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PSI AND THE TWO HALVES OF THE BRAIN

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(based on a lecture delivered to the Society for Psychical Research)

MY theme concerns a specific area of psychological research, namely, the functional differences between the two halves of the brain and the possible importance this work may have for parapsychological investigations. I should like first to discuss generally some of the main aspects of what we call hemisphere specialization and then why I think this work may prove very important for parapsychologists.

One of the most striking features of the human brain is the fact that the largest part of it, the cerebral cortex, is neatly divided into two seemingly identical halves. This has probably caught man's eye ever since he first started cracking the skulls of his fellow men. In about the middle of the last century, however, evidence began to accrue to indicate that, in fact, each half of the brain may have its own particular skills. The most prominent fact at the time was that for right handers the left hemisphere of the brain was the one which controlled language, while the right hemisphere did not. This gave rise to the persistent tendency to refer to the left half of the brain as the dominant hemisphere.

Despite the fact that as early as 1864 Hughlings Jackson had postulated special functions for the right hemisphere (Taylor, 1958), there was, until comparatively recently, a general feeling that the lowly minor hemisphere had no immediately obvious function. About forty years ago that picture began to change as information gathered from studies of patients who had suffered injury to one side of the brain began to show that there were other special functions besides language which could be said to be localized in one or the other half of the brain. Not long afterwards experimental techniques were devised to examine further these

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interesting localizations of function indicated by the lesion or injury studies.

A major acceleration of research on lateralization effects took place in the early 60's due in large part to the work of Sperry, Gazzaniga, Bogen, and others with the now famous 'split-brain' patients. A few words of background may be in order here, in connexion with the relevant features of the brain. What I am dealing with is the cerebral cortex, the large top area of the brain which is divided into two parts. Motor control of the body and sensory input are primarily contralateral, that is, each half of the brain receives sense impressions from and exercises motor control over the opposite half of the body. With the eye the situation is more complex but still very elegant. Each hemisphere receives signals from the opposite half or hemi-retina of *each* eye. The net result is very simple: the left hemisphere sees what is in the right half of my field of vision and the right hemisphere sees what is in the left half. Now for motor control and sensation this crossing over is not absolute. There are a certain amount of ipsilateral or same-side connections, though the contralateral connections are by far the most dominant ones. One further point, with respect to the general motor control and raw sensory input the two hemispheres are pretty much identical. The two halves of the brain are, of course, in continuous communication with each other. There are large bundles or tracts of nerve fibres, called commissures, running between them, and the largest of these is called the corpus callosum.

For a long time the only apparent function of the corpus callosum seemed to be the transmission of epileptic seizures from one to the other side of the brain. In an effort to relieve a number of his patients from severe, uncontrolled epilepsy Dr P. J. Vogel performed an operation, called commissurotomy, to sever these connecting nerve fibres. This was not the first time such an operation had been performed, but by this time enough was known about the hemispheres for a more thoroughgoing follow-up study to be made.

Working with these split-brain patients the team of Sperry, Gazzaniga, and Bogen, along with many other distinguished researchers who visited their laboratories, designed experiments to detect deficits in the integration of the cognitive functions of the two hemispheres and to tease out any localizations of special functions. In summarizing their findings, Sperry and his colleagues said that the results with these patients, who had undergone the operation to disconnect their cerebral hemispheres from one another at the corpus callosum, 'indicate functional disengagement

of the right and left hemispheres with respect to nearly all cognitive and other psychic activities' (Sperry, Gazzaniga, and Bogen, 1969).

Some of the experiments which they used with these patients are really quite interesting. With the callosum cut the right hemisphere did not have access to the language facilities which are in the left hemisphere. So when a patient felt an object, a pencil for example, in his left hand which was out of sight he could not name it since information about the object went only to his right hemisphere. However, if you put the pencil in a sack with other objects and asked the patient to retrieve the object he had just been holding he could do this quite readily with the left hand. Again, if you asked him to name the object he might reply that he didn't know or he might take a guess and say that it was a fork or suchlike. Of course, if he had done this with his right hand there would have been no problem at all about naming the object.

