

Brain Hemisphere Specialization and ESP:  
What Have We Learned?

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That the specialized cognitive capacities of the cerebral hemispheres might interact with paranormal abilities can be considered both one of the most recent ideas of parapsychologists and at the same time one of the earliest. The current enthusiasm for this idea began only about 10 years ago when William Braud in Texas began investigations on cognitive style and paranormal abilities and Richard Broughton in Edinburgh started studies of lateralization effects and ESP. It is primarily this research and the few studies which have followed which I will review in this paper but first I would like to recapitulate some of the reasons why a few of us parapsychologists are interested in this topic.

The first serious interest by investigators was brought about by the observation that the productions of graphic automatists, those mediums who practiced automatic writing, bore a remarkable similarity to the writings of patients who had lost the use of their left hemispheres. As anyone in the medical profession can attest, the fragmentary communications produced by aphasics, persons who have lost the language facilities of the left hemisphere, is of a rather distinctive character. The automatic writings produced by trance mediums seemed, at least to one investigator, to spring from the same source as aphasic communication, namely the right hemisphere of the brain. Among the similarities noted were an embarrassing tendency for the automatic writing to contain swearing, a characteristic repetitive nature of the utterances, and the apparent word-blindness of the writer who frequently was unaware of what the hand was writing.

These observations were not made recently, nor were they made in the few decades since the split-brain operations associated with Roger Sperry's work. The observation that the right hemisphere seemed implicated in mediumistic communication was made almost 100 years ago by Frederic W. H. Myers (1885). Fodor (1933) indicates that the Italian investigators of Eusapia Paladino also suspected minor hemisphere involvement in mediumistic states.

Clearly the early psychical researchers were aware that hemisphere specialization might hold a clue to understanding the seance room phenomena which interested them but this awareness did not continue through to the early development of parapsychology. In fact there is little mention of it until the renewed interest of the '70s brought it into the forefront again. This is rather surprising since there are a number of interesting hints in the literature which could indicate that hemisphere specialization affects psi processes too.

One of the most obvious hints at the possible disproportionate involvement of the right hemisphere, which can be found in both the spontaneous literature and the experimental approaches, is the visual character of the ESP experience. The surveys of the spontaneous cases in the United States, Britain, Germany and India have indicated that the majority of the experiences are visual in nature, frequently occurring as dreams.

Rhea White, in her seminal 1964 paper, reviewed the manner in which certain gifted subjects responded to experimental tests. Almost all of the very successful subjects in White's review reported that their correct responses were visually mediated. White emphasized that there usually was a deliberate effort to disengage the conscious mind in the techniques employed by these subjects and that frequently a special effort was required to keep the mind receptive.

One of the more impressive of the recent special subjects, Bill Delmore, was studied at length by Kelly et al. (1975) who reported on their work at the PA conference 10 years ago. They noted that their subject "like many other sensitives...strenuously insists on the quasi-visual character of his ESP experiences". Their study demonstrated that the errors made by Delmore in ESP target recognition were very similar to those made under conditions of very weak visual stimulation. The investigators concluded that, "for him at least, ESP information is regularly encoded in the form of fleeting visual imagery; errors appear at a secondary stage when he attempts to identify the images" (Kelly, et al., 1975).

In this same context we have only to consider the current experimental approaches to ESP which are yielding the most impressive results. The ganzfeld and remote viewing approaches are very visual and both attempt to emulate the techniques which White's subjects evolved naturally. Researchers (e.g. Targ and Puthoff, 1977) report that actively encouraging subjects to visualize the target or even draw their impressions tends to give better results than relying on verbal responses.

The visual character of much ESP seems a strong hint that the right hemisphere plays a very important role but there other hints too. Among the more intriguing is the evidence that dreaming is largely a function of the right hemisphere. The precursor of the ganzfeld, the Maimonides dream studies provided some quite spectacular evidence of ESP. Also, Honorton (1972) has reported that subjects who claim to dream frequently showed a significant advantage in ESP in a standard card guessing test over those who claimed to dream only occasionally. This confirmed earlier findings by Johnson (1968).

