

Contributions by Physics and Psychology to Parapsychology*

William G. Roll and Bryan J. Williams

Abstract: There are two principal types of parapsychological or *psi* occurrences, extrasensory perception (ESP) and psychokinesis (PK). ESP has two components, a receiver of information, usually a person, and a distant source of information that can be another person or an inanimate object. PK also has a receiver and a source, only the source is a person and the receiver is an inanimate object that is distant from the person. Psi then deals with correlations between *pairs* of objects, one of which is a person (or animal) in present time, while the other is at a distance and is thereby *non-local*. ESP is a *response* to non-local objects, and PK is *action* on non-local objects. ESP is divided into telepathy and clairvoyance. Telepathy is a response to a non-local person, and clairvoyance is a response to a non-local physical object or scene. ESP is further divided into precognition and retrocognition, apparent response to events in the future and past, respectively.

There are two main methods of exploration, one called quantitative and the other qualitative. The quantitative method deals with sequences of ESP and PK directed at sequences of random targets. The method uses statistical averages to determine if there is psi in the data. If the outcome is statistically significant, psi is inferred. The method is especially suited for experiments with unselected subjects, that is, people with no apparent aptitude for psi, and has been in the forefront of parapsychology since the work of J. B. Rhine in the 1930s. The qualitative method, which is typically used for subjects with supposed psi abilities, such as psychics, relies on observation of the subject's responses rather than on statistics, is rare. Experiments in remote viewing, which combine the quantitative and qualitative methods, are relatively frequent.

Beginning with Walker (1975, 1979, 1985), statistical psi has come under the roof of quantum physics, which has had the effect of normalizing what was formerly thought to be paranormal. A principle theme of Walker is that quantum physics, like psi, is based on consciousness, a theme that Jahn and Dunne (1987) have further explored. Because psi involves living beings, Josephson (2002) and Josephson and Pallikari-Viras (1991) have proposed a biological quantum theory for psi. We discuss the various types of psi in light of this theory, and then explore the relationship between psi and the brain. We propose that the function of the right brain hemisphere includes interaction with non-local objects, while the left hemisphere is mainly concerned with local objects, as in sense perception and bodily behavior. It is well known that familiar forms of perception and behavior are functions of the left hemisphere, and there is some indication that ESP and PK may be functions of the right hemisphere. Neuropsychological studies of two male psychics indicate that their ESP is associated with structural and functional anomalies in the occipital and parietal regions of the right hemisphere, and a study of a gifted female PK subject suggests a neuronal process that may underlie her ability.

Keywords: extrasensory perception, psychokinesis, non-locality, biological quantum theory, right brain hemisphere

1. Introduction

On January 28, 2008, University of Hertfordshire psychologist Richard Wiseman was quoted in the London *Daily Mail* as saying: "I agree that by the standards of any other

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area of science remote viewing is proven, but begs the question: do we need higher standards of evidence when we study the paranormal? I think we do...Because remote viewing is such an outlandish claim that will revolutionise the world, we need overwhelming evidence before we draw any conclusions. Right now we don't have that evidence" (Penman, 2008, p. 28).¹ In remote viewing, the mental images of the subject are correlated with a distant scene, without sensory signals from the scene.²

Remote viewing is a form of extrasensory perception (ESP), one of the two main types of psychic, or psi,³ phenomena, the other being psychokinesis (PK). ESP and PK both entail interaction with *non-local* objects, that is, objects that are outside the range of the body and its sense organs. Traditional science and everyday living are mostly concerned with local objects, a fact that makes it difficult for people like Wiseman to suppose that you could interact with non-local things.

ESP has two components, a receiver of information that can be a person or an animal, and a non-local source of information that can be another organism or an inanimate object. PK also has a receiver and a source, only the source is a person and the receiver is a non-local inanimate object. ESP is divided into telepathy, clairvoyance, precognition, and retrocognition. It is uncertain if these reflect different processes, but they are widely used. Telepathy is to interact with a non-local organism, usually another person (Bem & Honorton, 1994); clairvoyance is to interact with a non-local inanimate object or scene (as in remote viewing); precognition is to interact with something in the future (Honorton & Ferrari, 1989; Radin, 1997, 2004a); and retrocognition is to interact with something in the past (Barrington et al., 2005; Roll, 2004; Schwartz, 1978/2001), which is therefore also non-local. PK is of two types, micro-PK and macro-PK. Micro-PK is not directly observed but is inferred from the non-random behavior of falling dice or balls, and now mostly from the non-random output of random event generators (REGs) (Bösch et al., 2006). Macro-PK consists of the movement of large-scale objects and is directly observed (Roll, 1972/2004, 1977).