Similarly, in a visual set-up, if a word was flashed on a tachistoscope so that half of it was on one side of the midline and half was on the other, the right hemisphere would recognize the part which was in the left half of the field of vision and the left hemisphere would recognize that part of the word which was in the right half of the visual field. For example, if the word 'HEART' was flashed so that the midline fell between the 'E' and 'A' and the split-brain patient was asked to name the word he would reply 'ART', but if he was asked to point at the correct word with his left hand when shown a card with 'HE' and 'ART' on it the patient would point to 'HE' (Gazzaniga, 1967).

Interesting as these examples are, they represent only the tip of the iceberg as far as the work with the split-brain patients goes. The dramatic findings of the Sperry group along with the independent work of Zangwill and others caused a veritable explosion of interest in hemisphere lateralization in the last decade. Techniques were rapidly developed then, and new ones are being developed even today, to investigate the phenomenon of functional lateralization in the brain with normal subjects, not just the split-brain patients or persons with brain injuries. Methods of presenting stimuli (visually, using the tachistoscope, or aurally, using what is known as dichotic listening) to one hemisphere at a time are combined with a response method such as reaction time to provide an experimental situation in which one can tap, to a certain degree, the responses of a single hemisphere.

Much good work has been carried out, and it would take hours even to summarize briefly all the experiments which have been

done: here I can only touch upon some of the more interesting findings.[1]

With the split-brain patients it was found that after the operation the right hand was still able to use language, that is, copy or compose language, but it could not do even the most simple drawing tasks. The left hand now could not even copy language, but it could reproduce simple drawings, and, using a set of coloured cubes, two dimensional geometric figures, but these tasks could not be performed at all with the right hand.

With normal subjects using tachistoscopic presentation a host of investigators have found that verbal materials are recognized more easily in the right visual field, whereas meaningful forms (like faces) as well as meaningless forms are better recognized in the left visual field (Levy, 1974).

Durnford and Kimura (1971), Trevarthen and Levy (1973), and others have found a right hemisphere superiority for depth perception, line orientation, scanning, and visual point location.

Galin and Ornstein (1972) have reported that in electroencephalographic studies the amount of alpha frequency activity, generally an indication of a relatively quiescent state in the brain, tends to increase in the hemisphere opposite the one being engaged by a task. In other words, in a language task there is a greater percentage of alpha wave activity in the right hemisphere and in a visuospatial task there is more alpha activity in the left hemisphere. Recently a similar differential effect on visually evoked potentials[2] has been reported (Galin and Ellis, 1975).

Dimond and Beaumont (1974) have carried out studies indicating that the left hemisphere is capable of limited periods of high level vigilance performance while the right hemisphere appears to maintain a lower but more consistent level of vigilance. Also they report a right hemisphere advantage in creative associative responses to stimuli.

Both before and after the experimental work a considerable amount of information regarding specialization had emerged from neurophysiological studies of unilateral brain lesions, that is, injuries to only one side of the brain. Most of this work ties in very nicely with the experimental findings. For example, Brenda Milner and her associates found that right temporal lobectomy

[1] Several good summaries of this work are available, both popular and technical: Dimond and Beaumont (1974), Dimond (1972), Gazzaniga (1970).

[2] An evoked potential is the specific response to a stimulus. The usual method of detecting this is to use a computer for averaging successive segments of brain activity in synchrony with repeated presentations of the stimulus.

severely impairs ability on visual and tactile mazes, whereas left temporal lobe lesions of equal size produce little or no effect on this response. Moreover, patients with right temporal lobe lesions show a consistent impairment in the perception of irregular patterned stimuli (particularly when it is difficult to apply verbal labels) as well as an impaired ability to discriminate tonal patterns and tonal quality. Patients with left temporal lobe lesions show little, if any, of these impairments but do show significant impairment in verbal memory tasks (Milner, 1965). Hécaen and Angelergues (1962) found inability to recognize familiar faces more frequent in patients with right hemisphere lesions.