Despite these suggestions emerging from ongoing research it was not until 1974 that work addressing the hemisphere specialization question was reported. Braud and Braud (1975) attempted to induce in subjects either a "right hemispheric" mental attitude or a "left hemispheric" mental attitude. This was done by having subjects listen to tapes which included various mental exercises of the type thought to fall within the province of one or the other hemisphere. The reasoning behind this was that the nature of right hemispheric specialization fit what those researchers termed the "Psi Conducive Syndrome" and that if a right hemispheric state could be induced then this should facilitate psi function. Correspondingly, a left hemispheric state might inhibit or at least not help psi.

Each of twenty subjects had to undergo progressive relaxation and then listen to either the right hemisphere or the left hemisphere tape. Following the tape was a five-minute impression period during which a single free response trial was performed. The results indicated a marginally significant advantage for those responses which followed the right hemisphere tape.

This experiment is very much in line with Kinsbourne's attention sharing model of hemisphere function (Kinsbourne, 1974) which suggests that a general

activation of one hemisphere will facilitate attending to other input in the characteristic style of that hemisphere. Unfortunately Kinsbourne's model has not met with unequivocal experimental success. However, one of the facts which has emerged from this and other lines of research is that the relative balance between the activation of the specialized processing facilities of the hemispheres is a dynamic, ever changing one which responds on a moment by moment basis to the demands of the perceptual input. The assumption that the hemisphere activation presumed to be accomplished by the tapes continued for any length of time after the tapes ended is a serious weakness of this study which could have contributed to the marginality of the results.

A different approach to hemisphere differences was exemplified by a series of experiments conducted at about the same time at the University of Edinburgh by Broughton (1976). The rationale behind this line of research derived from two hunches. One involved the venerable old theory that there might exist some sort mechanism or process which generally prevents psi from reaching our primarily verbal consciousness, a psi filter in the Bergsonian sense. Clearly a common factor in many of the successful research approaches mentioned above is an attempt to bypass the normal verbal consciousness and it was a reasonable supposition that such a filter, if it exists, might be connected with the mechanisms which serve to generate that experience which we call consciousness. The second hunch is the one suggested by the points I made at the start, namely that the visual character of so much of the ESP evidence may be more than coincidence. The specialized processing capabilities of the right hemisphere may be of importance to ESP.

The first requirement of this work was to devise as close to a hemisphere-neutral psi test as possible. Broughton decided upon a forced choice design using tactual recognition by the fingertips of common three-dimensional objects. Somatosensory representation of the fingertips is thoroughly in the hemisphere opposite the hand and tactual recognition of easily recognizable shapes has been shown to have no particular hemisphere advantage. This is largely due to the fact that both split-brain and normal persons can make simple matches or recognitions with either hemisphere depending on whether the stimulus is verbal or visuospatial. A right hemisphere advantage for tactile recognition does seem to arise as the task increases in spatial complexity, as with unfamiliar or nonsense figures and complex polygons but some recent disconfirmations of earlier work must qualify even this conclusion (cf. Bryden 1982). Thus the task chosen by Broughton can be safely said to have no intrinsic hemispheric loading.

Following designs popular in cognitive hemisphere research the second aspect of the experiment was the use of an interfering task, specifically, a task which could be expected to load heavily on only one hemisphere at a time. The interfering task also had to be one which could be monitored continuously to insure that the subject was not turning it off at the moment a response on the ESP task was required. A common interference task for the left hemisphere is reading which, for right handers, is known to be a left hemisphere task. Unfortunately for the experimental design corresponding right hemisphere tasks proved harder to come by because the ways of monitoring them generally created confounding problems. Various spatial tasks were proposed but all foundered on the monitoring problem. Tasks such as tracing patterns could be used if one did not have to use the right hand at some time since the fine hand movement required would most certainly involve the left hemisphere in what was meant to be right-hemisphere-only task. Broughton's experimental design required the use

of each hand in turn for the guessing.

