to have "sufficiently immediate access."

The unity of the members of a series of experiences which makes them the experience of a single objective world, is a necessary condition of consciousness; these experiences are thought to be accessible to a single subject. Split-brain patients' hemispheres share certain more or less crude sensory inputs in normal situations, which they are prevented from sharing in experimental situations. So depending upon how "elements of experience or other mental events" is to be interpreted, it can refer either to crude, sensory input, or to an introspectible awareness of the presence of an object. An equivocation in the description of mental events results in the immediate possibility of an equivocation of the subject(s) of that experience, with the equivocation only becoming apparent in shifts from normal to experimental situations.

There is a second, related difficulty with this loose description of mental events. If we want to postulate that split-brain patients are each multiply conscious, we have to deny that each patient experiences a single, objective world; otherwise, the suggestion of multiple consciousness is without interest. It would appear then that either each split-brain patient is not capable of consciousness at all, which is not the result that we intended, or that each patient

somehow has more than one set of experiences; these sets of experiences make up more than one world. This latter result implies two alternatives. Either the two sets of experiences (elements of experience or other mental events) are systematically integrated in some way, prior to the patient's subjective, introspectible experience, so that his subjective experience is unified; or a split-brain patient represents two subjects, with separate spheres of consciousness.

The plausibility of this first interpretation relies upon some means of resolving the suggestion that sets of conscious experiences might not be recognized as distinct sets. Presumably, subjects can integrate stimuli from different sense-modalities; they experience the stimuli, but do not experience their integration. "Experience" is being used here in two senses, one of which is presumably introspectible and one of which is not. Given this equivocation, split-brain patients can each be said to have unified consciousness. This condition for the unity of consciousness then appears to be markedly similar to the parallel-process model of the unity of consciousness.

This reading probably amounts to a willful misreading of Nagel's account, for Nagel does specify "a single mind has sufficiently immediate access to its <u>conscious</u> states" (emphasis mine). Nagel, however, does not seem to have a clear conception of conscious states, and his remarks leave open the possibility that conscious states do not imply that the subject

whose states those are, has consciousness of them. Nagel writes:

> I do not wish to claim that the line between conscious and unconscious mental activity is a sharp one. It is even possible that the distinction is partly relative, in the sense that a given item of mental activity may be assignable to consciousness or not, depending on what other mental activities of the same person are going on at the same time, and whether it is connected with them in a suitable way. (p. 404)

Nagel elsewhere mentions the possibility that "everyone has two minds, but that we don't 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 provides their anatomical bases" (p. 409). Obviously, the crux of the problem here lies in determining why we should be able to introspect conscious states, if our ability to introspect them varies according to what other mental activities are occurring concurrently. The truly interesting problem concerns the relation of conscious states to consciousness.

Unfortunately, on Nagel's account, this relation appears to be closely tied to the problem of direct access, or "sufficiently immediate access," and this is extremely deceptive. Nagel compares direct access with integrated behavior, and this comparison can only lead to confusion. The apparent integration of the overt behavior of split-brain patients accustoms researchers to describe patients as single subjects in ordinary situations, and as two subjects in experimental situations. But without some comprehensive account

of the relation between the unity of consciousness and integrated behavior, the inclusion of a criterion involving direct access in descriptions of overt behavior is meaningless. Describing such access as "sufficiently immediate" only compounds the problem, for this description leaves open to question whether such access incompasses or excludes strategies.

If by "sufficiently immediate access," Nagel means to require introspection, excluding strategies, then split-brain patients are each invariably two subjects. Neither hemisphere can introspect the other's mental states at all; the failure to introspect is demonstrated by the confabulatory responses offered by the "verbal" hemisphere in explanation of the activities of the other hemisphere. Confabulatory responses are defined as the "chatty filling-in" of gaps in experience. If introspection is required, the two hemispheres do not comprise a single mind. However, if Nagel means to permit the kind of strategies accessible to both hemispheres to constitute sufficiently immediate access, accepting the transfer of information across the body, then the patient may meet Nagel's condition for possessing a single mind. The patient meets this condition in a rather unorthodox manner, as we are unaccustomed to voluntary physical actions as comprising a form of mental access. It is of great importance that one standard for the immediacy of access be applied to subjects in both experimental and normal situations; the

unorthodoxy of voluntary physical actions as comprising mental access makes it difficult to remember to apply a uniform standard.