There are two main ways to explore psi, one is known as quantitative and the other as qualitative. The quantitative method deals with sequences of ESP or PK attempts directed at sequences of random targets. The method analyzes statistical averages to determine if psi is present in the sequences. If the outcome is statistically significant, psi is inferred. The method is especially suited for experiments with unselected subjects, that is, people with no apparent aptitude for psi, and has been in the forefront of parapsychology since the work of J. B. Rhine (1937) in the 1930s. In recent years, automated test equipment is often used to run experiments and assess results, which reduces, but does not prevent, error, fraud, and other extraneous factors. The qualitative method is typically used for studies of people who excel at ESP or PK. The method does not use statistics or automated equipment, but seeks to exclude data that could be due to non-psi. Experiments in remote viewing combine the quantitative and qualitative methods, and have often been successful. Such tests are now popular in parapsychology.

ESP and PK typically occur within *pairs*, one member of which is a person in the present, while the other member is at a distance and is non-local. Except for the fact that one member of the pair is non-local, ESP and PK are about common physical objects. Before the 1970s, it seemed impossible that there could be a physical process that links people with non-local objects, but this has now become possible, not because of

discoveries in parapsychology but because of discoveries in physics that transformed physics to quantum physics, and in the process may account for ESP and PK.

2. Quantum Physics and Psi

Walker (1970, 1975, 1979, 1985) has pointed to several principles of quantum mechanics that also occur in statistical psi, and seem to demonstrate that this type of psi is a variant of quantum mechanics (or vice-versa). First, quantum mechanics, like psi, deals with nonlocal events. Second, there is no transfer of energy in quantum mechanics, similarly there is no transfer of energy in psi. Third, quantum mechanics is based on statistics, which is true also for statistical psi. Finally, Walker cites a more complex reason for considering quantum mechanics to be on par with psi. Quantum effects only occur in an experiment when observed, until then they are only possibilities; the same may be said about psi. He then notes that the observer in quantum physics is a conscious living being. This seems obvious but the term “consciousness” is antithetical to many physicists, although not to all. Robert Jahn (in Jahn & Dunne, 1987, pp. 220 – 347), who belongs to the latter group, has developed a theory of consciousness that starts with quantum physics (Section 11).

The famous thought experiment of Einstein, Podolsky, and Rosen (EPR) (1935) shows how quantum effects are produced. Briefly stated, EPR says that when a fundamental particle is split into X and Y, the two parts will remain correlated regardless of how far apart they are from each other. If part X is sent to detector 1, which is being observed by experimenter 1, and part Y is sent to detector 2, which is not connected to detector 2 in any way, the experimenter at detector 2 will of necessity observe Y for the other part (conversely, if Y is registered by detector 1, detector 2 will show X).

Before X or Y is measured on detector 1, each of the particles in the system represent both X and Y with equal probability, a condition known as quantum superposition. When experimenter 1 measures X on detector 1, the system is no longer in superposition, but has “collapsed” to X1 Y2. Things that are in superposition have no definite location and cannot be measured.

It should be added that although Einstein was a co-author of EPR, he was convinced that the conclusion of the experiment was wrong, in other words that quantum theory itself was wrong. He believed that if detector 2 showed Y, it would be irrelevant if detector 1 showed X. The idea that detector 1 and experimenter 1 could affect detector 2 and experimenter 2, across space without any signal from 1 to 2, Einstein (1949) called “spooky action at a distance.” If spooky means psychic, then this is in fact what is observed. Einstein was convinced that reality is independent of human observation, an assumption that is basic to classical physics and common sense.

However, a mathematical restatement of the predictions of the EPR experiment by John Bell (1964) showed that if Einstein’s local realism theory was correct, then the statistical predictions of quantum theory would be negated. The issue could not be addressed by another thought experiment, but required actual testing. Aspect et al. (1981, 1982a, 1982b) were able to do this in three experiments conducted 18 years later, and the results confirmed the predictions of quantum theory and negated Einstein’s local theory. This provided empirical evidence to suggest that “quantum entities that have interacted with each other remain mutually entangled” (Polkinghorne, 2002, p. 80). Since that time, quantum entanglement and the EPR paradox have been independently

verified using multiple particles (Häffner et al., 2005; Pan et al., 2000; Sackett et al., 2000) and distances of several kilometers (Marcikic et al., 2004; Tittel et al., 1998). More importantly, the effects of quantum superposition and entanglement have been experimentally extended to large-scale objects (Friedman et al., 2000; Julsgaard et al., 2001), raising the possibility that such effects could occur on the level of human existence. Vedral (2008) states: “In less than a century, researchers have moved from distrusting entanglement because of its ‘spooky action at a distance’ to starting to regard it as an essential property of the macroscopic world” (p. 1004).

