

# Paraneuroscience?

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*Psychology is the study of individual cognitive behavior and parapsychology is the study of psychic phenomena. Neuroscience is the study of the brain and is a discipline closely related to psychology—so why is there no paraneuroscience?*

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The study of psychic phenomena, or psi, is often associated with psychology, and even though most psychologists aren't enthusiasts (Bem and Honorton 1994), psi research is also known as parapsychology. Neuroscience, the study of the brain, is a discipline related to psychology, though it generally has a more biological perspective. However, neuroscience doesn't seem to get the attention of psi researchers.

Psychology has parapsychology, so why isn't there a paraneuroscience? Not that neuroscientists are complaining, but you just can't help noticing that most of the other sciences have "fringes": physics has metaphysics, chemistry has alchemy, biology and physiology have vitalism, astronomy

has astrology, anatomy has phrenology and palmistry.

But no paraneuroscience, as yet. Neuroscience is a young discipline—the term “neuroscience” only came into use in the late 1960s—but it has enjoyed some important advances recently amid a surge of research in the 1990s (the “Decade of the Brain” as declared by President Bush in 1990). Over 20,000 scientists typically attend the annual convention of the Society for Neuroscience; the breadth and depth of the work presented there is impressive. Neuroscience encompasses all aspects of brain function, including computation, development and learning, and behavior.

The relatively short history of neuroscience means that there're no roots in superstition, as there are in the older sciences. So there's no history for a fringe to perpetuate, no “ancient wisdom” to latch onto. Still, neuroscience is an attractive setting for a fringe. There is presently a notable lack of general theories that would otherwise constrain speculation, unlike in physics and chemistry; also, the wide range of topics covered in the field is fertile ground for budding paraneuroscientists.

The absence of a paraneuroscience is therefore puzzling. Some of the reasons involve the nature of psi, which could presumably form the basis of a paraneuroscience. But most of the reasons have more to do with the nature of neuroscience research—the interpretation of which is usually difficult and often humbling to those who try. Consequently, neuroscientists are a rather cautious lot.

Let's begin with the fundamental principle of neuroscience: Many functions of the brain (such as sensation and perception, movement, and thinking) derive from the electrical activity of small cells in the brain called neurons (and some help from other cells called glia).

Evidence for this is legion. Electroencephalography (EEG) is a record of the electrical activity of the brain, or “brain waves,” and EEGs invariably correlate with a person's behavior and conscious awareness. (Newer methods to image the brain, such as Positron Emission Tomography and functional Magnetic Resonance Imaging, detect metabolic changes and not electrical currents as does EEG, but the metabolic changes are a consequence of electrical activity.) Researchers are also able to correlate perception with the activity of single neurons recorded from small electrodes (Parker and Newsome 1998). Even consciousness is attributed to the activity of neurons, and some ideas of how that happens have started to appear in the scientific literature (Crick and Koch 1998).

### The Improbability of Psi

If neurons are crucial to cognition, a fact that neuroscientists are convinced is true, then this precludes a number of interesting phenomena, including out-of-body experiences and ghosts. Such things are impossible, since perception and movement are mediated by neurons. Of course you can simply pos-

tulate cognition without active brain cells, but that wouldn't be paraneuroscience—that would be antineuroscience.

A big problem with psychic phenomena is that they just don't fit the way that neural networks and the brain function. The transfer of information due to telepathy or clairvoyance would be perplexing to say the least. Not that information can't be transmitted through space—it happens all the time in the form of electromagnetic waves (Krauss 1998)—but how would the information get coded and decoded by the brain?

It's currently believed that knowledge and memories are stored in synapses, which are junctions where one neuron com-

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municates with another. Neurons make a lot of synapses, forming complex “circuits” known as neural networks which process information. The computations necessary for various perceptual and motor tasks are thus performed by neurons working together and communicating via synapses. Changes in the synapses alter this process, of course, and that's how a person or an animal learns and remembers. Synaptic changes, if relatively long-lasting, represent knowledge gained by experience.