I think this is sufficient to give an idea of the general picture regarding hemisphere differences. There is far more work going on than can be discussed here.

How are we to interpret this great mass of data? The most apparent fact is that each hemisphere seems to have its own characteristic way of processing information and because of this each hemisphere exhibits superiority in the activities which are best suited to its particular processing style. Probably the most cautious way of delineating these processing styles is to say that the left hemisphere is geared for discrete information which is processed sequentially, where as the right hemisphere is better at more diffuse, holistic, gestalt information which is processed simultaneously. This simplification must inevitably obscure the many more subtle differences observed within and between the hemispheres but it will have to serve as a temporary working classification.

So far we have spoken only of differences in function, but there is evidence to indicate that the two hemispheres are different in their structural organization as well. The most prominent difference, noted by Geshwind (1974), is concerned with the language area. Without going into technical details it appears that in a large percentage of right handers the area involved with speech is enlarged in the left hemisphere in comparison with the same area in the right hemisphere. Wada (1969) has found that this condition exists from birth, indicating that such structural differences are genetically programmed.

Semmes and her associates have found in their extensive studies of brain-injured war veterans that, in the left hemisphere, deficits in performance in a specific task could be identified with a specific lesion, while there was no such localization in the right hemisphere. A lesion of the left hemisphere might interfere with the performance of a particular task but a lesion of the right hemisphere, if small, might have little or no observable effect, but if large might affect a

whole range of tasks. Their conclusions are that the left hemisphere is anatomically specialized for discrete, focal information processing, and the right hemisphere is more diffusely organized for tasks requiring simultaneous processing of information, such as spatial perception (Semmes, 1968).

I should like to mention now some theories of hemisphere function proposed by various investigators, but it must be noted that this material is still open to different interpretations.

With regard to how the two hemispheres work together, this is still very much an open question. Obviously the particular abilities of each hemisphere seem to complement each other but their specific method of interaction is far from known. There are suggestions, however, and we will take a look at some of these. Galin and Ornstein (1972), on the basis of their EEG studies suggest that, rather than actually integrating the two modes of cognition, a person is constantly shifting back and forth between them, perhaps in time periods of only a fraction of a second. Kinsbourne (1970) has proposed a similar idea with an attention switching mechanism governing the time-sharing procedure. In reaction time experiments when the stimulus is directed to the non-competent hemisphere the response takes slightly longer. Kinsbourne interprets this delay as the time necessary to reactivate the competent hemisphere rather than the more common view that the delay represents the time necessary for the information to cross the callosum. Ledlow, Swanson, and Levy (1973) have presented evidence that this might be the case.

How does this specialization come about? There is no lack of hypotheses, far from it, but to achieve even a modicum of agreement on any particular one is a feat not yet accomplished.

Jerre Levy (1974) has proposed a genetic model to account for cerebral and manual dominance and presents a considerable amount of data from her own work to support the model. It is not difficult to see that natural selection could favour the particular genetic combinations which enabled humans to use the best arrangement of these complementary modes of cognition, both on an individual and a collective level. However, the proposed model still needs further independent experimental confirmation.

Obviously the structural differences between the hemispheres must have a genetic component and Gazzaniga (1974) suggests that this structural asymmetry may result in an increased probability that the right hand will be used to explore the environment more than the left hand. In a young child this results in a positive feedback loop in which the engrams or memory traces already laid down encourage the right hand to ask more questions of the

environment. As development progresses the dominant focus of activity on the left suppresses the duplicate engrams on the right. Unfortunately this theory fails to answer many questions posed by the hemisphere lateralization work but it is a start.

