

Consciousness and Commissurotomy: IV. Three Hypothesized Dimensions of Disconnected Left-Hemispheric Consciousness

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If a conception like the commissural-integrative conception (e.g., Sperry) of the normal stream of consciousness is correct, then we should expect to find that the consciousness of the disconnected left hemisphere is not a normal consciousness, because the right hemisphere cannot contribute to the left hemisphere's stream except by means of inadequate subcortical connections. Therefore, the present article considers, from the literature, three hypothesized dimensions of disconnected left-hemispheric consciousness: (a) Is the disconnected left hemisphere alienated as agent from behavior produced by the respective right hemisphere? Or does the disconnected left hemisphere appropriate the latter behavior to the person, as it does behavior that the left hemisphere itself produces? (b) Is the stream of consciousness of the disconnected left hemisphere more narrow and more disunified than the normal stream? Or is the left hemisphere's total state of consciousness of the moment just as rich as the normal stream, both in the part-experiences that comprise it and in awareness of relations among these part-experiences? (c) Is the disconnected left hemisphere unaware of the commissurotomy-produced deficiencies characterizing its stream of consciousness? Or does the disconnected left hemisphere have awareness of what it, taking itself to be the whole person, can no longer accomplish? Discussion of these questions should go forward; they represent natural directions in which to investigate what is distinctive about left-hemispheric consciousness—which, the commissural-integrative view holds, has been produced by surgery.

Commissural-Integrative View

Subtitled "Some Pertinencies for Conscious Functioning," the second article of the present series suggests, at the end, that psychologists should problematically approach the consciousness of people with complete forebrain commissurotomy (Natsoulas, 1988, pp. 543-544). I was discussing the com-

missural-integrative view of how unity of conscious experience (i.e., one stream of consciousness) is accomplished in the normal brain. Sperry (1976, 1977, 1984) proposed such a view, as did Dimond (1979, 1980) and Kinsbourne:

Experience arises from the occurrence, at a given time, of a particular pattern of activation distributed widely across the brain The suggestive contours of the fore-brain, when viewed as an anatomical specimen, and the separate hemispheres are a deceptive guide to how [the brain] works. Functional systems overlap sulci, traverse gyri, and even straddle hemispheres via the great forebrain commissure. (Kinsbourne, 1982, p. 412)

At the neural level awareness is based on the concurrent activities of distributed loci in the differentiated, cortical neuronal network. (Kinsbourne, 1988, p. 253; cf. Sperry, 1976)

According to the commissural-integrative view, conscious experience emerges only upon callosal activation, as Puccetti (1987) stated correctly except for possibly implying the corpus callosum must be activated for any conscious experience to occur. Commissural integration applies to the normal case; under other conditions, consciousness "flows on" without commissural involvement: for example, after the commissures are fully severed (for relief of *grand mal* seizures), and after a cerebral hemisphere is removed (Austin, Hayward, and Rouhe, 1974; Bogen, 1969a; Ogden, 1988, 1989; Smith, 1966, 1974).

There appears to be some small inclination toward the commissural-integrative view by a prominent advocate of a major competing interpretation: Gazzaniga (1988) writes, "What was thought to be one module actually is the product of the interaction of at least two modules, each located in a different brain area" (p. 230; cf. Gazzaniga, 1987a, p. 37: "The left may normally contribute certain executive functions to specialized systems in the right brain"; but see Natsoulas [1988] on Gazzaniga and LeDoux's repeated interpretation that a verbal consciousness system in the left hemisphere produces the single stream of [specifically human; see Natsoulas, 1988, p. 527] consciousness belonging to any normal or commissurotomed individual). In the above statement, Gazzaniga (1988) was referring to tasks considered right-hemispheric (e.g., the block design test) but which, after surgery, some commissurotomed individuals can no longer perform with either hand, or with difficulty and poorly. The interpretation is that such tasks involve processes extending across hemispheres. Perhaps, in the normal case, no voluntary behavior is independently controlled by a single hemisphere (cf. Sperry, 1984, p. 669). This follows from these hypotheses: (a) voluntary behavior is caused or controlled by the stream of consciousness (cf. Natsoulas [1991d] on Gibson's [1979, Ch. XIII] account of visually-guided locomotion; contrast Gazzaniga, 1985, p. 5); (b) according to the commissural-integrative view, the stream, throughout its length, "straddles" the hemispheres (Dimond, 1980, p.

425; Sperry [1976]: "The callosal activity becomes part of the conscious event" [p. 171]); cf. Schacter [1989, p. 371]; (c) the stream may be intrinsically complex but is unitary, fully and integrally constituted by each successive pulse of consciousness (James, 1890; cf. Lockwood's [1989] "maximal experience").

Strange and Mysterious

Cook (1986) had already issued a call similar to mine (Natsoulas, 1988), asking investigators to be alert to the details of how the disconnected left cerebral hemisphere functions linguistically—rather than assuming that the absence of the right hemisphere's contribution makes no difference since the left hemisphere already controlled speech before surgery. Shallice (1988), emphasizing that even simple tasks involve complementary functioning across hemispheres, stated, "Any conscious experience limited to one hemisphere would be quite unlike the one we have" (p. 395; cf. Dimond [1980, pp. 428–431] on dreaming in the commissurotomized, and a brief review that concludes, "In sum, the consciousness of the left hemisphere is not the consciousness of a whole brain" [Levy, 1978, p. 289]). Here is how I expressed what I was proposing:

This suggestion, which I draw from the commissural–integrative view, is not meant to be as extreme a suggestion as LeDoux's (1985) questioning of the humanness of the mute hemisphere's consciousness. Yet there is some resemblance, since I suggest that investigators look for how consciousness is different for the commissurotomized. (Natsoulas, 1988, p. 544)

I meant to advise psychologists who adopt something like the prominent commissural–integrative view, and are concerned with the consciousness of one or both mutually disconnected cerebral hemispheres, to proceed using the following working assumption: the commissurotomized individual, in his or her consciousness, is very different from intact people; both of his or her streams of consciousness will turn out to be, when we come to understand them adequately, very strange and mysterious to us. Aside from its possible truth, why should psychologists adopt this assumption? To increase curiosity about part of psychology's truly astonishing subject matter; as Gibson urged, psychological science would greatly benefit were psychologists to stand more in awe of their subject matter, rather than mainly treating psychology as their bread and butter (Reed, 1988, p. 1).

Assimilative Tendencies and the Pluralistic Approach

A second purpose for assuming that the consciousness of commissurotomized people will always be strange and mysterious is as a counterforce to

assimilative tendencies to ascribe (a) the same consciousness as one's own, as one knows this to be firsthand, or (b) the same psychological processes as happen to be especially familiar from one's role as psychological scientist. As regards the influence of such tendencies on psychological thought, study of Gazzaniga and LeDoux's account of consciousness is instructive (Natsoulas, 1988; Shallice, 1988, p. 396). In a recent article (Natsoulas, 1990), I described and justified "the pluralistic approach" to psychological questions. (a) Psychologists do well as scientists to modify how they think: specifically, *to replace as much as possible the prevailing eliminative patterns of reasoning, which work to reject and exclude from the science alternative approaches to or conceptions of subject matter, in favor of one or another purportedly correct approach or conception*. In effect, I proposed that psychologists reduce their need to be and have others be "scientifically correct." (b) I advocated that psychologists, individually, go so far as *to adopt a plural as opposed to a singular conception of the respective phenomena under investigation*. About a cognitive psychologist who would permanently ignore the raw feeling of pain because it is not a cognitive state, I stated,

Why does he not develop for himself a plural conception of the nature of feelings that includes both his computational conception of mind and a conception of the mind along the lines, say, of Melzack's (e.g., 1989) thinking about the brain and pain? Nothing requires him to rest with a singular conception, not even incompatibilities between the alternative accounts constituting a plural conception. (Natsoulas, 1990, p. 179)

(c) In much the same spirit, as fostering diversity within the thinking of individual psychologists, would seem to be *restraining one's assimilative tendencies that cause one as a psychologist to fasten onto likenesses among phenomena at the expense of their differences*.

