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Odyssey

tation should be resisted, for there is no reason to suppose that the brain evolved in such a way as to reveal much about how it works from the inside. Whether there is anything going on in the brain that corresponds to "unity of consciousness" or to "center of consciousness" (inchoate as these notions are) is an empirical question, and if our pretheoretical intuitions find themselves on the outs with the facts, then it is our intuitions that must stand to be schooled.

Perhaps what underlies the conviction that it is reasonable at this stage to entertain estimates on the number of centers of consciousness in a normal human is the idea that whatever else neuroscience might tell us about conscious states, at least it is obvious that there is one single type of state or process involved, and so once we know the behavioral manifestations of consciousness, we can at least argue reasonably about whether there exist one or two or five hundred centers. Yet what is obvious in the nascent stages of theory may well be quaintly preposterous from the hindsight of developed theory, and it is surely possible that this conception of consciousness as one single type of phenomenon will be found to be so. The brain may well be fitted out with a synod of self-monitoring mechanisms that operate variously and at varying degrees of efficiency at different times, with none functioning as the "center of consciousness." And all this, unbeknownst to introspection. Different mechanisms may ascend to physiological prominence under different circumstances – e.g., when the organism is vigilant in foiling a predator, as contrasted to resting contentedly after a meal, or when it is fatigued or sexually aroused, or when its attention is divided between reading a bedtime story and fantasizing its fortune, or when it is dreaming or in deep sleep, or hysterical, high, or hypnotized (Hilgard 1977). Distinct neuronal structures may figure in distinct types of awareness, and, indeed, some such structures may be in the left hemisphere and some in the right. Information may be differentially available to different processes, and control may be distributed and shifting rather than the unique and abiding province of one particular mechanism. Even if two mechanisms are operating in the right and left hemispheres, the idea that one's "inner life" would thus be a tandem affair is no more plausible than inferring that the retina cannot have a blind spot because if it did our visual field would contain a black hole in the center. The reason we do not perceive a black hole in our visual field is that the brain has no means for detecting the edges of such a hole, and neighboring areas "fill in the gaps." If, as seems likely, there are a variety of attentional processes, their ascending and receding may go unmarked by introspection because the brain has no means for detecting the onset and offset of such processes.

What all this suggests to me is not so much that "persons" or "centers of consciousness" turn out to be more numerous than we thought. Rather, it suggests that the notions of "person" and "center of consciousness" do not have the objective empirical integrity we thought they did.

NOTE

1. The official count was 6,500. See Andrew Dickson White 1896, vol. 2, p. 143.

Cognitive processing is not equivalent to conscious processing

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Although the study of consciousness has lain and continues to lie at the core of much research in the biobehavioral sciences, it is only recently that investigators have attempted to formu-

late questions about this phenomenon in more precise terms that lend themselves to empirical testing (e.g., Davidson & Davidson 1980). One of the most prevalent confusions of workers in this area is equating complex cognitive processing with conscious processing. Higher mental operations are often considered to be synonymous with conscious activity (e.g., Battista 1978).

A number of authors have argued on the basis of both empirical and logical considerations that many, if not most, cognitive operations proceed in the absence of conscious awareness (e.g., Davidson 1980; Piaget 1973; Nisbett & Wilson 1977). For example, the processes by which we decide whether a sentence is grammatical are typically inaccessible to conscious awareness. Similarly, the operations required for determining whether a face to which we are exposed is familiar are also typically unavailable for conscious report. These and other similar examples lead to the suggestion that the occurrence of complex cognitive processing is insufficient evidence from which to infer the presence of consciousness.

One of the central assumptions upon which Puccetti's thesis is based is that complex mental activity is associated with or implies conscious processing. On numerous occasions, claims about mental duality are quickly translated into arguments for conscious duality. For example, Puccetti suggests that "mental duality [can] be surgically induced, so that the potential for *double consciousness* already exist[s] in the normal – if epileptic – human brain" (italics added).