The problem for wannabe psychics is that people have widely varying experience, and thus different neural networks. Individual differences can include even the location of the neural network; the speech centers of the human brain, for example, can be found in either the left or the right hemisphere. And regardless of location differences, neural networks evidently don't work exactly the same way in every person. This is particularly clear from the imaging studies, which show that there's a lot of variance in how brains work. Variability is also prominent in animal studies.

So how would telepathy work? It wouldn't.

Even if you could somehow get neurons from different brains to communicate across space and time, they wouldn't know how to talk to each other. In order to decode a signal you've got to know how it was coded, and unless you've got a long time and a lot of recordings of the individual who “sent” a message, there's no way you'll figure it out.

But the problem gets even worse. Not only do people have their own personal codes and cognitive strategies, but these things change quickly over time. One reason for the changes is attention: when a person pays attention to certain stimuli, and not others, this affects which neurons will respond to the

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stimuli and what the response will be.

Thus, a message transmitted from one brain to another has little chance of being decoded; it probably wouldn't even end up in the right place, either, depending on the state of the receiver's brain.

To get around this unfortunate impasse, you could postulate the existence of a mind, separate and distinct from the brain, which operates on vastly different principles. Some philosophers do, and there are various arguments for and against it (Churchland 1986). But even so, it wouldn't be parapsychology, because it would have nothing in common with neuroscience.

There's something else about psychic phenomena that makes them extremely difficult to accept: Psi has a distinct inability to make sense.

Hypotheses in neuroscience, as in biology, require accumulation of considerable evidence before they're taken seriously. That's because of stochasticity, or randomness; not only is there variability in individuals, but even neurons of the same individual are not easily predictable. (We say they are stochastic.) You need a lot of evidence to show something is true in such cases, otherwise you could be misled by normal statistical fluctuations (Cohen and Stewart 1998).

Since overwhelming statistical evidence is sometimes hard to come by, new ideas are often judged to be worthy of pursuit, or not, by how well they fit in with principles that are already well established. It's the plausibility factor, and psi just isn't plausible.

Evolution, for example, is a cornerstone of all biology, as well as related disciplines such as neuroscience. If psi exists it must have evolved, and since it would confer an enormous advantage, you'd think everyone would have psychic power. Not so. That requires an explanation.

Furthermore, if psi really exists, how come psychics haven't been able to loot the Las Vegas casinos? Dean Radin, a prominent psi researcher, claims that there are too many distractions in casinos, and that the odds are too great for weak psychics (Miller 1998). If you accept that, then how about the stock market? In particular, what about derivatives like options and futures? With that kind of leverage, you could make a fortune if you knew what would happen in advance, even if you're not always right on the mark. And you can place your bets using the Internet in the comfort and silence of your own home, or while engaged in a seance if that's your thing. Why aren't psychics rich? That requires an explanation. Like cooks and meals, too many explanations spoil a hypothesis, and improbability builds up quickly.

It's not that new ideas are necessarily bad. A new idea should always be considered, even if there's no evidence for it, in which case it's called "speculative." If the new idea runs counter to an empirical fact or widely accepted theory, and thus requires an explanation, then it must be considered with suspicion. It's called "anomalous." If the new idea runs counter to many facts and accepted theories, as does psi, it probably won't get much consideration. It's called "absurd."

## Alternatives

But there's another factor in the evaluation of ideas: are alternatives available? Can you explain the phenomenon in some other way?

That's one of the main things that seem to bother skeptics of psi: there's no definition of psi except a negative one. No one knows what psi is, so it can only be inferred to exist by eliminating every alternative explanation. And that's hard to do (Hansel 1989).