Nagel has difficulties in applying one standard consistently to split-brain patients in both experimental and normal situations; he appears to vacillate between the two standards of immediacy. Nagel states "functions of the right hemisphere are inaccessible not only to speech but to any direct combination with corresponding functions of the left hemisphere" (p. 405, emphasis mine). But Nagel suggests later:

> There is little doubt that information from the two sides of their brains can be pooled to yield integrated behavioral control. And although this is not accomplished by the usual methods, it is not clear that this settles the question against assigning the integrative functions to a single mind. . . . Nevertheless, if we assign the integrative functions to a single mind, we must also ascribe the experimentally evoked disassociation to that mind, and this is not easy. (p. 406)

Although Nagel appears here to be accepting behavioral integration as affording sufficiently immediate access, he argues against this view by abandoning this view and endorsing some other form of access. In arguing against this view, Nagel explains why it is not easy to ascribe the experimentally evoked disassociation to that mind; he writes, "there is nothing about the experimental situation that might be expected to produce a fundamental internal change in the patient. In fact, it produces no anatomical changes" (p. 408, emphasis mine). This rejoinder can only be interpreted as evidence of

a gross confusion of conditions of access, which results in a confusion of mind and brain. If strategies are accepted as constituting a form of mental access, then the prevention of strategies cannot be described as a purely physical change; their prevention constitutes a change in the mind. This change requires neither internal nor anatomical changes.

If what is significant in the mind, is the transfer of information, and no assumptions are made concerning the means used to transmit that information, then the explanation for the loss of interhemispheric integration in experimental situations is obvious. The changes produced in the experimental situation can be attributed to the blockage or saturation of the bodily channels used in information transfer by strategies. The cases demonstrating a loss of the ability to respond in an integrated way, when strategies are disrupted, is similar to the failure to respond normally shown by persons whose central nervous systems cannot assimilate all the information they are given, or are not given enough information. For example, stuttering and language difficulties result as a consequence of forcing a person to switch "handedness," because both hemispheres give each other needless and duplicated information; failure results because there is too much information to be assimilated. Too little information, such as results from other forms of disconnexion syndrome (e.g., loss of a visual association area) results in confabulatory responses similar to those manifested by split-brain patients in experimental situations in which strategies are prevented.

Once the confusion engendered by a change in the conditions for access to mental states is resolved, there is consistently either one subject or two; we are no longer troubled by minds "popping in and out of existence," and the unity of consciousness is not a somehow transient phenomenon. But if it appears that whether strategies can be permitted to constitute access or not remains a decision question, this illusion is only a consequence of our ignorance of the way strategies function. The fundamental issue lies in assessing what strategies do, to permit behavioral integration, and why split-brain patients do not experience the use of strategies in their subjective experience; after all, strategies are based upon voluntary action. Yet it appears to be voluntary action which is not introspectible. It is the presumption that voluntary action <u>is</u> conscious action which gives this statement its suggestion of paradox; we then appear to have conscious states which are not accessible to consciousness. The suggestion that voluntary actions are conscious leads to the view of strategies as observable by the split-brain subjects, and the view that strategies are somehow observable leads to the idea that strategies constitute inferences as to the mental states of the opposite hemisphere. This view lends the two-minds position much of its attractiveness; it offers the juxtaposition of direct access and inference which forms one of our criteria for the individuation of mental

subjects. In my next section, I argue that this view is fundamentally mistaken. I demonstrate, using Nagel's five alternative descriptions of split-brain patients, some of the profound conceptual problems which this view faces.

CONCLUSION: CONSCIOUS STATES AND CONSCIOUSNESS

The most fundamental issue in interpreting split-brain experiments as demonstrating the possibility of multiple consciousness, lies in the relation between conscious states and the consciousness of those states. This relation is very difficult to describe, partly because of the necessity to rule out whatever conscious states originate in the midbrain, but also because the human mind can discriminate "mental events" at different levels of simplicity. We find the inability to introspect certain features of our experience baffling. If we can see something at various levels of simplicity or complexity, depending upon how much detail we wish to discriminate, then we feel that we ought to be able to recognize and introspect features of our conscious experience of seeing that thing. Strategies used in split-brain experiments are puzzling, because it seems that the subject must either perform consciously and be aware of his use of strategies, or must behave automatically. In the first case, split-brain patients have multiple introspectible consciousness; in the second, they each have single minds. The interpretation which is offered, and the one which is perhaps best, is one which can describe both hemispheres as capable of intelligent, purposive action and then offer an account of our experience of that action.