Finally, Trevarthen (1973) argues that there are two principal strategies for information uptake which hold true for virtually all the sensory-motor systems of the body and that these strategies may be the clue to understanding the differences between the hemispheres. The strategies can best be illustrated by considering the eye. Trevarthen points out that there are two types of vision. What he calls *ambient vision* refers to the sensory uptake of what is in our peripheral area of vision. In contrast to this there is *focal vision* in which a very small part of the visual field is held fixated or focused for a short period of time, normally a fraction of a second. Thus we use ambient vision strategy to scan the environment and derive our next focus of attention by reacting to the appearance of a source of information. Focal vision strategy, on the other hand, invents foci according to the structure of a mental image and checks to see if it is supported by appropriate stimuli present in the field. 'Focal vision is more concerned with assimilating information according to our goals, and is less likely to accommodate to unexpected events in the environment,' he points out. In relationship to the hemispheres he remarks:

'I interpret what we know at present to indicate that the right hemisphere is more concerned with establishing intelligent priorities in the pre-focal field, and with an assessment of the composition of the field in relation to the sum total of the contents of immediate awareness. We may deduce that its memory functions are organized to assimilate and retrieve a record of personal or egocentric experience in its fullest and least rationalized or categorized form. The left hemisphere is more selective within the field of experience seeking to establish and use categorical universals, especially those more related to the semantic categorizations of speech, and to apply them in solving problems with thought, and in communicating.'

COULD PSI BE LATERALIZED TOO?

When I first began to think about these studies of hemisphere specialization from a parapsychologist's point of view a number of things seemed clear:

1. If we assume that some paranormal information, an extrasensory percept, somehow gets into the nervous system of a human

being, then for it to come out in any of the familiar ways this signal will have to pass through the cerebral cortex at some point, if it isn't already there at the start.

2. If this hypothetical ESP signal is processed by the cerebral cortex, might it not be subject to the same sort of laterality effects as normal cognition?

3. ESP as it appears in the laboratory is at best flighty and unstable, and if it is a valid effect it is subject to a number of critical variables about which we have no idea yet.

4. Most of the experimental techniques popular in the parapsychological field, with few exceptions, expect a response through the dominant hemisphere.

It was essentially just these few points which started me wondering, 'Just for the fun of it, perhaps we should give the so-called minor hemisphere a better chance at the ESP game.' Maybe there is something in the left hemisphere which does not like ESP or is incompatible with the kind of information which ESP represents.

I began looking through the parapsychological literature with this in mind and, with the help of my colleagues in Edinburgh, I was surprised to discover that people have been attributing psychic powers to the right hemisphere almost as long as they have been attributing language to the left.

As early as 1855, in a periodical called the *North American Review*, an article entitled 'Modern Necromancy' reviewed two books concerned with the spiritualist movement of that time. After dismissing the spiritualist hypothesis the authors go on to discuss cases of 'dual consciousness' and suggest that this might be due to the 'duality of the brain'. Furthermore, they say that the human body is like a living battery and ordinarily produces enough power to keep only one hemisphere active. In exceptional cases, however, an excessive charge might build up and activate the second hemisphere which could account for the spirit personality and the phenomena of the seance room. An interesting historical antecedent, even though it may not help us much now.

Another interesting reference comes from Nandor Fodor's monumental *Encyclopaedia of Psychic Science*. He mentions that some of the investigators of the famous medium, Eusapia Palladino, noted that in her trances the normally right handed medium became left handed. This was interpreted to signify increased participation of the right lobe in mediumistic states.

Finally, almost exactly ninety years ago the great Frederic W. H.

Myers addressed this very society reporting on his extensive studies of graphic automatism. In a detailed and closely reasoned paper he discussed the different types of productions coming from the 'planchette', a device something like a writing ouija board. He believes that the cases with which he deals represent something paranormal, but telepathy rather than any supposed spirit communication. The utterances scrawled out by the planchette resemble very closely the efforts to communicate made by people who have suffered injury to the language hemisphere of the brain. He proposes that, if it is the case that in agraphic and aphasic patients it is the right hemisphere which is making the attempt to communicate, then perhaps it is the right hemisphere which is controlling the output of the planchette operators. Continuing, he says that these seemingly right hemisphere productions of the planchette might either be unconscious remembrances or occur as a result of the right hemisphere being more telepathically sensitive (Myers, 1885). So, I must confess that what I am proposing is not as novel as it might sound.