It's particularly hard for neuroscientists to do, since there are often alternative explanations for many phenomena in this discipline. Neuroscience experiments are often difficult. I've already mentioned the stochasticity, which is of course a problem. But there are other difficulties. Often the subject of the experiment isn't a reasonably behaved mechanical device, as in physics, or a set of compounds as in chemistry, but a very complex object—the mammalian nervous system, for example. Results can be hard to interpret, and can all too easily lead you down the wrong path.

One recent example involved electrical recordings of stimulated neurons in the cat visual system. Many cells fired together, as if each knew what the others were doing—well beyond what would be expected from typical neural communication. Spooky action at a distance? Not quite; it was found to be due to the vertical refresh signal of the computer that generated the visual stimuli (Wollman and Palmer 1995). The neurons were responding en masse to this signal, which had nothing to do with the intended stimulus.

Experiments involving animal learning provide many more examples. Getting an animal to learn something can be frustrating; you can't just give instructions in the appropriate language. Even more frustrating is trying to figure out exactly what the animal actually learned. Often what it learned isn't the same thing as what you tried to teach it.

Let's say you show monkeys a visual stimulus (say, a picture of a butterfly), then present a series of visual stimuli, one of which is the same butterfly again. You then reward the monkey for responding to the second butterfly. Have you taught the animal to respond to the one stimulus in the series which matched the original stimulus?

Careful. In reality the monkey may be simply responding to any repeated stimulus. If you show a stimulus twice in the series—even if this repeated stimulus is different from the original—the monkey might respond (Miller and Desimone 1994).

Rats are also notorious for developing alternative strategies to perform a task. "They learn every way to do a task except the way you want them to," an exasperated graduate student once told me.

## Priming and Psychics

So interpreting how an animal thinks is tricky. Is the same true for people? One interesting phenomenon is that people are often influenced by nonconscious memories. This is known as priming (Tulving and Schacter 1991). You see or

hear something, maybe something that's not important enough at the time to form a conscious memory of, but then later your judgment and decisions may be subtly affected by it—and you don't know why, because the memory isn't conscious.

Priming is probably responsible for a lot of "intuition." It may also explain, in some cases, reports of "psychic" ability. A "telepathic" transmission may simply be due to subconscious stimuli or memories. The same mechanism may be responsible for the claimed ability to predict the future.

I once saw the future, about three seconds in advance. I had a witness, too, who widely and persistently proclaimed the fact. He was one of my roommates when I was in the Air Force; one morning at 5:00, just before an important mission, I jumped out of bed and ran across the room to turn off an irritatingly loud alarm clock a few seconds before it was set to go off. (It had just begun to ring as I reached it.)

My roommate, who had been awake, was astounded. So was the rest of the squadron, when they were told. So was I, until late that evening, when I did some experimenting with the clock and discovered that three seconds before the alarm went off, there was a barely audible click. Of course I never told anyone.

One final problem is that people love patterns and go out of their way to find them. It's not easy to produce anything that is totally random. There always seems to be some sort of pattern in a set of data or ambiguous stimuli, if you look at it long enough. That's indeed true for many of the random number generators used in biological and neuroscientific research. Often they are so-called *pseudo* random number generators, since they are generated by sophisticated algorithms running on computers (which are deterministic, not stochastic devices).

The problem is that the algorithms sometimes produce patterns, which can be detected by people. Sometimes detection is difficult and takes a while; sometimes not (I once had a UNIX computer which had a pre-written routine to generate

"random" numbers—but the sequence of numbers it generated invariably alternated between even and odd). The same applies to other "random" events, whether generated by computers or other machines.

People certainly aren't good random number generators. Write down a series of numbers as quickly as you can, and try to make the series random. Review the numbers afterward; do you see a pattern?

People with the same experiences tend to see the same patterns in what is supposed to be random stimuli—which isn't psychic transmission, but simply a common aspect of nervous systems.

So what about paraneuroscience? I'm afraid it's going to be tough to start one. Not that there isn't any "anomalous" data; the problem is there's too much. And too many plausible ways, completely unrelated to psi, to explain it.

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