Surgically Created Consciousness

If, as the commissural-integrative view holds, the stream of consciousness in the intact individual is an anatomically tripartite process in the brain—that is, a molar, integrated process proceeding as a unit (entitatively, as Sperry would say) in a wide area of the brain that includes part of each cerebral hemisphere and the connecting corpus callosum—then the two streams that, according to the commissural-integrative view, proceed one in each cerebral hemisphere after complete forebrain commissurotomy, may well have a different character than the stream of consciousness that proceeds in human beings whose brains are intact and functioning normally. This hypothesis should be attractive to the now rapidly increasing number of psychologists of consciousness (Natsoulas, 1991c); they will be intrigued by the idea that, to extend the metaphor, the stream of consciousness may be par-

tially diverted to flow entirely within the confines of only part of its original channel, or in two mutually separated parts forming two distinct nonmerging, noncrossing, nonadjacent channels. Presumably, such a diversion would modify properties of consciousness; the two new streams of the commissurotomed individual would possess properties that the original stream of consciousness did not possess and vice versa. (Let me emphasize that, in referring to channels of flow, I am speaking metaphorically and not theoretically. Also, I am not suggesting that the old stream continues to flow in the form of either new stream; cf. Zuboff, 1990, pp. 47–48). Psychologists of consciousness will be much intrigued by hypotheses of new kinds of consciousness brought surgically into existence (e.g., see Kinsbourne [1982] on “the inconsequential person”). For one thing, what is the stream of consciousness of the disconnected left hemisphere really like? This is the question of the present article. Does it not make a difference to what the disconnected left hemisphere’s stream is like that this stream “flows” entirely inside an anatomical area of the left cerebral hemisphere, that the right hemisphere makes no direct contribution to this stream on consciousness, that the disconnected right hemisphere is, as it were, no part of this stream on the left? As in the previous articles of this series (Natsoulas, 1987, 1988, 1991a), I mainly consider aspects of what is known or knowledgeably held about the consciousness of fully commissurotomed people—aspects relevant to the character of the left one of their hypothesized two streams of consciousness (cf. Levy, 1978). Two sets of comments are in order before discussion of three hypothesized dimensions of disconnected left-hemispheric consciousness.

Disconnected Right-Hemispheric Consciousness

The same question as above should be raised and addressed about the stream of consciousness of the disconnected right hemisphere. I am concerned in the present article with the disconnected left hemisphere not because the right one is of little psychological interest. I simply do not want to distract from the impression of strangeness that the disconnected left hemisphere’s stream of consciousness may evoke. I would be doing so if I considered repeatedly the consciousness of the disconnected right cerebral hemisphere, which may be an object of somewhat greater interest at least initially. (a) The right hemisphere has captured the public’s imagination. As Kinsbourne (1982) stated critically, “Some have confused the relational function of the right hemisphere with holistic ways of thinking, such as are advocated by West Coast partisans of East Asian philosophies” (p. 417; cf. Gazzaniga, 1985, Chapter IV, 1987a, pp. 26–27). (b) Moreover, for investigatory and explanatory purposes, psychologists seem to favor hidden processes, events proceeding behind the appearances, over consciously accessible pro-

cesses (Natsoulas, 1991c). Psychologists like to explain the unhidden in terms of the hidden. Some of them say, consciousness is “product,” as distinct from “process,” which silently produces the “product” (e.g., Cam, 1989; Gazzaniga, 1985, pp. 4–5). Not all that happens in the disconnected right hemisphere is nonconscious; I agree with Puccetti (1989, p. 143) that we have no good reason to doubt that the disconnected right hemisphere consciously retrieves objects with the left hand (see my discussion [Natsoulas, 1991a] of Gillett’s [1986, 1987a, 1987b, 1988] alternative view; cf. Dimond, 1979, p. 207). I only mean to mention psychologists’ predilection for events transpiring behind the scenes, whether these be nonconscious psychological processes or conscious processes that can be poorly reported at best, as occur in the disconnected right hemisphere; psychologists’ attention often turns away from the disconnected left hemisphere, being drawn to the relatively unfathomable right hemisphere. Given this predilection, psychologists will find the James of *The Principles* (1890; Natsoulas, 1991c) difficult to take, if they read him closely, and Searle (1989, 1990; Natsoulas, 1991e) even more disturbing. After all that has transpired in psychology in the full century since James’ *Principles* appeared in print, Searle has been insisting, as James did, that all literally psychological occurrences are conscious. Were Searle’s view accepted, psychologists would have little to say about many psychological phenomena, which they have explained to their satisfaction by means involving reference to directly inaccessible psychological processes (e.g., Gazzaniga’s [1985] non-conscious modules that do mental work). As Piattelli-Palmarini (1990) responded to Searle (1990):

The terms of a brain vocabulary, which Searle so strongly recommends, would not only miss all the crucial linguistic and cognitive generalizations, they would not even allow us to state properly the relevant linguistic and cognitive facts, not even at a proper descriptive level. (p. 619)

Alternative Theoretical Interpretation

Gazzaniga (1988) stated what the prevailing implicit view underlying commissurotomy research has been: “While most prior studies have been carried out in the belief that each half-brain is a functioning, independent system that operates no differently when separated than when connected, new studies are now beginning to challenge this original view” (p. 229). There are other theoretical views of intact consciousness than the commissural–integrative view. Some psychologists do not expect anything unusual to be discovered about the disconnected left hemisphere’s stream—that is, anything unfamiliar from understanding consciousness in the intact case, or anything that we could not learn from studying intact individuals. An example of such

a theoretical view which may come to mind first is Puccetti's hypothesis that the intact, healthy individual already has two streams of consciousness, one proceeding in each cerebral hemisphere (Puccetti, 1973, 1981, 1989; cf. Bogen, 1969a, 1981, 1986, 1990; Oakley and Eames, 1985; Wigan, 1844/1985; Zaidel, 1987; Zaidel, Clarke, and Suyenobu, 1990). In fact, Puccetti holds that commissurotomed and normal individuals are *each two persons* (while Cook [1986], DeWitt [1975], Gillett [1986], Hannay [1990], MacKay [1980, 1987], Marks [1981], Moor [1982], Rigterink [1980], Trevarthan [1979], and Wilkes [1978] hold that they are *each one person*, Zuboff [1990; see Unger, 1986] that they are *all one person*, and Parfit [1987] that, in a sense, *no person is ever involved*). Thus, according to Puccetti, the two streams continue as they were before commissurotomy except for no longer receiving and being affected by direct information from the other cerebral hemisphere. (Indirect information is another matter, as when affect evoked by presenting certain materials to only one hemisphere is experienced by ["spreads to"] the other hemisphere via subcortical connections [Gazzaniga and LeDoux, 1978; cf. Cronin-Golomb, 1986a, 1986b, and Gazzaniga, 1987a, pp. 61-63, 1988, pp. 220-224, on "blind-naming"; and Geschwind, 1985, p. 174, on a case in which nonsurgically disconnected hemispheres experienced different emotions; also, Bogen, 1985, p. 312; Cook, 1986, p. 138; Lockwood, 1989, pp. 88-92; Trevarthan, 1987, pp. 389-390; Zuboff, 1990, pp. 48-49].) Puccetti (1987) argued: if the commissural-integrative position were true, we "would perceive two full subjective visual fields side-by-side" (p. 154; Puccetti, 1981; cf. Berlucchi, 1981, 1983; Berlucchi and Antonini, 1990). Since we do not, and the facts about the commissurotomed being as they are, each of us, however well integrated physiologically we may be, also has two streams of consciousness. Part of the reason we do not know this in our own case, according to Puccetti, is that neither stream has direct (reflective) awareness of the other stream, though they are connected and affect each other (cf. Claridge's [1987, p. 37] view of schizophrenics as having direct [reflective] awareness across streams; also, postmortem examination of chronic schizophrenics' brains reveals a relatively large corpus callosum [Beaumont and Dimond, 1973]).