Nagel offers five different descriptions of the minds of split-brain patients. They are the following:

1. The patients have one fairly normal mind associated with the left hemisphere, and the responses emanating from the nonverbal right hemisphere are the responses of an automaton, and are not produced by conscious mental processes.

2. The patients have only one mind, associated with the left hemisphere, but there also occur (associated with the right hemisphere) isolated conscious mental phenomena, not integrated into a mind at all, though they can perhaps be ascribed to the organism.

3. The patients have two minds, one of which can talk and one of which can't.

4. They have one mind, whose contents derive from both hemispheres and are rather peculiar and dissociated.

5. They 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 (perhaps the single mind splits in two and reconvenes after the experiment is over).

Nagel's argument in rejecting these five alternatives relies on the assumption that either the responses of the right hemisphere are unconscious and automatic, or they are conscious. Denying that the responses are unconscious and automatic, Nagel is forced to affirm that they are conscious; he cannot give an account of conscious experience which approximates that of normal persons. Nagel postulates that these conscious thoughts are isolated, or "peculiar and disassociated." But Nagel does not appear to have an answer to the question: how can these contents be experienced <u>at all</u>, if they are not

integrated into the rest of experience? If these experiences are isolated, disassociated or peculiar, the answer appears to be, that they are not experienced; someone else, or something else experiences these aspects of experience.

Nagel suggests that either the right hemisphere is conscious, or it is merely "a collection of unconscious automatic responses." Nagel then argues against the possibility that the activities ascribed to the right hemisphere could be unconscious automatic responses. Nagel describes these activities as "too elaborate, too intentionally directed, and too psychologically intelligible" to be unconscious. The fact that these responses are elaborate and intentionally directed does not make them necessarily conscious. Kenneth Sayre has pointed out in Consciousness: A Philosophic Study of Minds and Machines, that purposeful activity need not be conscious. Sayre points out that certain animals manifest elaborate and intentionally directed forms of behavior, and yet we ascribe the behavior to instinct, and question whether the animals are conscious. The difficulty in interpreting the responses of the right hemisphere as collections of unconscious automatic responses lies in accepting them as automatic. Nagel's use of the term "automaton" rather prejudges the issue; if these responses are described as evincing common and familiar actions, to which we are so habituated that we are capable of performing them without consciously attending to our performances, then this alternative is much more attractive.

Moreover, nothing Nagel offers as an activity performable by the right hemisphere exceeds this ability. The right hemisphere responds to complex visual and auditory stimuli. Nagel states that the right hemisphere also responded to language, but the patients' language ability in this hemisphere was interestingly limited. Patients responded to nouns, but not to verbs. Oddly, the patients responded correctly to nouns such as "butter," "letter," etc., but not to similar nouns derived from verbs, such as "fighter," "locker," etc. Gazzaniga states in The Bisected Brain (p. 119) "there was no evidence that verbs were understood or comprehended at all." If the possibility is allowed that the right hemisphere functions intelligently in integrating these stimuli, and in performing certain actions, then there is less resistance to the concept of "unconscious responses."

The difficulty with this view is that it is hard to reconcile purposeful attentive action with the requirement that the subject cannot be conscious of those actions. If the behavior is intelligent, then it seems that it must be at least potentially conscious; if the actions performed (apparently by the right hemisphere) are merely actions to which we are, perhaps, habituated, then they are in some sense voluntary and ought to be such that we are at least capable of introspecting them, or being self-conscious of them.

Nagel's second possibility allows that the right hemisphere's activities are conscious, without belonging to a mind

at all. There are difficulties with this view; chiefly, the possibility that there are conscious states that do not belong to a mind seems unintelligible. Nagel wants to refute a view similar to that just presented in rebuttal of his first proposal; he wants to argue against the view that the activities of the right hemisphere merely represent slices of purposeful behavior. The issue in question is whether a system capable of "carrying out tasks which require the integration of diverse psychological determinants" must consciously integrate those determinants, or at least, must be capable of consciously integrating those determinants. Nagel appears to presuppose this conscious integration in arguing that the right hemisphere's activities belong to a subject of experience and action.