Broughton was unable to devise a right hemisphere distracting task and elected to proceed with an unbalanced design. At the core was the fingertip ESP task which could be directed by either hemisphere with apparently equal facility. To this was added an interference task which was loaded on the left hemisphere yielding the following conditions:

- Left Hemisphere control of guessing with no interference task
- Right Hemisphere control of guessing with no interference task
- Left hemisphere control of guessing while additionally occupied with the interfering task
- Right hemisphere control of guessing while the left hemisphere is occupied with the interfering task.

Because of the unbalanced design Broughton did not initially venture any specific hypotheses although he clearly leaned toward expecting a right hemisphere advantage with the interfering task having some effect.

A series of three similar experiments were carried out and their results will be briefly summarized here. In the first experiment there was no overall effect at all in the total data but a post hoc analysis of the data revealed an effect of hand differences with the greater divergences from chance found with the left hand. The left hemisphere interfering task produced an insignificant increase in scoring magnitude. For this first experiment Broughton had used a backwards counting task to occupy the left hemisphere but information came to light after the experiment indicating that such a task did not seem to produce the intended interference effects in other research and was probably a poor choice for this work. The post hoc results were sufficiently encouraging to warrant further explorations.

The second experiment incorporated two changes. The first was the use of a clairvoyance mode instead of the GESP mode used in the first experiment since securing pairs of subjects was difficult. The second was to employ the reading of law reports as the left hemisphere interference task. The second experiment yielded both hand and task effects in the same direction as the first experiment but these fell short of significance.

A third experiment was performed using the same interference task but employed the GESP mode again with the 20 subjects bringing an agent. The results of the third experiment provided a significant effect of the interference task: Subjects had higher ESP scores while they were reading, i.e. when the left hemisphere was occupied. There was also a suggestive but non-significant effect of hands giving an advantage to responses made with the left hand.

A very interesting post hoc finding was noted in the data of this series. Another researcher early in 1976 alerted Broughton to the emerging sex differences in lateralization findings. Specifically he noted that verbal interference tasks were effective only for male subjects. They seemed to have little or no effect on female subjects. This is of course related to the now well documented differences in degrees of lateralization between males and females but was not something Broughton had planned on in the design.

The new findings caused Broughton to reexamine his data for sex differences and he found that the verbal interference task yielded increased ESP scores only

for the male subjects. In the third experiment the significant difference between the conditions with and without the interference task was wholly confined to the male subjects. In the second experiment, which was thought to have failed, the male subjects alone (of which there were only five in contrast to 15 females) did in fact show a significant interference task effect. The details of these findings are in Broughton (1976) and Broughton (1978).

What is to be concluded from this complicated and not unproblematic series of experiments? Principally it is the idea that the loading of an extra task on the left hemisphere had the effect of improving the forced choice ESP scores for male subjects. There was also some evidence of a left hand advantage but generally this was not significant. The fact that the post hoc examination of the data found a sex difference which was exactly in line with other hemisphere research was particularly reassuring because it instilled confidence that the experiment was really tapping brain hemisphere specialization. Was this experiment successful in disrupting the oft postulated psi filter? Perhaps, but because of the problem with the unbalanced conditions one cannot say with any certainty. Do these experiments show a right hemisphere advantage for ESP? If one regards the ESP task as hemisphere neutral it suggests a right hemisphere advantage. Other investigators, however, do not regard the fingertip guessing as hemisphere neutral and have drawn rather different conclusions which we shall consider below.