However, Puccetti clearly expects one disconnected stream to function differently than prior to commissurotomy because it now comes under less interference from the other hemisphere. Puccetti (1981) described the right hemisphere as a kind of self-conscious helot before surgery, due to the left hemisphere's dominance in producing behavior (contrast Oakley and Eames [1985, p. 227] who propose that left-hemispheric dominance is achieved through cross-hemispheric suppression of the right hemisphere's "self-awareness system," whose function it is "to read out the contents" of the right hemisphere's stream of consciousness). Thus, Puccetti would expect the right hemisphere to function more freely once it is able, finally, to exercise some

control over the contralateral side of the body; at least, it is now better able to express itself than during its long period of subordination. Examples of spontaneous disconnected right-hemispheric behavior are indeed given in the literature, but not as often as one would expect on Puccetti's hypothesis of the right hemisphere's having felt oppressed for all those years. Gazzaniga (1988, p. 234) implies that a "transient state of dyspraxia" (presumably, "diagnostic dyspraxia"; Bogen, 1985, p. 313) of the left hand occurs often enough to devise a different test of a certain (confabulatory) phenomenon, in which (a) the influence of the right hemisphere can be witnessed in right-handed behavior and (b) the left hemisphere, therefore, does not feel impelled to interpret the right hemisphere's behavior of the left hand. Puccetti (1989) mentioned instances that Dimond (1980; Bogen, 1985, pp. 312–313; and below) reported to him: a right hemisphere's throwing down a newspaper that was occluding the TV, and slapping the face when it was time to awaken. (See MacKay's [1987, p. 10] example, which Puccetti would call the continued subordination, after surgery, of the right hemisphere to "its master's voice.")

An Hypothesized Dimension of Disconnected Left-Hemispheric Consciousness: Alienation as Agent of Right-Hemispheric Behavior?

Gazzaniga (1987a, 1988, pp. 225–229) mentioned the reaction of fully commissurotomed J.W.'s left hemisphere during testing of his right hemisphere's ability to follow verbal instructions:

Quite remarkably, if a picture of something, for example a horse, is flashed to the right brain, the left brain will typically speak out and say that it saw nothing. The examiner can then say things like, "Don't draw what it is; draw what goes on it." The patient might say something to the effect of "What are you talking about; I didn't see anything." Then the left hand will pick up a pencil and draw a saddle. In this particular case, JW drew an English saddle, a sketch that would appear ambiguous if you did not know the context. JW said that he did not know what he had drawn. He was then asked to draw a picture of what was flashed. The left hand then drew a horse and, after completing the picture, JW grinned and said, "That must be a saddle." (Gazzaniga, 1987a, p. 15; Gazzaniga, 1988, p. 227; J.W.'s right [left] hemisphere performed all drawing [speaking])

The right hemisphere's perspective does not concern us here. Can we learn from how left hemispheres are aware of right hemispheres' behavior something about the disconnected left hemisphere's self-consciousness? Gazzaniga and LeDoux (1978) believe that therein is revealed a crucial dimension of all consciousness.

Such left hemisphere's reactions as quoted above raise the question: How does the left hemisphere understand what goes on when the left hand follows instructions by using information provided only to the right hemisphere? How should we characterize the left hemisphere's self-consciousness as

regards right-hemispheric behavior (cf. Dimond, 1980, pp. 431–436)? Does the left hemisphere feel alienated from the left hand or that the left hand's behavior belongs to a different agent? Alienation as agent of right-hemispheric behavior sometimes does occur in commissurotomy people. Kurt Goldstein's patient "complained that her left hand was evil and beyond her control" (Geschwind, 1985, p. 174). Reviewing the disconnection syndromes, Bogen (1985, pp. 313–314) includes a brief section "The Alien Hand," wherein are identified two main phenomena: the left hemisphere's (a) experiencing the left hand as foreign, alien, or uncooperative, and (b) expressing surprise or astonishment at the left hand's behavior. Bogen acknowledged the confabulatory interpretations Gazzaniga emphasized, but pointed out that even years later, patients occasionally are surprised by the left hand's intelligent behavior. Under (a), Bogen (1985) said in part this:

Even our youngest patient, who had no long-term appreciable apraxia to verbal command, manifested this alienation three weeks after surgery: while doing the block design test unimanually with his right hand, his left hand came up from beneath the table and was reaching for the blocks when he slapped it with his right hand and said, "That will keep it quiet for a while." Among our patients it has been most persistent in a subject with a rather flamboyant personality which we believe contributed materially to her frequent complaints about "my little sister" in referring to whoever or whatever it was that made her left hand behave peculiarly. (p. 313)

Dimond (1980) gave special attention to the left hemisphere's attitude toward the right hand's actions. Two patients said in part,

If I'm reading I can hold the book in my right hand it's a lot easier to sit on my left hand than to hold it with both hands than fighting it. I compensate for everything that's wrong or feels wrong. One hand that fights you. I cannot use it a lot. If I had to lose an arm I'd rather lose my left arm than my right one [cf. Melzack, 1989, p. 5]. The right one knows what I want it to do and it does it. (p. 432)

You wouldn't want to hear some of the things this left hand has done—you wouldn't believe it. It acts independently a lot of times. I don't even tell it to—I don't know it's going to do anything. Sometimes I go to get something with my right hand the left hand grabs it and stops it—for some reason. The one time I was sitting down watching television my left hand just got up and slapped me. (p. 434)

She then told of awakening one day to the left hand's slapping her. Dimond (1980) pointed out that the disconnected left hemisphere sees the difference in behaviors of the two hands as a difference in what the person can control or not control. Clearly, this way of experiencing the matter is determined not so much by what the left hemisphere can do with the right hand as by what it cannot do with the left hand. The first patient states he cannot use the left hand as prior to commissurotomy, for example, to pick up a metal nail; he almost does, but fails to grasp the nail. The first patient says also that he cannot cause the left hand to relax: the muscles remain tight, "ready to go,"

the thumb "straight out." The left hand seems to initiate its own actions and is prevented from doing so by being held or sat on (its actions are "products of alien volition;" Oakley and Eames, 1985). Neither the patient's statement nor Dimond's comments mention controlling the left hand from the inside. Regarding the second patient, Dimond called attention to the left hemisphere's only nearly attributing a separate mind to the right hemisphere. The illusion of unity persists; loss gives no impression of otherness in this patient.

Gazzaniga (1988) would answer as follows my question about left-hemispheric alienation as agent of left-handed behavior:

It is interesting to note that, although the patients possess at least some understanding of their surgery, they never say things like, "Well, I chose this because I have a split-brain and the information went to the right, non-verbal hemisphere." Even patients who are brighter than PS, based on IQ testing, *view their responses as behaviours emanating from their own volitional selves*, and as a result, incorporate these behaviours into a theory to explain why they behave as they do. (pp. 233-234; italics added; Gazzaniga, 1987a, pp. 63-65)

The disconnected left hemisphere is aware of some behaviors only after the fact and yet takes itself to have initiated them, takes them to be its own actions. The left hemisphere appropriates to itself actions of the right hemisphere, though having, as Shallice (1988) stated, "no information about the causal antecedents of the action" and no awareness of having "acted from an 'intention'" (p. 396).

What would Gazzaniga say about those apparent cases of the disconnected left hemisphere's alienation as agent of right-hemispheric behavior? Although Gazzaniga (1988) did not mention any cases from the literature, he surely knows of them and believes they are not what they seem. Judging from his interpretation of possible future such cases, he believes that, in all previous cases of apparent alienation, the disconnected left hemisphere either (a) chooses not to interpret right-hemispheric behavior in the natural appropriative way, because of "an overlying psychological structure" or (b) learns by rote to give (the "cliche" of) a split-brain interpretation (Gazzaniga, 1987a, p. 65, 1988, p. 234). I believe Gazzaniga means the appropriate interpretation would occur but not be given overtly.