Now for the present. In testing normal subjects for laterality effects a major difficulty is uncertainty as to whether one is really separating the hemispheres in any sort of effective way. There is little in the recent parapsychological literature that has any direct bearing on the problem although there are a number of things which are very definitely suggestive.

Some of the most dramatic reports of laboratory ESP have come from the dream studies of Ullman and Krippner. May I recall the main features of this work? A subject would go to sleep and be monitored to detect the onset of dreaming. Generally there would be an agent elsewhere who would look at a target, usually an art print, during the subject's dream periods. As the subject ended his dream period he would be awakened and asked to report his dream. The results were analysed using several blind matching techniques and in many cases were statistically significant, sometimes highly so. Of considerable interest also was the fact that during the course of these experiments quite a number of surprisingly close correspondences of report with target were noted (Ullman, Krippner, and Vaughan, 1973).

In addition to these studies, there is a continual flow of anecdotal reports of ostensibly telepathic dreams, frequently between persons who are involved in some way with one another and in a time of need.

It is interesting to note, in the light of this, that there is a certain limited amount of evidence, to suggest that dreaming is connected with the right hemisphere. Humphrey and Zangwill (1951) report

that injuries to the right parietal lobe interfere with dreaming and Bogen (1969) reports that his split-brain patients note the absence of dreams after the operation, perhaps because of the disconnection of the dream area from the verbal output area.

To speculate a little at this point; it is not hard to imagine a situation such that the right hemisphere is in some way more amenable to telepathic information and this occasionally shows up dramatically during the particular period of a person's day when the verbal hemisphere has a certain amount of reportable contact with the more esoteric activities of the right hemisphere, namely during dreaming. Even here, though, we are expecting the ESP evidence to come through the dominant hemisphere, in this case, verbally. The work of Ullman and Krippner suggests however that this may be an unfair expectation. They point out that subjects would often correctly indicate the target picture on the basis of a non-verbalizable 'feeling' that a particular picture reminds them of the dream, whereas the judge involved in the blind matching techniques would rate the target lower on the basis of the subject's verbal report (Ullman *et al.*, 1973).

To mention a few related studies, Austin (1971) administered standardized tests to separate subjects who had an intellectual bias toward rational, scientific thinking and those whose bias was towards more imaginative and artistic endeavours. The groups are called convergers and divergers respectively. Worth noting is that a number of investigators of hemisphere differences will interpret this sort of dichotomy as reflecting more or less emphasis on the cognitive styles of the two hemispheres, the left being associated with the rational, scientific preference and the right with the creative and artistic.[1] Austin then conducted a dream lab study with these subjects and found that the divergers were significantly likely to recall their dreams more frequently and in greater detail than the convergers. Divergers recalled almost 100% of their dreams while convergers managed only 60%. Homes (1973) has followed up this research and has interpreted the differences in recall between convergers and divergers as reflecting different strategies of defence against the possibly threatening material of the dream.

With that in mind it is interesting to note that Honorton (1972) has carried out a study indicating that those who reported frequent dreaming showed significant differences in ESP ability from those reporting only occasional dreaming. He interprets frequent dreaming to be associated with higher ESP. Another clue? Perhaps.

[1] A very readable account of this interpretation can be found in Ornstein (1972).

Probably one of the most interesting and potentially one of the most important programs of research, is the work of Helmut Schmidt of the Institute for Parapsychology with his random number generators (Schmidt, 1971, 1973, Schmidt and Pantas, 1972). Briefly, he has found that a few subjects can cause the otherwise random fluctuations of atomic decay or electronic noise to cohere into some form of order and, with a certain degree of consistency, produce highly significant deviations from normal randomness. If this effect is sufficiently robust to allow other investigators to confirm and extend these findings then the implications will be enormous. It is not hard to see how the electronic or atomic noise of the random number generator might, in a very, very coarse sort of way, be analogous to the ongoing neural activity and 'neural' noise of the brain. If there are a few people who can apparently impress a crude form of information on these machines, what are the possibilities when it comes to the incredibly complex fabric of the brain's electrical activity?