Broughton followed this series with a completely different experimental design which made use of reaction time as the dependent psi measure, a technique pioneered by Stanford. In this experiment the subject was expected to press a button (with either hand in turn) in response to a bilaterally presented tone. For some of the trials an agent in another room received a one-quarter second "advance warning" of the subject's tone and it was hoped that this would be communicated by psi to the subject. As in the earlier series the psi task was meant to be hemisphere neutral and Broughton was looking for a possible "advance warning"/control (no warning) difference, indicating the presence of psi and perhaps a difference in the psi measure according to which hand was responding, indicating a hemisphere difference. The experiment was fully automated and two versions of the experiment were run. In the first experiment the subject simply responded to the tone. In the second a left hemisphere interference task was employed and subjects were required to read the law reports throughout the testing period.

The results were as follows: In the first experiment there were no effects at all, not even a simple hand effect. In the second experiment, when the left hemisphere interference task was used, there was a highly significant interaction between the "advance warning"/control condition and the hand responding. When the left hand gave the responses the "advance warning" condition gave shorter reaction times than did the control condition. When the right hand was used the "advance" condition yielded significantly longer reaction times.

This result was not expected by the investigator and is not easy to interpret. One could argue that this rather primitive sort of psi task showed no particular hemisphere advantage but had opposing effects in each hemisphere. In the right hemisphere it facilitated the subject's reaction but in the left hemisphere it had an inhibiting effect, perhaps because it conflicted with the subject's conscious awareness that there was no tone yet and caused an ever-so-slight delay when the tone actually did come. All of this occurring, of

course, only during left hemisphere interference. This sort of ad hoc explanation is not particularly useful and is given only in the hope of suggesting possibilities that future investigators should be aware of.

One could be tempted to treat these results as a fluke but it is interesting that the apparent psi effects showed up only when the verbal interference task was used. What is even more interesting is that when the same post hoc examination for sex differences was done on these data as in the shapes series it revealed that the significant interaction effect was present only in the data of the male subjects. Thus despite the unexpected nature of the interaction the sex-related effect of the interference task was confirmed.

In summary Broughton's work provided some suggestion for a right hemisphere advantage for ESP but the bulk of the evidence indicated that using a verbal interfering task with the male subjects somehow permitted more evidence for psi in two rather different contexts. Obviously Broughton's design is inadequate to permit a conclusion that some type of "psi filter" was being tampered with but the results certainly merited further work.

The shapes series did not spark off the many replications and extensions that were hoped for. In fact only one investigator and her associates even bothered to follow up this work. Maher and Schmeidler (1977) disagreed with Broughton's interpretation of the shapes recognition as being a hemisphere-neutral task but instead argued that it was a task at which the right hemisphere would excel. They suggested that there may be no general hemisphere advantage but each hemisphere merely processes information acquired by ESP in the same manner as that acquired through normal sensory means. Accordingly, they devised an experiment with two psi tasks, one meant to favor the right hemisphere and one meant to favor the left. The right hemisphere task was a psi based discrimination between a clover and bits of clear plastic enclosed in plastic cubes. The left hemisphere task was a discrimination between the word "CLOVER" and the word "WRONG" printed on slips of paper and also enclosed in plastic cubes. The subject was to try to choose the clover when picking the plastic cubes out of an opaque cloth bag using either hand in turn.

Maher and Schmeidler also sought to avoid the unbalanced conditions which were a weakness of Broughton's design by employing an interfering task for each hemisphere. For the left hemisphere interfering task they gave the subject syllogisms to solve. For the right hemisphere task they chose a pattern tracing task which was monitored by having the free hand actually trace the pattern. This, of course, involved precisely the hemisphere activation confounding described above and which Broughton found unacceptable but apparently Maher and Schmeidler did not regard this as a serious problem.