The representation of information in one hemisphere that duplicates the information contained in the other is taken as evidence to support "conscious duality." The obvious adaptive advantage of the bilateral representation of sensory information is not necessarily of direct relevance to the claim of dual conscious processors. Information can be represented and utilized in the absence of conscious awareness. For example, one is rarely conscious of the contextual information (sometimes referred to as "scripts") that enables us to understand communications with incomplete elaboration. These considerations suggest that arguments about the duplication of sensory information in the hemispheres are not of direct relevance to the assertion of dual streams of consciousness within each hemisphere.

Given his thesis of conscious duality, Puccetti must account for the absence of conscious recognition of dual streams of consciousness. He reasons by analogy and offers a hypothetical example of a person unable to distinguish between a real and a televised football half field. This argument, however, does not bear directly upon whether the activities and processes occurring within each hemisphere are themselves conscious. A claim of conscious duality must rest upon evidence demonstrating separate spheres of consciousness within each hemisphere. Puccetti does not make explicit the criteria by which he infers the presence of consciousness within the separated hemispheres of a commissurotomy patient.

The lack of awareness of the two separate streams of consciousness in the real-versus-televised-football-half-field analogy rests upon the assumption that the delay between the real-time events and the televised replay will be sufficiently short as to escape notice. While this state of affairs may be characteristic of televised replay, it is unclear whether the same assumption should be made about the human brain. First, the likelihood that the information-processing operations within each hemisphere will be in perfect synchrony with one another is probably small. Functional differences between the hemispheres apparently influence the speed with which each processes and responds to different classes of information (see, for example, Dimond & Beaumont 1974). Furthermore, the hemispheres have recently been found to differ in their ratio of gray to white matter (Gur, Packer, Hungerbuhler, Reivich, Obrist, Amarnek & Sackeim 1980).

This structural difference is likely to result in differences in processing rate between the hemispheres which might interact with the type of stimulus to be processed.

Structural and functional hemispheric differences are not the only sources of variance likely to result in asynchrony between the hemispheres. The delay resulting from the interhemispheric transfer itself may be sufficiently long to be detectable if processing activities within both hemispheres achieved conscious status. Estimates of interhemispheric transfer time using electrophysiological procedures fall within the range of detectable time differences (see, for example, Salamy 1978). Thus the analogy to the transmission of a televised image may be particularly inappropriate with respect to temporal parameters since neural conduction time is considerably slower than electrical conduction time.

As Puccetti recognizes from the claims he is making about conscious duality, one would logically deduce that our perceptions ought to appear doubled. In order to avoid this clearly inappropriate suggestion, Puccetti invokes a process of confinement whereby the conscious information in one hemisphere is inaccessible to the conscious processing mechanism in the other. The nature of this information-gating mechanism is never clearly specified. It is unclear how the brain makes a decision to transfer only nonconscious information between the hemispheres and block the transmission of information that is conscious within each hemisphere.

The corpus of literature to which Puccetti refers does indeed suggest that considerable duplication of sensory information in the two hemispheres occurs, and probably has important survival value. However, the leap from this evidence to the assertion of conscious duality rests largely on the assumption that higher cognitive processing is conscious, and this latter assumption is inconsistent with contemporary literature on this topic.

Mental dualism and commissurotomy

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A general criticism of this paper is that there is confusion in linguistic usage. Without any qualification, material structures the cerebral hemispheres, are given mental attributes in a manner that seems to be begging the question. With this initial assumption the case for mental duality would follow convincingly from there being two cerebral hemispheres. For example, Puccetti writes in the third paragraph of the section on the human split-brain: "Thus for purposes of attributing mental events to split-brain subjects we are forced to use the 'homuncular' language of referring to a 'left hemisphere' stream of consciousness and a 'right hemisphere' stream in the same subject. Others may take umbrage at this, but what is the alternative?" And in the second paragraph of the section on evolutionary considerations: "But surely what each hemisphere sees is real enough. If there is any illusion here, it is only the illusion each hemisphere has that it alone perceives and acts on those perceptions." And in the fifth paragraph of this section: "... neither half brain has introspective access to the conscious contents of the other."