Is N.G. merely mouthing a cliché when she says to Sperry, "What is the matter with me? . . . I mean, am I thinking or what?..k...keep pointing to that one, and I don't know why. Whose face is it?" (Sperry, Zaidel, and Zaidel, 1979, p. 159)? Is "cliche" how Gazzaniga would interpret J.M.'s reactions to the remarkable repetitive competition between his two disconnected hemispheres during visual and verbal tasks when, occasionally, the two hemispheres gave different answers (Loring, Meador, and Lee, 1989; cf. Levy, 1990, p. 235, but see p. 237). Perplexed and frustrated on such trials, J.M. was

described as follows: "Whenever the left hand appeared to behave independently from verbally mediated conscious volition, the patient would refer to it as having 'a mind of its own'" (Loring, Meador, and Lee, 1989, p. 825; cf. Sperry's [1966–1967, p. 309] subject who said, "Well, I must have done it 'unconsciously.>"). Was this a mere rote response obscuring the left hemisphere's actual awareness of the right hemisphere's behavior as belonging to the person, no less so than the competing left-hemispheric responses on the same trial? Loring, Meador, and Lee (1989) commented in a way Gazzaniga might approve: J.M.'s failure to benefit from right-hemispheric answers on visual tasks is due to the left hemisphere's inability to recognize their correctness. The right hand's choices being inexplicable, the left hemisphere did not take them as from a conscious intention. And so, they were not appropriated, nor were they ascribed to another agent (cf. Gillett's [1986] "mistakes" interpretation of right-hemispheric behavior).

Shallice (1988) tentatively accepted Gazzaniga and LeDoux's confabulatory interpretation of the disconnected left hemisphere's reaction to the right hemisphere's independently produced behavior, but Shallice objected to Gazzaniga's (1983) following generalization:

The emerging picture is that our cognitive system is not a unified network with a single purpose and train of thought. A more accurate metaphor is that our sense of subjective awareness arises out of our dominant left hemisphere's *unrelenting need to explain actions taken from any one of a multitude of mental systems that dwell within us* (Gazzaniga and LeDoux, 1978). These systems, which coexist with the language system, are not necessarily in touch with language processes prior to a behavior. Once actions are taken, the left, observing these behaviors, constructs a story as to the meaning, and this in turn becomes part of the language system's understanding of the person. (pp. 535–536; italics added; cf. [a] Bisiach [1988] on "C₂"; [b] Cam [1989] on multiple faculties each producing conscious states; and [c] Churchland [1988]: "Confabulation seems to be normal, inveterate, and habitual, and does not involve anything like Freudian repression, nor is it done with deliberate or conscious awareness" [p. 289])

Shallice understood Gazzaniga's statement to say that, in the normal case, consciousness of actions is usually after the fact; thus, in this regard, the consciousness of the disconnected left hemisphere is the same as the consciousness of the normal individual.

However, perhaps there is a difference in the two cases according to Gazzaniga and LeDoux's own general account. Commenting on maturational development of self-control, LeDoux, Wilson, and Gazzaniga (1979, p. 550) wrote of the verbal system (or "conscious verbal self," or "interpreter module") as coming to know some of the "impulses to action" belonging to other systems or "selves," and learning how to interfere with or facilitate the particular actions' occurrence. Evidently, these "impulses" are not inputs to those other systems; rather, they must be a certain kind of process internal to or an output from the particular nonconscious system. When the commissures

are severed, the disconnected left hemisphere would continue to exercise self-control over itself and other systems located within the left hemisphere since its consciousness system would continue to have awareness of left-hemispheric impulses. Thus, Gazzaniga (1988) suggested that despite loss of advance information and ability to exercise internal control over the right hemisphere's actions, the left hemisphere continues to appropriate them.

MacKay (1987) found that he could get the two cerebral hemispheres of a commissurotized person to cooperate on shared tasks, such as each hand controlling one of two possible directions of motion of a plotting-pen around a course, but

despite all encouragements we found no sign at all of recognition of the other "half" as a separate person, nor of independence at the normative level where priorities and criteria of evaluation are themselves evaluated—the characteristic human activity with which we associate the term "will." (p. 9)

Thus, when one patient identified three-letter words presented to the right hemisphere, he claimed that, though he could not see the words, he "wrote them with his nose," produced head movements in the pattern of letters, which the left hemisphere "read" (cf. Zaidel, 1990a). Only the right hemisphere could accomplish this cross-cueing, yet the left hemisphere did not attribute it to a distinct agency.

The question here is straightforward. Are such people poor in discriminating actions that they (their left cerebral hemispheres) produce from certain actions they witness but do not produce? These actions are not just seen or heard; to a degree they are felt when they occur, and in this regard they resemble those initiated by the left hemisphere. It seems likely that such people can tell the difference, but they provide an account for right-hemispheric actions to give themselves diachronic unity. However, Gazzaniga is suggesting otherwise, and we should not simply assume what seems more likely from familiar cases. If Gazzaniga is right, these people do not need advance awareness to have awareness of themselves as agents.

Rather than understanding all consciousness, as Gazzaniga does, on the model of the left hemisphere's interpretations of the independent choices, Zemach (1986) suggested these interpretations are due to fear of the right hemisphere's obviously purposeful behavior, fear of its own inability to determine or know it in advance: "It is one of the deepest and oldest fears of human beings that the body that one is accustomed to regard as one's own, nay, as one's very self, may be snatched away from one's control and made to obey an alien will" (p. 142). Zemach might add that this fear is exacerbated in medical and psychological settings, where people are largely passive, or in the hands of cognitive neuroscientists whose main interest is to understand, predict, and control behavior, and who are submitting people to certain tests.

Perhaps, however, the research subjects are not as terrified as Zemach suggested: to the point of having to rationalize their right-hemispheric behaviors; rather, the inquisitory character of the situation and constant interaction with the psychological authorities in the role of being their research subjects, may be causing these subjects to want to give a proper account of themselves. "Paul, why did you do that?" Gazzaniga asks, clearly implying that Paul should explain a left-handed behavior.

The latter implication may be in force especially where the psychological authorities believe as Gazzaniga does. Sometimes J.W. tells Gazzaniga he does not know why he does anything, especially when being questioned by Gazzaniga (1985, p. 73). To snap J.W. out of this posture, Gazzaniga needs only to give him still another task that demonstrates the left hand's intelligent behavior, thus making it costly for J.W. to keep saying he does not know why. Referring to the return of confabulatory interpretations, Gazzaniga (1985) adds with obvious satisfaction, "It went on like that, trial after trial" (p. 73). However, it does not usually go on like that; rather, J.W. becomes agitated after a few trials and the test is halted. Gazzaniga believes the right hemisphere becomes dissatisfied because it disagrees with the interpretations. Or is the left hemisphere unhappy about what its having to fabricate means? When one reads several times, "An environment that conditions some of our mental modules to actions that may not be in the long-term best interests of our general belief systems ought to be avoided" (Gazzaniga, 1985, p. 6), one must wonder whether the subjects were tested in social conditions conducive to recognizing a second agential source in the one body. Evidently, the conditions did allow such cognitive freedom; we are told that J.W. continued to interpret in a confabulatory way his right hemisphere's behavior after it was explained to him again that his commissurotomy prevented him from knowing the reasons for some of his left-handed behavior (Gazzaniga, 1985, p. 146).

Suppose, instead, that Zemach (1986) is correct:

Those lame rationalizations are, to my mind, dramatically and remarkably reminiscent of the attempts of various mental patients (especially hysterics and cases of neurotic obsession) to rationalize the compulsive behavior they manifest. These attempts to fit a behavior into an alien context and account for it by using sometimes ingenious, sometimes ridiculous excuses are, of course, pathetic and the epitome of irony. (p. 142)

Would, then, Gazzaniga (1987a) find "watching the interpreter work under strict experimental conditions . . . most dramatic" (p. 63)? Gazzaniga (1987a, p. 60) described as "insistent" the tendency to make these interpretations. Gazzaniga and LeDoux find their subjects' confabulatory behavior sincere and "reflexive"; the subjects believe and are not just making excuses (though Gazzaniga [1987a, p. 60] suggests behavior may cause the interpreter doubt).