The experiment thus created by these investigators provided a nicely balanced design of three interference levels (left, right, none) by two ESP tasks (object, word) by two hands. Unfortunately the overall analysis of variance failed to detect any differences between the conditions. Of the twelve principal subsets of the data one yielded interesting suggestions and that was the 120 right hand choices of word targets while the left hand was tracing the pattern. This condition gave a deviation of +12 for which the authors report a  $CR=2.74$  ( $p<.007$ ). (A single mean t-test would have been more appropriate for assessing the effects of the hand manipulation on the group of subjects but none is reported by the authors.) A further interesting post hoc finding was that the above chance scoring with the words while tracing patterns was concentrated

in the data of the male subjects.

In their post hoc analysis Maher and Schmeidler create a category of "maximum facilitation" which combines right handed word choice while the right hemisphere is occupied with the left handed object choice while the left hemisphere is occupied. Scores of the male subjects in this category achieved a significant CR but those of the female subjects did not. This "maximum facilitation" category clearly implies that the investigators expect one hemisphere to have an inhibiting effect on the opposite hemisphere's ESP ability, or else there should be no need to distract it.

Maher and Schmeidler use the above findings along with their interpretation of Broughton's results to suggest that "each hemisphere is better at processing the kind of ESP input and output which corresponds to the sensory input and output it normally processes better." This interpretation might be acceptable if there was any evidence that the psi tasks they chose were lateralized in their normal sensory mode. There is, in fact, none.

Merely because a discrimination task is composed of two words does not mean that it is necessarily processed by the left hemisphere. There are dozens of experiments showing a right hemisphere advantage for word matching or discrimination when the physical characteristics are emphasized. The left hemisphere advantage shows up only when sufficient language processing is involved. Where the subjects making ESP responses because of lexical considerations or because one could "recognize" the characteristic hook of the "C" in clover or some other visual characteristic? One cannot say. Even more problematic is the supposition that "concrete objects" are processed by only the right hemisphere. This is nonsense and there is nothing in the literature to support such a sweeping generalization. What several decades of research have shown is that when the task requires a spatial analysis of the object the right hemisphere is likely to predominate. But the left hemisphere is perfectly capable of recognizing or discriminating between objects too, particularly when the task requires naming or other forms of categorization. One only has to look at Sperry's early work with the split brain patients to see that the left hemisphere has no problems with simple object recognition. Thus we have no evidence that the tasks which Maher and Schmeidler hoped to accomplish by psi have any tendency to be generally lateralized.

The hypothesis which Maher and Schmeidler have advanced, that each hemisphere handles ESP as it does other cognitive functions, is a perfectly reasonable one and it serves as a useful antidote to the frequently encountered propensity to ascribe anything we do not understand to the right hemisphere, ESP included. Unfortunately, the above study simply fails to test adequately that hypothesis.

As if to confirm this conclusion, Maher, Peratsakis and Schmeidler (1979) reported an attempt to confirm the effects suggested by the data of the seven male subjects in the first experiment. For the replication they used a pool of 24 males and essentially the same design as the earlier experiment. Maher, Peratsakis and Schmeidler found no significant effects whatsoever. The condition which yielded the highest scoring in the first experiment, right hand guessing of words while doing pattern tracing, provided a deviation of zero in the replication.

The view that neither hemisphere has an intrinsic advantage for ESP is also

shared by Stanford and Costello (1977) who reported on some preliminary work which attempted to manipulate the "cognitive mode" of the subject in a rather different way than did Braud and Braud. The dependent measure in this experiment was a psi-influenced response time in a word association task. A need-related aspect was introduced into the experiment by requiring subjects who failed to produce their shortest response time for a randomly selected key word to spend 20 minutes in a dull and tiring pursuit rotor task. The investigators attempted to manipulate cognitive mode by requiring logical coordinate responses from some subjects and predication responses from others. Because these classes of responses are negatively correlated and because persons who give many of one kind tend to give few of the other, Stanford and Costello reasoned that the two classes of words activated two different cognitive modes. They further thought that these cognitive modes would engage separately the hemispheres of the brain.

The experimental design yielded a two by two factorial (two cognitive modes by sex of subject) but the investigators reported that no significant effects were found.