Perhaps the most obvious point is one made in Section 3: it is at best problematic to assert that the right hemisphere independently carries out such tasks. It is questionable whether any integration of "psychological determinants" is performed by the right hemisphere alone. What may perhaps be conceded is that the right hemisphere independently experiences consciousness' "simplest elements, the raw sensations like the color red, for example, the colors, sounds, taste, touch, and smell" (Sperry, "Brain Bisection and the Mechanisms of Consciousness," p. 313); the ability to experience such sensations can surely proceed in parallel, without disturbing anyone's concept of consciousness.

And so, we are left with Nagel's fifth alternative. The hemispheres function in parallel. An explanation can be given for the apparent appearance of two minds in experimental situations; it has been presented in Section 4. Strategies constitute a form of mental access, and their disruption causes a loss of integrated activity at least with regard to the activity being tested; aspects of behavior unaffected by the experiment continue undisturbed. The fundamental problem with this account is that although it offers a solution, the connection between integrated behavior and our experience of it, depends upon structuring a situation into a context in the light of our goals.

Although it is relatively easy to demonstrate the difficulty of establishing that the hemispheres of a split-brain patient's brain could have divergent goals, this demonstration does not suffice to show that the hemispheres could not have divergent goals. The primary weakness of the description given, in which split-brain patients do not subjectively experience disunity, lies in the possibility that split-brain subjects are two different subjects, or do diverge to become two different subjects during experimental situations. If split-brain patients each had two sets of goals, generally uniform but occasionally distinct, then perhaps they would each be two subjects, or would diverge to become two subjects when attempting to work toward those goals. The difficulty in refuting this possibility is that

no appeal can be made to the patients' subjective experience.

But the possibility that the patients are each two subjects is not an attractive view to defend, nonetheless. On this view, it is difficult to explain the ability of the hemispheres to function together. In order to perform strategies in situations in which the hemispheres' access to the perceptual input available to the opposite hemisphere is deliberately restricted by the experimenter, the hemispheres can devise fairly sophisticated strategies. On the two-minds view, the ability to perform strategies of this kind is problematic. It is difficult to grasp how the two hemispheres could structure a situation independently so that the lack of information from one hemisphere to the other could be informative. The problem with an interesting defense of the two-minds view, lies in explaining the significance of negative information in response latencies. Given the view that there are two minds, which somehow observe each other, and make inferences (which at least in principle are introspectible), from the actions of the opposite "side," accounting for the ability to make inferences when the other side did literally nothing is difficult.

A somewhat burlesqued example can be given of this point. In one of Arthur Conan Doyle's stories ("The Case of Silver Blaze"), there is a famous exchange in which Sherlock Holmes refers to "the curious incident of the dog in the night." When someone states "the dog did nothing in the

night," Holmes replies "that was the curious incident." Taken literally, this exchange suggests an interpretation worthy of Fridugis; "nothing" obviously names something, or refers to something, in this case a very significant action by the watch-dog in the case. But that the dog did not do something (namely, bark at an intruder) is significant only in the context of certain expectations.

The same point can be made of split-brain patients; in those experiments upon which the two-mind view depends, there must be a context of shared expectation in order for the feedback strategies to work. Either the experimental subjects' hemispheres independently perceive the same aspects of the situation as significant because they share the same purposes, or because the experimental situation is itself so structured that each hemisphere perceives what is required of it. The first alternative suggests a unanimity of purpose which suggests a pre-established harmony, if the ability to perceive the situation as significant really depends on the subjects. The second alternative depends on the ability of the sides to respond to a situation, in which their tasks somehow can be grasped and performed solely in the context provided by the experiment. Because the situations cannot be so perceived by the hemispheres independently, and because they frequently rely upon the ability to contrast or compare isolated objects, this explanation is inadequate. But if in this latter situation, the subjects are postulated to share

an understanding of the purpose of the experiment, then the situation is simply that described in terms of the resolution of redundancy of potential command. There is no need to postulate that split-brain patients each have two minds.

The suggestion that split-brain patients have two minds requires the individuation of perceptions (including somesthetic sensations), purposes, etc. into two distinct sets, as well as an explanation of the fact that these sets must overlap and share identical members. It requires an explanation of the internal coherence of one of these sets, and either an account of the internal coherence of the other or an explication of its somewhat anomalous status vis-a-vis the other. Although the account of the relation of "the naive attitude" and the possibility of reflective awareness offered by the parallel-process explication of consciousness could use improvement, the account offered in the two-minds view shares those difficulties and adds others of its own.

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