Perhaps Gazzaniga and LeDoux could come to accept Dimond's (1980, p. 483) "generative mechanism of self," a distinct left-hemispheric system responsible for how we are conscious of ourselves and for directing our lives.

For a theory of consciousness, the crucial aspect of the left hemisphere's reaction to the right hemisphere's behavior would seem to be, not only reflexive confabulation, but also the left hemisphere's inability to tell that it did not initiate the behavior, that is, its inability to internally "perceive" the difference. Or, perhaps the left hemisphere can tell the difference but the compulsion to interpret the right hemisphere's behavior swamps this knowledge of difference. That is, we may have here cases of self-deception: the adoption of a policy that "ties one's hands," prevents spelling out what one can spell out, but will not due to its potential disastrous effects on how one conceives of oneself (Fingarette, 1969, 1974; cf. [a] Bogen [1969b] on "the illusion of mental unity" as "the most cherished opinion of Western Man"; [b] Lockwood [1989] describing the disconnected hemispheres as highly motivated toward behavioral integration, as evidenced by cross-cueing: "cunning strategems to defeat the experimenter" [p. 85; Gazzaniga, 1987b, p. 121]; [c] Levy [1977, p. 279], puzzled, speaking of "denial"). The commissurotomy is especially at risk, knowing that two major parts of their brain are no longer in direct contact. Although self-deception implies a motivated condition, perhaps it can affect behavior routinely; one need not be agitated when practicing it, having already adopted and used the respective defensive attitude. Perhaps I should welcome Gazzaniga and LeDoux's account: it makes the disconnected left hemisphere more mysterious, different from ourselves who distinguish behavior we initiate from behavior that surprises us (e.g., Oakley and Eames, 1985, p. 225).

A Second Hypothesized Dimension of Disconnected Left-Hemispheric Consciousness: Relative Narrowness and Disunity of Stream of Consciousness?

On the basis of studies of noncommissurotomy people with damage to one cerebral hemisphere, Kinsbourne (1988) claimed that, in the normal individual, the left hemisphere "lends depth" and the right hemisphere "lends breadth" to "awareness": "By depth I mean relation of present to previous (and prospective) relevant experiences. Breadth describes the extent of current experience" (p. 248). On the commissural-integrative view, the right hemisphere would "lend breadth" to a single stream of consciousness "flowing" within structures distributed across both cerebral hemispheres of the normal brain. If Kinsbourne's proposal about the contribution of the right hemisphere is valid, we would expect to find (assuming no complicating factor) that the commissurotomy person's left stream is more comprised of

experiences restricted in their "extent" than is the intact person's stream of consciousness—since disconnection from the left hemisphere's consciousness process prevents the right hemisphere from making its contribution, which includes "lending breadth," to this process. The commissurotomed individual would have a left-hemispheric stream that was "narrower" on the average than the single stream before disconnection. Perhaps we could say that the left hemisphere has "narrow experiences," or many more "narrow experiences" than the intact individual had.

Also, the stream of consciousness of the disconnected left hemisphere would be, presumably, "narrower" than that of the disconnected right hemisphere, assuming the right hemisphere's "lending breadth" to awareness would continue relative to the awareness flux of the right hemisphere. This further expectation depends on: (a) whether the right hemisphere can perform the function of "lending breadth" to its own stream, but cannot do the same by means of the subcortical connections between hemispheres except to a relatively small degree; and (b) whether the disconnected right hemisphere's stream is not itself "narrowed" (in a sense explained below using Lockwood's [1989] "co-conscious part-experiences") due to the disconnected left hemisphere's not "lending depth" to the right stream, as it did to the original stream according to Kinsbourne.

Here is how Kinsbourne (1988) described the noncommissurotomed person with damage to the posterior right hemisphere:

The visual-spatial agnostic can attend to only one object at a time. As he does so, he loses awareness of everything else. For him, identifying concurrently present items is hardly the issue. He is not even aware of them (although a moment earlier they might have been the focus of his pathologically constricted attention). Adjacent and even overlapping forms slip from awareness. The function of maintaining a structured perceptual field is impaired. One form, perceived, blocks both the current impact and the recent memory of the others, so that the patient cannot relate the one in view to the existence, let alone the locations, of others. (p. 248)

Clearly, a loss of "breadth" has occurred. In presenting an "integrated field theory of consciousness," Kinsbourne (1988), moved almost directly from "Left Hemisphere Lends Depth, Right Hemisphere Lends Breadth, to Awareness" (which contains the above description) to "Awareness Is Surgically Divisible" but did not integrate the two topics by reference to evidence that the disconnected left hemisphere's visual awarenesses are narrow. The only mention of narrowness occurred in very brief commentary concerning which disconnected hemisphere was more likely to work as an automaton. Kinsbourne hypothesized that the functioning of the right hemisphere could be routinized less easily and less frequently because of the large variety of relations that the right hemisphere, given its specialization, has to distinguish; whereas the left hemisphere, given its specialization, could respond

specifically and repeatedly on the basis of a "narrow range of awareness." If this were true, it would not be evidence for special narrowness of the left hemisphere's visual field because, depending on the task, such narrowing may occur in the intact brain as well.

By "breadth," Kinsbourne (1988) meant the visual field's extent, or "the simultaneous perception of multiple objects in a structured perceptual field" (p. 248). His general approach—"the conscious domain is not the product of an all-or-nothing vantage point, but is a multi-compartmental field" (p. 241)—inspires the question: How much do disconnected streams contain as compared to those that straddle hemispheres? (Cf. Kinsbourne [1980]: "The sum total of the activity of the cortical analyzers determines the content of awareness at the moment" [p. 165]; Dimond [1980]: "We may not want to assume . . . a single strand of action but regard [the consciousness circuit] as like a mighty river where many streams and tributaries are gathered up and amalgamated" [p. 440].) I am reminded of Lockwood's (1989) maximal experiences, each made up of co-conscious parts that are experiences (cf. Dimond, 1979, pp. 208–209):

"Experience" [i.e., "maximal experience" or "phenomenal perspective"] here is to be understood in the philosopher's slightly technical sense of a conscious state, happening, or sequence of states of happenings, that is experienced *as a whole*. Thus a single note, or the corresponding auditory sensation, can be experienced as a whole, provided it is not too prolonged, and so, one might think, can a series of notes confined within the space of a second or less And likewise, if I see a woman standing by a horse, I have a visual experience which contains as parts the experience of seeing the woman and the experience of seeing the horse. Likewise, I may have an audio-visual experience which contains, as parts, the experiences of seeing a man playing a trombone and of hearing the sound he is producing. (I am not denying, incidentally, that there is more to each of the larger experiences just cited than the parts I have mentioned; for example, I am also experiencing, in the first case, the temporal *relations* between the notes, and in the second, the spatial relation between the woman and the horse. Experiences are typically more than the sum of their experiential parts.) (Lockwood, 1989, pp. 87–88; cf. Kinsbourne [1988, p. 243] on "overall configuration" of awareness composite)

[glossary entry] **phenomenal perspective (maximal experience)**: A total state of awareness. Given something, X, that one is *directly* or *immediately* aware of, the corresponding phenomenal perspective includes X itself and, in addition, everything that one is aware of together with X. (Lockwood, 1989, p. 334)

Lockwood speculated that with the progressive decay of the brain, with loss of fibers within and between hemispheres, there would take place an increasing narrowness of the stream; each maximal experience (defined also as an experience that is not a part of another experience) would, on the average, include fewer "co-conscious" part-experiences than earlier in the process of decay.

Thus, one is led to wonder which kinds of part-experiences (that were parts of the single unified stream of consciousness) are absent from the new left stream? This question assumes that the left hemisphere does not compensate for the disconnection and cannot create for its stream the kinds of part-experiences the right hemisphere provided the stream when it could "lend breadth"—those part-experiences that the right hemisphere is specialized for. On left-hemispheric compensation, Kinsbourne (1982) wrote that each hemisphere can function as the other hemisphere does though less well; when no longer inhibited by the other hemisphere, each hemisphere can "process in the manner complementary to that for which it is most specialized" (Kinsbourne, 1982, p. 416; cf. Sperry, 1982, p. 1224). And, indeed, if the left hemisphere shows no deficiency in identifying concurrently presented items, it may be because it functions postsurgically to give "breadth" to consciousness, as Kinsbourne held the right hemisphere normally does.