For much the same reason that I have reservations about the tasks used by Maher and Schmeidler I think it is very unlikely that the Stanford and Costello study even got close to addressing hemisphere differences. "Cognitive Mode" at best refers to lists of cognitive activities presumed to reside in one or the other hemisphere of the brain. Except for the obvious ones, such as verbal or visuospatial abilities, these activities tend to be ill-defined and difficult to operationalize. The connection between "cognitive mode" and hemispheric activity is, as Bryden (1982) has noted, either trivial or very tenuous. Individuals can be shown to prefer either verbal or spatial strategies in reasoning and tasks can be devised which force subjects into employing one or the other strategy for periods of time, but there is little evidence to suggest that "cognitive mode" can be manipulated in any other than this trivial fashion.

With the verbal tasks used by Stanford and Costello the only thing we can be fairly confident about is that they engaged the subjects' left hemispheres, assuming (since it is not reported) that they were all right handed. Whether or not the right hemisphere also participated in any way is open to question. It is very unlikely that the task manipulation had its intended effect.

Another approach to examine possible psi lateralization is to look for asymmetry in EEG activity during psi tasks. There is a substantial amount of research looking for EEG asymmetries in ordinary cognitive tasks but it is an extremely difficult area in which to work. Except for confirming the gross distinctions between verbal and non-verbal activity this area of research has provided very ambiguous results. Kobayashi, Terry and Thompson (1979) segregated subjects into groups of psi hitters and non-hitters on the basis of card tests. Subjects were then put into a ganzfeld with relaxation followed by a task period during which subjects verbally gave a guess at an ESP card in an envelope which the experimenter placed on the subject's right hand. Percent-time alpha wave activity was measured from both hemispheres during the relaxation period and the ESP task period.

Kobayashi, Terry and Thompson were of the opinion that the right hemisphere has a general advantage for ESP and hypothesized that psi hitters would generally show less right hemisphere alpha than non-hitters (presumably indicating a more active right hemisphere) and that the right hemisphere would be more active (less alpha) than the left during the psi task. Neither of these



hypotheses were supported. There was some suggestion, though it is difficult to evaluate from the sketchy details in the RIP report, that right hemisphere alpha decreased during the psi task for the psi hitters but for the non-hitters left hemisphere alpha decreased. They tentatively conclude that the unsuccessful subjects seemed less able to keep the left hemisphere relaxed during the psi task. While this finding would fall in line with Broughton's results, the hemisphere EEG work remains too problematic to place much weight upon this conclusion without further confirmation. Percent-time alpha measures are notoriously susceptible to task effects and the design used could lead to a number of confounds.

Careful replication will, of course, be very necessary in understanding the relationship between brain hemispheres and psi. Lest anyone think that Broughton shall emerge from this review relatively unscathed, it must be noted that in 1977 at the annual SPR Conference Broughton reported two meticulous attempts to replicate both the shapes series and the reaction time series. In each case, the replication was as close to the original as possible with the sole exception being that equal numbers of male and female subjects were used to allow for more rigorous examination of sex differences. Unfortunately, none of the effects replicated in either the shapes or the reaction time experiments, not even the very promising sex difference for the interference task (Broughton, 1978). Thus the reliability of Broughton's effects has not been demonstrated.

The title of this paper posed a question: "What have we learned?" Obviously, I think we have learned that it is not very easy to conduct research in this area. Brain hemisphere research bears many similarities to parapsychology. Many cognitive lateralization effects seem unstable and subject to all sorts of unexpected influences and many simply prove to be artifacts of the test procedure. Not surprisingly, a fair bit of reported hemisphere differences suffer from repeatability problems. In merging parapsychology and brain hemisphere research we are giving ourselves a difficult job.