In the penultimate paragraph of the section on mute hemispheric cooperativeness I am credited with the view (Popper & Eccles 1977) "that the mute cerebral hemisphere of the split-brain patient simply doesn't have any mental states but is a kind of automaton." This is a serious misquotation. On p. 329 I wrote: "The assertion is made that the intelligent performance of the minor hemisphere establishes that the activities of the minor hemisphere are associated with a consciousness that is equivalent to that of the dominant

hemisphere, merely differing because of linguistic disability. . . . The erroneous interpretations of Puccetti (1973), Zangwill (1973), Doty (1975), and Savage (1975) occur because they fail to distinguish between the self-consciousness associated with the dominant hemisphere, as reported by the conscious subject, and the consciousness that is assumed to be associated with the minor hemisphere because of its skilled responses that display insight and intelligence." My point was that with the commissurotomy patient the minor hemisphere gives no conscious experience to the subject. I conclude on page 329: "Commissurotomy has split the bihemispheric brain into a dominant hemisphere that is exclusively in liaison with the self-conscious mind and controlled by it and a minor hemisphere that carries out many of the performances previously carried out by the intact brain, but it is not under control by the self-conscious mind. It may be in liaison with a mind, but this is quite different from the self-conscious mind of the dominant hemisphere - so different that a grave risk of confusion results from the common use of the words 'mind' and 'consciousness' for both entities."

Fig. E 7-5 in Popper & Eccles (1977, p. 375) illustrates, in the normal subject, the possibility of a direct path from the minor hemisphere to the self-conscious mind.

In view of the recent work of Sperry, Zaidel, and Zaidel (1979) I have admitted in a book published since Puccetti's article (Eccles 1980, lecture 1) that after commissurotomy the minor hemisphere has "a limited self-consciousness," finally concluding on page 13: "These tests for the existence of mind and of self-conscious mind are at a relatively simple pictorial and emotional level. We can still doubt if the right hemisphere has a full self-conscious existence. For example, does it plan and worry about the future, does it make decisions and judgements based on some value system? These are essential qualifications for personhood as ordinarily understood (Strawson 1959; Popper & Eccles 1977, sections 31 and 33)." And on page 14: "Thus the commissurotomy has split a fragment off from the self-conscious mind, but the person remains apparently unscathed with mental unity intact in its now exclusive left hemisphere association."

I have given these extensive quotations with their overtones of dualist-interactionism as a background in my attempt to discover what is the mental duality that is the central theme of Puccetti's disputation. In fact, I raise the question: What more does Puccetti require for his mental duality? Clearly there is mental duality in the commissurotomized patient, though it is far from being a symmetrical duality. If we could reestablish the corpus callosum, this duality would surely be merged by the tremendous impulse traffic between the two hemispheres. That is the case with the normal brain, though Puccetti seems to have difficulties with this conventional view, expressing at the end the strange belief "that the function of the corpus callosum is to duplicate conscious experience on both sides of the brain. . . ." He apparently derives this belief from a comparison of commissurotomized with chiasmal patients. I find no difficulty in accommodating the findings on these patients given in the section on bitemporal defects with the conventional view of the corpus callosum. There must be a serious misunderstanding somewhere.

In the second paragraph of the target article the claim is made that "some facts that it [mental dualism] predicts can be documented in the literature and in clinical practice, but have gone unnoticed until now just because the hypothesis was not seriously considered by workers in the field."

I do not think that this claim is supported by the text of Puccetti, where only one such "fact" is documented in the section on bitemporal defects, and that is, I think, fully explained by the conventional view of the function of the corpus callosum. A concluding remark is that Puccetti seems to have given up the strange notion that there are two persons in the one skull!

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