Of course, the disconnected left (and right) hemisphere, having much less access to certain input sources and output means, does show a kind of breadth deficiency, but different from that referred to in Kinsbourne's hypothesis about "breadth," which is the composition (number and variety of components) of the stream of consciousness, rather than, for example, whether relative to what is experienced, the left hand is as useful to the disconnected left hemisphere as before commissurotomy. Kinsbourne's (1988) following statement suggests, probably unintentionally, that the disconnected hemispheres' awareness deficiency is of only the latter kind: "Each hemisphere supports its own independent representation across the whole range of conscious experience but is depleted of data to which only the other hemisphere is privy" (p. 250).

I should mention, as well, Lockwood's view that the set of co-conscious part-experiences constituting a total state of consciousness, a temporal unit of the stream, may include experiences occurring in subcortical centers (e.g., emotional experiences). These would be parts of the present maximal experience, which is the present section of the stream of consciousness. Moreover, the identical particular part-experience can be, in Lockwood's view, part of two maximal experiences at the same time. For example, both disconnected hemispheres can share a particular identical affective part-experience, though their respective total experiences (phenomenal perspectives) at the time would be different due to their otherwise different constituent experiences, the two different experiential contexts of the identical affective part-experience. Thus, Lockwood holds an extended view of the intact stream; this "flows" not only in (a) anatomical structures of the two cerebral hemispheres and in (b) their connecting links at the cerebral level, but also in (c) subcortical structures (cf. Kinsbourne, 1974, p. 286). The affective component of emotional maximal experience is supposed to be literally located at the subcortical level. Compare:

The possibility remains that some elemental components of consciousness stay unified in the split brain. (Sperry, 1976, p. 172)

Since the effective component appears to be an eminently conscious property, the fact that it crosses at lower brainstem levels is of interest in reference to the structural basis of consciousness. (Sperry, 1982, p. 1226)

Nevertheless, there can be large differences in maximal experience between intact brain and disconnected left hemisphere, since the latter's maximal experiences do not include any co-conscious part-experiences provided by and located in the right hemisphere. Thus, the particular affective part-experience could be part of two substantially different emotional maximal experiences due to presence versus absence of the part-experiences provided by the right hemisphere. Cook (1986) suggests something along these lines when he writes,

That is if prior to the expression of emotions there is an asymmetry of high-level cognition such that the left hemisphere is continually involved in the literal decoding of language, while the right hemisphere is continually processing the context and implications of language, then it would invariably be the right hemisphere which understands the emotional content of language, while the left hemisphere revolves in the world of literal meanings (and, by inference, the lighter emotions involved in puns and verbal quips without most of their cognitive implications). (p. 138)

Accordingly, given the same verbal information delivered to both an intact individual and a disconnected left hemisphere (e.g., a report of the death of a close relative), if the respective affective part-experiences are the same because they are produced by both hemispheres in the identical subcortical centers, the two emotional maximal experiences would be expected to be different since, according to Cook, the disconnected left hemisphere would not grasp what had happened except literally and superficially. The bare fact would fail to be linked up to its ramifications; even if these were explained to the disconnected left hemisphere, they in turn would not be linked to their full meaning for the person's life. (This may help to explain the reported jocularity of the disconnected left hemisphere and its being relatively untouched by "the darker emotions" [Dimond, 1979, 1980, p. 129].) Of course, the above assumes the validity of Cook's (1986, 1989) understanding of the different linguistic functions of the two cerebral hemispheres. The evidence Cook offers is from right- or left-hemisphere damaged individuals. As he states, the commissurotomy subjects have not yet been studied under the hypothesis that left hemisphere will tend to be very literal in its understanding of language and will fail to grasp implications. Zaidel (1990b) stated, "The [disconnected left hemisphere] has no clinically detectable language deficit . . . using the usual gross clinical measures [and not testing] specifically for subtle or higher-order deficits" (p. 310; Nebes, 1974, 1978). But then, in press, Zaidel added a

footnote to the effect that he has now found some large "parapragmatic" deficits: in discerning affect from the rhythm of heard speech; in associating sentences to pictures on a metaphorical basis; and in retelling heard stories.

To the problem that a part-experience would seem to be a different experience when it is part of different maximal experiences (i.e., when occurring in different experiential contexts), Lockwood responded by identifying a maximal experience with a certain brain process, whereas part-experiences cannot be so identified because they depend on the context (the respective maximal experience). Thus, different part-experiences may be identical to the same brain process, since what experience a part-experience is depends on the brain process (maximal experience) of which it is a part.

Disconnected from the part-experiences occurring in the right hemisphere, or absent those part-experiences that normally straddle the two hemispheres, what are the disconnected left hemisphere's maximal experiences like? Are they narrow? Kinsbourne (1982) stated about the intact brain,

Those modes of thought that invoke logical sequences deal in terms of ordered item information uncomplicated by spatial (multiple, simultaneous) relationships and, thus, rely on the left hemisphere. In contrast, the need to deal with complex relationships between even relatively simple items will enlist right-hemispheric participation The relational component organizes the item information, and only in combination do they yield overview. (p. 417; cf. Bogen and Bogen, 1983, pp. 519-520)

Does the disconnected left hemisphere have "overview?" It seems correct to say that the disconnected left hemisphere is deficient in certain abilities present in the intact brain and in the disconnected right hemisphere. These deficiencies led Levy (1978, p. 289) to say (a) that the world of the disconnected left hemisphere "consists of symbolically represented features and functional relations, organized in a temporal domain," (b) that this hemisphere "cannot construct representations containing the richness of perceptions," and (c) that the left hemisphere is "a digital, not an analog computer." (Cf. the following description of the noncommisurotomized right-hemisphere damaged person: "resembles a 'sophisticated language machine' responding appropriately to linguistic messages, but with a tendency to extrapolate illegitimately on the basis of fragmentary linguistic data" [Gardner, Ling, Flamm, and Silverman, 1975, pp. 409-410]; the latter researchers also found that such patients show dissociation of their cognitive and affective reactions: "whether a patient laughs bears little relation to his comprehension of the cartoon" [p. 410]).

Levy's description certainly paints a strange picture of the left hemisphere's consciousness. It seems to imply a narrowness of the stream of consciousness, unless the disconnected left hemisphere can—in its own (relationally disunified) way—include a number of part-experiences with-

in a single temporal unit of its stream. Assuming an absence of relational awarenesses, there could still take place co-conscious part-experiences, though the disconnected left hemisphere's deficiency in apprehending relations might mean the part-experiences are mutually isolated from each other. That is, the stream of the disconnected left hemisphere might consist of a continuous succession of phenomenal perspectives each relatively disunified internally compared to the components of the original stream before commissurotomy. Might there be a left-hemispheric problem of, for example, linking sights and sounds? The maximal experiences of the left hemisphere might or might not be more "narrow" on the average, but they would be less well integrated. Therefore, one would expect what Bogen (1985) says about "the callosal syndrome": "Individuals with cerebral commissurotomy are less apt than normal individuals to discuss their feelings, conflicting or otherwise (p. 312). There may be no less feeling in such people (both hemispheres can produce and share feelings [cf. Cook, 1989, p. 11]), but reporting how one feels requires either (a) an integration of the affective and cognitive content of the emotion (given a self-intimational perspective, e.g., Freud's [Natsoulas, 1989b, 1991b]), or (b) an integration with whatever process is responsible for direct (reflective) awareness (see, e.g., Rosenthal's [1986] "appendage" theory [Natsoulas, 1989a, in press]). Normally, the right hemisphere gives relational awareness that makes integration possible. Similarly, Cook (1989) explained the disconnected left hemisphere's "difficulty in affective verbal expression" ("alexithymia") as due to its lacking the right hemisphere's "affective contribution."