Keeping Schmidt's experimental findings in mind, let us move on to consider some of Rex Stanford's theoretical proposals. Recently Stanford has proposed a wide ranging hypothesis which he calls the Psi Mediated Instrumental Response model (PMIR) of how some forms of ESP might occur (Stanford, 1974a, b). It is an ambitious piece of work and will keep parapsychologists busy for some time. I should like to discuss the relevance of some of the points he makes to the topic at hand.

Stanford notes that the influence of psi on a person need not produce a gross, easily observable change of behaviour but can be a small, very subtle modification of ongoing mental or behavioural processes. Thus he proposed '(6) PMIR occurs in part through psi mediated facilitation or triggering of otherwise ready or available responses (including actual behaviour, thoughts, memories, or feelings). (7) PMIR tends to be accomplished in the most economical way possible.' In other words, it makes only the smallest change necessary in ongoing brain activity.

Stanford further proposes that we should consider the possibility that telepathy, in many cases if not all, has an active-agent component, and that it is the PK of the agent which is responsible for the information transfer or behaviour change in the subject. He takes up the implications of the Schmidt work which I have just mentioned as well as reports of possible PK influence on living tissue to lend further strength to his hypothesis.

I must stress here at this point that we are dealing with hypotheses, not experimental results. The question I would like to pose is, 'In the light of what is known regarding hemisphere

specialization, can we afford to ignore the possibility that one hemisphere may be neurologically organized in such a way as to be more susceptible to psychokinetic intervention?'

There remains, of course, the question of why we should expect certain psi abilities to be lateralized in the first place. Here are a few plausible suggestions.

Recall, if you would, Trevarthen's tentative categorization of the different types of information-gathering strategy in the two hemispheres, the focal and projected type of information uptake of the left hemisphere and the ambient (peripheral) and attracted scan of the right hemisphere. It would seem to me that if paranormal abilities are real and presumably serve some function in human existence then we might expect that function to be more compatible with the information seeking, environmental scan of the right hemisphere. The evolutionary advantages of the complementarily functioning halves of the brain would hold true for extrasensory abilities also.

In terms of human evolution it may be supposed that some type of psi ability existed prior to elaborate linguistic communication. (Some of the animal studies in the future may be able to shed some light here.) Psi ability could be very helpful in group hunting and just group survival. As linguistic communication developed, psi communication could have waned in importance or perhaps even become socially undesirable so that mechanisms were evolved to suppress it or restrict its appearance in normal social behaviour. Where then might we expect to find the last vestiges of effective and sometimes useful psi communication? A good guess would be during man's most vulnerable time, namely sleeping.

This, of course, is speculation at its wildest, and I am not proposing it as a serious model. It is the sort of thing which my colleague, Brian Millar, and I do in our idle moments at the Edinburgh lab. It does illustrate, however, that one does not have to stretch the imagination too far to come up with a reasonable conceptual framework for the evolutionary aspects of psi and why it might be lateralized.

It has been argued, most recently by Beloff (1973) and Rushton (1971), that it may be desirable and even necessary to have a means of restricting or inhibiting psi information from coming into consciousness. Psi activity may still be there, influencing our behaviour, as Stanford suggests, but under normal circumstances it is prevented from entering our awareness. Without discussing the nature of consciousness, may I suggest that it may be reasonable to look for such a hypothetical defence mechanism against conscious psi in a context related to language development, both

in evolution to the limited degree that we can, and in the way such mechanisms may be structured in the brain.