Although we may have learned some methodological pitfalls to avoid I do not think we have made any progress in understanding the relationship between ESP and hemisphere specialization. As we have seen there are two prevailing views of what this relationship might be. One view considers that there is a strong suggestion in the literature (as I outlined at the start) that the right hemisphere has a special role in ESP. The other view is that we have no reason to expect either hemisphere to have any special relationship to ESP and that probably ESP is processed in the same manner as ordinary perception. The latter view serves a useful function as a form of null hypothesis against which advocates of general right hemisphere superiority will have to test their hypothesis. Proponents of both views have made some reasonable attempts to garner evidence for their position but none of it is particularly compelling for the reasons I have given.

Whether we are able to resolve the issue in favor of one view or the other, or whether we find that it is a combination of the two remains to be seen. Indeed current research is showing that many superficially simple cognitive tasks have complex lateralization patterns depending upon the stage of processing that is examined. The whole thrust of brain hemisphere research is away from the urge to create dichotomies and to study in depth the integration of hemispheric capabilities in generating the unitary experience we call consciousness.

In parapsychology we are clearly at some disadvantage in this quest. We, unfortunately, have no idea what even constitutes ESP. Is it analogous to perceptual input and thus can be verbal or spatial or is it a goal oriented quantum mechanical nudge of some electrons on a synaptic cleft somewhere in the brain? One view would lead us to look for cognitive analogues of ESP and the other would suggest we see if some parts of the brain are more easily nudged than others. And there are many other views too.

Parapsychologists have been looking at the hemisphere questions by emulating experimental designs in which the nature of the stimulus and the task demands are, or at least should be, clearly specified. Those details, however, are precisely what parapsychologists are unable to specify, so it is little wonder we are getting ambiguous results. Can we reverse the design and use the known specialties of the hemispheres to give us some clues as to the nature of ESP? Perhaps we can, but it is not an easy task and we must be very careful about the assumptions we make in our experimental designs.

As I have already mentioned, hemisphere specialization research has matured over the last decade and investigators have found that it is not possible to put units of cognitive experience into little bins in the brain. The hemispheres of the brain most certainly exhibit patterns of specialization but we have found that our units of cognitive experiences are far more complex than we had imagined.

When I first became interested in hemisphere research I was introduced to a view of hemisphere specialization which seemed more inclusive and useful than the common distinction between verbal and nonverbal activities. This view, first propounded by Trevarthen (1973) and which since has been embraced by Kinsbourne (1974), relates hemisphere specialization to the two principal strategies for information uptake employed by the human perceptual system. This can best be illustrated by taking vision as an example but it can be extended to all sense modalities.

Trevarthen points out that there are two types of vision. What he has termed 'ambient vision' refers to a highly proprioceptive type of seeing which serves to perceive overall structure and detect changes in that structure in the peripheral area of vision in which behavioral acts may take place. In contrast to this there is 'focal vision' in which a very small part of the visual field is held fixated for a short time, normally a fraction of a second, thus isolating perceptual objects for detailed scrutiny. Ambient vision then serves to scan the environment and derive the next focus of attention by reacting to the appearance of a source of information. In this way it is very much like what Neisser (1967) calls 'preattentive processes.' 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. Trevarthen characterizes his interpretation of hemisphere specialization as follows:

"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." (Trevarthen, 1973)

In other words, the right hemisphere serves generally to be aware of what is happening around us without any need to label or categorize. But it also serves to assess this information in terms of what might be important for our focal attention. Our left hemisphere is geared for hypothesis testing and it is always testing input to see if it can be categorized and manipulated.

Certainly this is only one view and I am not about to engage in an extended defense of it against competing views. I mention it here because I have found it particularly useful in guiding my own muddled thoughts in this area. Trevarthen's view highlights the interaction between the hemispheres in a way which may be more crucial to our understanding of psi than attempts to fit psi in one or both hemispheres. For those of us who look for evidence of psi in conscious experience I urge that we look toward those mechanisms which govern the interaction between the hemispheres and the assignment of attentional priorities in our conscious experience.

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