Let me end this introductory discussion of the phenomenal perspectives (in Lockwood's sense) of the disconnected left hemisphere with brief mention of the stream of consciousness of patients who suffer from confusional states due to right-hemisphere damage (Cook, 1989; Geschwind, 1982). For example, people in confusional states show incoherent patterns of thought and action in which the fragments remain intact. It would be instructive to attempt to apply the above concepts of narrowness and disunity of the stream to such states of mind, as a propaedeutic for applying them to the disconnected left hemisphere. What might we look for, analogously to confusional states, in the commissurotomed person, whose right hemisphere is ineffective vis-à-vis the left stream of consciousness?

A Third Hypothesized Dimension of Disconnected Left-Hemispheric Consciousness: Unawareness of Deficiency Due to Commissurotomy?

Kinsbourne (1988) mentioned the following further intriguing possible feature of commissurotomed left-hemispheric consciousness:

The patient's behaviour when functioning through one disconnected hemisphere suggests that he is unaware that his control over ipsilateral sensory-motor facilities has become grossly restricted. Nor does he exhibit the bewilderment and distress at this loss of control that one might expect. Disconnected from the relevant areas of representation, he simply fails to represent that loss within awareness. (p. 242)

This statement is somewhat surprising after one has read, for example, about G.E., a young woman who, because of tumor, had her entire right hemisphere removed: "She was fully aware of both her high verbal intelligence and her defect in copying, and at the conclusion of the interview she said, 'Just imagine how smart I would be if I had both halves of my brain!'" (Bogen, 1969a, pp. 96–97). While trying to copy simple figures, she made comments such as "What a mess!" Her very poor ability for copying figures ("dyscopia") is evidently well "represented" in her remaining hemisphere. Deprived of the hemisphere by which she could copy figures well, she continues to represent this ability which she no longer possesses. Kinsbourne's above statement refers, of course, to the disconnected left hemisphere's relation to the ipsilateral side of the body, while G.E. was commenting on her dyscopia with the right hand. Kinsbourne might suggest (see below) that her ability to represent this loss corresponds to and depends on her very limited residual ability to copy figures with her right hand, whereas commissurotomed people have extremely poor left-hemispheric control of the left hand ("unilateral [left] ideomotor apraxia" [Bogen, 1985, pp. 316–317]).

Disconnection produces large ipsilateral sensory loss in each hemisphere, in addition to large loss of ipsilateral control. For example, without looking or inference, the disconnected left hemisphere cannot tell which object the left hand is grasping ("unilateral [left] tactile anomia" [Bogen, 1985, pp. 318–319]). Also, environmental objects, events, properties, and so on, present in the left (right) half of the "field of view" (as defined by Gibson, 1979, Chapter VII) are not visually perceived by the left (right) hemisphere ("double hemianopia" [Bogen, 1985, pp. 314–315]). Commenting on two of his first commissurotomed subjects, Sperry (1966–1967) stated, "I would speculate that neither of the two inner visual spheres in either hemisphere notices itself to be particularly incomplete. We never hear complaints from the talking hemisphere at least that it cannot see in the left half visual field" (pp. 306–307). Sperry stated that the commissurotomed patient's failure to notice what is missing is like that of some people ("hemianopics") who, through an accident and cortical damage, have lost their ability to perceive in half of their previous full field of view (see McGlynn and Schacter's [1989, pp. 158–161] review of several controlled studies of unawareness of hemianopia). It may be surprising that a half field of view is not noticed to be different from a full field of view, assuming the patients can remember the latter. Memory for past visual experiences would be essential to such

noticing: specifically, remembering those particular visual experiences that were not simply of the environmental surfaces, objects, events, properties, and so on, but were visual experiences of “the seen-now and the seen-from-here” as such (Gibson, 1979; Natsoulas, 1989c). In other words, to have a standard of comparison, the patient would have to remember visual reflective experiences (Natsoulas, 1989d) of the total horizontal extent of surfaces facing, fully and unoccluded, the patient’s point of observation, when the latter was at the same distance from that array of surfaces as the present point of observation.

Dimond’s (1980) report on normal subjects wearing a contact lens that occluded half their field of view (experimental hemianopia) presents major difficulty for views attributing unawareness of hemianopia to brain lesions or to forgetting what a full field of view was like: “The subject experiences no subjective feeling of a loss of vision and the experience he has appears to him to be complete and whole in every respect” (p. 188). Dimond added that, though the field of view is restricted, the subjective phenomenon is not any narrower. In Gibson’s (1979, p. 114) terms, the “extent” of the subjective visual field (an experience) is not narrowed though the objective field of view (visual stimulation) is physically narrowed. Dimond, Bures, Farrington, and Brouwers (1975) stated,

The stuff of conscious experience . . . is essentially unrelated to the size and extent of the stimulation entering it. It cannot even be said that consciousness of the visual world is in any way dimmed although the individual is stimulated by only a fraction of it. This phenomenon . . . apparently makes use of what is available to fill up and complete the whole—and this suggests that, although visual information is fed through the system which provides consciousness, the span of consciousness itself is in level or completeness not dependent upon that visual information. The situation is perhaps akin to enlargement in photography, where the size of the picture remains the same, although the details which fill it differ not only in kind but in size and definition. (pp. 347–348)

By consulting one’s subjective visual field (unchanged in extent, *ex hypothesi*) and one’s memory, one might gather that one’s field of view is less wide than it used to be, but this discovery would be inferentially based because one’s field of view is not perceivable. The field of view is “the solid angle of the ambient light that can be registered by an animal’s ocular system” (Gibson, 1979, p. 111), and, as Gibson (1979, Chapter IV) convincingly argued, although we see the world because our photoreceptors are stimulated by light, we do not see this light itself by which we see the world (including, of course, the solid angle of ambient light that is one’s field of view at a particular observation point).

Dimond’s suggestion that the subjective visual field does not narrow when the objective field of view is cut in half runs against the common view that destruction of cortical tissue can result in a subjective visual field with miss-

ing areas or blind holes. These blind areas, however, are not experienced, and so Dimond's hypothesis raises the question of how to determine whether the subjects are correct when they report a subjective visual field unchanged in extent after their field of view has been restricted by lesions or instruments. (We cannot test this simply from what the subjects can perceive visually or respond to upon visual stimulation.)

In the passage quoted at the start of this section, what Kinsbourne (1988, p. 242) was referring to is something other than the disconnected left hemisphere's failure to acknowledge a second center of consciousness and volition in the one body (Gazzaniga, 1985). Kinsbourne was describing commissurotomed people as being, in their unawareness of their deficiencies of consciousness, like those noncommissurotomed brain-damaged patients who continuously and unwittingly neglect the left side of their body. Kinsbourne's proposed feature of disconnected left-hemispheric consciousness—unawareness of major deficiencies—would be a consequence perhaps, though Kinsbourne does not give this interpretation, of a deficient "depth" in the left hemisphere's awareness (in addition to its possible deficient "breadth"; see preceding section of present paper). I am referring to "depth" of awareness in Kinsbourne's (1988) sense of "relation of present to previous (and prospective) relevant experiences" (p. 248). I take it that a stream of consciousness possesses Kinsbourne's property of "depth" insofar as the stream's component maximal experiences include (a) awarenesses of previous or anticipated experiences relevant to present experiences (i.e., rememberings or anticipating of experiences) and (b) awarenesses of such relations or relevancies between experiences (i.e., transtemporal subjective unifiers). If indeed the unawareness of deficiency claimed by Kinsbourne characterizes disconnected left-hemispheric consciousness, then, in at least this regard, the left hemisphere's stream is deficient not only in "breadth" ("constriction of the range of consciousness" [Kinsbourne, 1980, p. 157]), but also perhaps in "depth" if the explanation is correct that present experiences are not being related to past experiences so that present experiences can be found wanting.