One final note on this idea. As you are well aware, there is quite a bit of work going on in parapsychology with what are called altered states of consciousness. Studies dealing with hypnosis, ganzfeld techniques,[1] sensory bombardment and deprivation, alpha wave production, and in some cases just simple relaxation are thought to be dealing with states of consciousness anywhere from slightly to greatly removed from the normal waking state. As Beloff (1973) points out, 'Common alike to all these approaches is the implicit recognition that one has to circumvent the brain's normal defence mechanism if psi is to be given a chance to show itself.'

To the degree that altered states of consciousness can be shown to facilitate the production of psi they are called 'psi conducive states'. At the 1974 Parapsychological Association convention two workers in the area of psi conducive states, Lendel and William Braud, proposed 'psi conducive' and 'psi antagonistic' syndromes. Not accidentally, the two syndromes tally closely with the way in which such investigators as Ornstein and Bogen describe the general modes of functioning of the right and left hemispheres of the brain (Braud and Braud, 1974). The essential point of Braud and Braud's paper is that the cognitive style of the right hemisphere might be psi conducive and that of the left psi antagonistic. At the moment I believe they are engaged in experiments which are said to elicit right or left hemisphere functioning to see if these hypotheses can be validated.

In conclusion, I should just like to emphasize that I do not suggest there is compelling evidence to say that ESP is all in one or the other side of the brain. What I do wish to convey is that there seems to be more than sufficient evidence to make it worthwhile to investigate whether ESP is subject, in whole or in part, to laterality effects as other cognitive functions are. Perhaps in examining this possibility we may get a handle on some of the critical variables which have been eluding parapsychologists for so long. This will not be a simple matter. Certainly the interrelations will be exceedingly complex. By all means, though, we should make a start in this direction.

[1] A ganzfeld is a homogeneous sensory field created in different ways with varying degrees of effectiveness. It is a way of simulating a type of sensory deprivation by providing diffuse, monotonous, constant stimulation. A common way reported in the parapsychological literature is to place halves of ping-pong balls over the eyes and feed white noise to the ears of a subject.

REFERENCES

Austin, M. D. (1971) Dream recall and the bias of intellectual ability. *Nature* **231,** 59.

Beloff, J. (1973) *Psychological Sciences.* Crosby Lockwood Staples, London, 301 ff.

Bogen, J. E. (1969) The other side of the brain, I, II, III. *Bulletin of the Los Angeles Neurological Societies* **34,** 3.

Braud, W. and Braud, L. (1974) Psi conducive syndrome: Free response GESP performance following evocation of 'left hemispheric' vs. 'right hemispheric' functioning. Brief report at the 1974 P.A. convention.

Dimond, S. J. (1972) *The Double Brain.* Churchill-Livingstone, London.

Dimond, S. J. and Beaumont, J. G. (1974) Experimental studies of hemisphere function. In Dimond, S. J. and Beaumont, J. G. (eds.) *Hemisphere Function in the Human Brain,* Elek, London.

Durnford, M. and Kimura, D. (1971) Right hemisphere specialization for depth perception reflected in visual field differences. *Nature* **231,** 394–5.

Fodor, N. (1966) *An Encyclopaedia of Psychic Science.* Citadel Press, Secaucus, N.F. (University Books Reprint. First published in 1934). P. 390.

Galin, D. and Ellis, R. (1975) Asymmetry in evoked potentials as an index of lateralized cognitive processes: Relation to EEG alpha asymmetry. *Neuropsychologia* **13,** 45–50.

Galin, D. and Ornstein, R. (1972) Lateralization of cognitive mode: An EEG study. *Psychophysiology* **9,** 412–18.

Gazzaniga, M. S. (1967) The split brain in man. *Scientific American,* Aug. 1967.

Gazzaniga, M. S. (1970) *The Bisected Brain.* Appleton-Century-Crofts, New York.

Gazzaniga, M. S. (1974) Cerebral dominance viewed as a decision system. In Dimond, S. J. and Beaumont, J. G. (eds.) *Hemisphere Function in the Human Brain,* Elek, London.

Geshwind, N. (1974) The anatomical basis of hemisphere differentiation. In Dimond, S. J. and Beaumont, J. G. (eds.) *Hemisphere Function in the Human Brain,* Elek, London.

Hécaen, H. and Angelergues, R. (1962) Agnosia for faces (prosopagnosia) *A.M.A. Arch. Neurol.* **7,** 92–100.

Holmes, M. (1973) REM sleep patterning and dream recall in convergers and divergers—Evidence for different defensive preferences. University of Edinburgh Centre for Research in the Educational Sciences, Occasional Paper 16.

Honorton, C. (1972) Reported frequency of dream recall and ESP. *J.A.S.P.R.* **66,** 369–74.

Humphrey, M. E. and Zangwill, O. L. (1951) Cessation of dreaming after brain injury. *Journal Neurol. Neurosurg. Psychiatry* **14,** 322–5.

Kinsbourne, M. (1970) The cerebral basis of lateral asymmetries in attention. In Sanders, A. F. (ed.) *Acta Psychologia* **33,** Attention and performance III, North Holland Pub. Co., Amsterdam.

Ledlow, A. S., Swanson, J. M., and Levy, J. (1973) Hemispheric differences in RT experiments: transcallosal transfer of information of shift in attention? (in preparation) cited in Levy 1974.

Levy, J. (1974) Psychobiological implications of bilateral asymmetry. In Dimond, S. J. and Beaumont, J. G. (eds.) *Hemisphere Function in the Human Brain,* Elek, London.

Myers, F. W. H. (1885) Automatic writing. *Proc. S.P.R.,* VIII, 1–63.

Milner, B. (1965) Brain mechanisms suggested by studies of temporal lobes. In Darley, F. L. and Millikan, C. H. (eds.) *Brain Mechanisms Underlying Speech and Language.* Grune & Stratton, New York.

North American Review (1855) Modern necromancy. LXXX, 167, 512–27.

Ornstein, R. E. (1972) *The Psychology of Consciousness.* Viking, New York.

Rushton, W. A. H. (1971) First sight—second sight. *Proc. S.P.R.* **55,** 177–88.

Schmidt, H. (1971) Mental influence on random events. *New Scientist,* 24 June, 757–8.

Schmidt, H. (1973) PK tests with a high speed random number generator. *J. Para.* **37,** 105–18.

Schmidt, H. and Pantas, L. (1972) PK tests with internally different machines. *J. Para.* **36,** 222–32.

Semmes, J. (1968) Hemisphere specialization: A possible clue to mechanism. *Neuropsychologia* **6,** 11–16.

Sperry, R. W., Gazzaniga, M. S., and Bogen, J. E. (1969) Interhemispheric relationships: the neocortical commissures; syndromes of hemisphere disconnection. In Vinken, P. J. and Bruyn, G. W. (eds.) *Handbook of Clinical Neurology,* vol. 4. North Holland Pub. Co., Amsterdam.

Stanford, R. G. (1974a) An experimentally testable model for spontaneous psi events, I extrasensory events. *J.A.S.P.R.* **68,** 1, 34–57.

Stanford, R. G. (1974b) An experimentally testable model for spontaneous psi events, II psychokinetic events. *J.A.S.P.R.* **68,** 4, 321–56.

Taylor, J. (ed.) (1958) *Selected Writings of John Hughlings Jackson,* Basic Books, New York.

Trevarthen, C. (1973) Aspects of the psychobiology of speech. Unpublished Manuscript, Dept. of Psychology, University of Edinburgh.

Trevarthen, C. and Levy, J. (1973) The perception of movement and orientation in space by split brain patients. (In preparation.) Cited in Levy 1974.

Ullman, M., Krippner, S., and Vaughan, A. (1973) *Dream Telepathy.* Macmillan, New York.

Wada, J. (1969) Paper delivered at the Nineteenth International Congress of Neurology, New York. (Unpublished.) Cited in Geshwind 1974.