But this ability to relate experiences across time was supposed to be, according to Kinsbourne (1988), a contribution of the left hemisphere to consciousness. Why should the left hemisphere's stream be comparatively "shallow" due to disconnection? Why do commissurotomed people not complain a great deal about their inability (i.e., their left hemisphere's inability) to make full, deliberate, and precise use of the left hand? Did their epilepsy or surgery cause left-hemispheric damage that would explain this apparently inferior "depth" of the left stream relative to the original stream? (Bogen [1969a] described the right-hemispherectomized patient G.E. as having developed normally before her tumor.) Should we expect to find, therefore, variation among commissurotomed people in unawareness of deficiency depending

on left-hemispheric damage? (Controlled studies of unawareness of hemianopia have been concerned with, among other things, its possible dependence on brain lesions additional to visual-cortical loss [McGlynn and Schacter, 1989]. Kinsbourne [1980] held that parietal-lobe lesions produce unawareness of deficiency in hemianopia; but there exist apparently unaware hemianopics who do not have lesions beyond their visual-cortical damage [McGlynn and Schacter, 1989]; cf. Dimond [1980] on experimental hemianopia mentioned above).

Alternatively, if the hypothesized "depth" deficiency is due to the right hemisphere's not contributing to the left hemisphere's stream, then such variation between commissurotomed patients would not be expected (unless they vary in their left-hemispheric ability to take over somewhat this disconnected right-hemispheric function [cf. Kinsbourne, 1982]). Disconnection may reduce left-hemispheric "depth" as well as "breadth" because, *ex hypothesi*, the right hemisphere normally provides the stream with "depth's" relational aspect (identified under [b] above) as well as "breadth."

Kinsbourne (1988) suggests an explanation of the left hemisphere's unawareness of deficiency that is not persuasive. Commenting on noncommissurotomed patients with certain anterior right hemisphere lesions who do not perform leftward actions and who do not seem to be aware that they are no longer performing such actions, Kinsbourne (1988) stated, "Organizing activity leftward ceases to be an option within the patient's repertoire of intentions. He is therefore unaware of the fact that he is not performing such acts" (p. 241). In this view, to be aware of no longer performing certain actions, one must still be able to perform them; inability is necessarily accompanied by loss of knowledge of inability although perhaps not entirely: about the brain-damaged person who no longer performs leftward movements, Kinsbourne (1988) stated, "Statements he makes about his left side are oblique and inferential. They represent attempts to draw upon his fund of knowledge about what it must be like, and reluctant attempts at that, as the lack of support from direct experience is perplexing" (p. 241).

But why should this "lack of support" be perplexing when, after all, does not the person know what he or she can and cannot do? Does not the person know this but fails to remember, or to keep in mind, what he or she cannot do? It often happens that an ability is lost due to peripheral injury. We do not therefore become unaware of our inability. We can recall what we can no longer perform. D.O. Hebb somewhere relates his surprise upon seeing someone else move in the usual way from a standing position to sitting on a low couch. Hebb had to remind himself that it was he, not everyone, who had the ankylosed hip and could not perform this feat that he had just witnessed with astonishment. Had Hebb been unaware of his disability, he would have taken in stride what the other person did.

What should be emphasized in Kinsbourne's (1988, p. 241) statement is Kinsbourne's reference to "organizing" the particular kind of movement. Kinsbourne meant as Bisiach (1988, p. 108) explained in the same volume (with reference to an earlier chapter of Kinsbourne's [1980]). If, for example, the organizing of leftward movement is prevented not peripherally, but at the function's "highest processing level," then the person will lack awareness of the function's absence. Somehow, in Kinsbourne's view, awareness of the function, even memory of it—of having performed the function—depends on the present ability to initiate an instance of it. Explaining unawareness of hemianopia, Kinsbourne (1980) stated,

The cerebral lesion has destroyed the relevant analyzer. As there is no output from an analyzer indicating absence of visual input in the half field, the individual is unaware of its absence; in other words, information (or lack of it) in his affected [field of view] can no longer control behavior. Awareness of this source of information has been lost to consciousness. The individual can now neither experience nor represent experience in that [field of view]. (p. 167)

This crucial dimension of Kinsbourne's explanation does not render the explanation persuasive because the explanation implies that the disconnected left hemisphere's ability to initiate precise movements with the right hand does not involve sufficient representational resources for remembering that one was able to do the same with the left hand prior to surgery. Kinsbourne's reply might be that the ability cannot be remembered in the sense that one cannot re-experience what one cannot now experience. Yet, one should be able to think and talk about whatever one cannot any longer do.

How would the following apparent fact be handled from this perspective? Sperry (1966–1967) stated, "Unlike the case for vision, we *do* hear complaints (that come from the major hemisphere, of course), that the left hand is numb, that it has no feeling, that it does not work properly" (p. 308). When the subject is shown, by instruction and stimulation of the right hemisphere, that the left hand does work properly, the subject does not consider the complaints about the left hand unwarranted. Evidently the complaints stand and the successful left-handed behavior requires explanation since the left hand does not, after all, work properly: "Whereupon after a number of correct trials in succession that show the subject that he can, in fact, work with the left hand, he may say something like, 'Well, I must have done it "unconsciously"'" (Sperry, 1966–1967, pp. 308–309). Use of the left hand does not meet a learned standard. Does not use of the right hand provide that standard or knowledge of the past use of both hands or seeing other people using their hands?

Kinsbourne (1980) might agree, for he stated that each disconnected hemisphere "constructs . . . its representation of ipsilateral space by inference from such relevant data as it has derived from the other side" (p. 174). However,

the disconnected left hemisphere's experience of ipsilateral space is not purely conceptual, not purely a matter of thought about what lies in that part of space: "For example, if a shape abuts the midline, by inference there is a part of it extending into the other (ipsilateral) field, and this apparently 'perceived' with the same feeling of reality as invests percepts that are veridical" (Kinsbourne, 1980, p. 172). That which the disconnected left hemisphere cannot visually perceive because it projects to the left half of the retinal surfaces, can be experienced imaginally. Is this due to inferential construction? Or is it due to the presence in each hemisphere of visual cortical processors for ipsilateral space (as well as visual cortical analysers for contralateral space)? Those visual cortical processors are no longer receiving inputs from the environment since, in the intact individual, these inputs come indirectly via the other hemisphere and corpus callosum. This does not mean that, after commissurotomy, the visual processors for ipsilateral space cannot function; rather, they are, so to speak, poorly informed about the present state of the environment, and their activity must be produced by other means, such as activity in the cortical analysers of the same hemisphere. This still leaves such questions as why the left hemisphere does not notice its deficit for seeing what lies in the ipsilateral part of the full field of view, since what is imaged as present in the left field of view is not subjectively as complete and detailed (full background of the figure) as what is perceived.

Let me mention the importance Levy (1990) assigned to each disconnected hemisphere's beliefs about which tasks it is competent to perform (though, of course, neither disconnected hemisphere thinks of itself as a hemisphere, but rather as the person). Levy explained the observed dominance of a hemisphere on a laboratory task in terms of the hemisphere's conscious assessment, often correct due to past experience, of its capability for performing the task:

Each hemisphere would process task instructions, evaluate these with respect to its beliefs regarding its cognitive characteristics and competencies, and via corticoreticular pathways would send signals for arousal or appropriate attentional activations. These signals would vary in strength, depending on the outcome of the evaluative process, and brainstem areas would respond accordingly, biasing control, through inherently lateralized component pathways, to either the left or right hemisphere. (Levy, 1990, p. 239)

Levy's line of thought suggests that unawareness of deficiencies on the ipsilateral side might be due to this adaptive process of a hemisphere's achieving dominance for the immediate purpose. A hemisphere's acknowledging an incapacity is its way of retiring from the task at hand. Therefore, there should be a reluctance, a refusal to so acknowledge unless it seems reasonable to stop trying and to make less deliberate choices that are, actually, outcomes

of the other hemisphere's work on the present task. Gott, Hughes, and Whipple's (1984) neuropsychological investigation of J.J., a normal woman's hemispheric functioning, suggests that Levy's hemispheric selection process can take place deliberately by conscious assignment of a task to one of two different central "states" involving much greater participation by a different hemisphere. J.J. had exercised such choices for fifteen years, calling her two modes of functioning "me" and "it" (cf. Kinsbourne, 1974, pp. 288-289).

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