Something else needs to be said about EPR. The correlated pairs are conjugate or orthogonal, in that X and Y represent electrons with opposite spin, if the spin of X is clockwise, then the spin of Y is counter-clockwise. Other conjugate pairs are position and momentum and energy and time. However, “inherent limitation on the simultaneous specification of such conjugate properties” (Jahn & Dunne, 1987, p. 211) leads to the Heisenberg uncertainty principle.

Going back to EPR, if the spins of the two electrons are the same, the two are indistinguishable and represent the indistinguishability principle, thereby falling outside the framework of EPR. The indistinguishability principle leads to the exclusion principle according to which two interacting electrons cannot exist in the same state. The two principles are not only theoretical but are seen in actual chemical reactions (*op. cit.*, pp. 222 – 223).

Extension of quantum mechanics to the vast assemblies of interacting atoms found in humans and their environment require statistical methods, and statistical rules reflect the basic probability units that govern elemental units.

3. Josephson’s Biological Quantum Theory

Josephson⁴ (2002) suggests that quantum physics is not the ultimate theory of nature, but “merely a theoretical account of the phenomena manifested in nature under particular conditions” (p. 43). He points to an inconsistency in quantum physics because “‘the observer’ is a system that, while lying outside the descriptive capacities of quantum mechanics, creates observable phenomena such as wave function collapse...” (p. 43). “Wave function collapse” is when a quantum entity, which is in superposition and thereby unobserved, is observed and enters the world of human reality. He brings in the idea by Stapp (1981, 1985) that “reality evolves by a mind-like process, decisions being made by this process being apparent...in physics as the collapse of the wave function” (Josephson, 2002, p. 43). Considerations like these, made Josephson and others (Conrad et al., 1988) propose a biological version of quantum theory. In a table we reproduce here (Table 1), the left side shows the characteristics of conventional quantum physics, and the right side shows the corresponding characteristics of biological quantum physics.

Table 1. Proposed Identification of Entities Described in Terms of the Respective Frames of Reference of the Quantum Physicist and the Biologist (from Josephson, 2002)

<u>Language of Quantum Physics</u>	\leftrightarrow	<u>Language of Information Processing [Biology]</u>
quantum subsystem, describable by a state vector	\leftrightarrow	signal or form
particle type	\leftrightarrow	type of signal or form
state vector representing a specific possibility	\leftrightarrow	signal representing a specific possibility
collapse of state vector	\leftrightarrow	decision process
measuring instrument determining state of subsystem	\leftrightarrow	structures which determine and regulate signals or forms

Josephson notes that although physics and biology differ, they may be derived from the same process. “Quantum mechanics would then be the specific theory that emerges as a good description in some domain of nature, whilst more biological accounts would be relevant in some other phenomenal domain. We thus envisaged the possibility, highlighted in the writings of Bohr (1958), that biological and quantum accounts of nature might, like the wave and particle accounts, of certain phenomena, be complementary rather than, as with the conventional view, the first being entirely derivative of the latter” (see more about Bohr in Section 11).

It should be noted that sense perception, unremarkable though it seems, appears to represent biological quantum entanglement. This is because perception consists of a pair of conjugate elements, a physical object and the perception of the object, an event in consciousness. The correlation between a mental and a brain event represent another pair of conjugate events. Following this train of logic, two conjugate pairs, consciousness-object and consciousness--brain, form the basis of perceived reality.

Josephson (2002) writes, “Biology concerns itself largely with processes, while quantum mechanics is fundamentally concerned with quantifiability. As already noted, these aspects may be complementary and also incompatible. Quantum mechanics achieves its quantitative aspects by an averaging process, but this may lead to neglecting characteristics of individual cases which may be relevant in the case of a biosystem, provided we are prepared to recognise the uniqueness of the individual case instead of treating all cases of a class as if they were the same. This may point to a fundamental inadequacy in the quantum point of view, as we illustrated by consideration of a classical gas where the options exist for statistical or deterministic accounts, there being an epistemology acknowledging only statistical properties or properties described in terms of macroscopic fields, and also an epistemology involving an entirely new area of knowledge relating to individual particles. One might then see the ruling role of quantum mechanics as an artefact of our scientific culture which, in the domain where quantum

indeterminism is of importance, has chosen to be blind as regards individual cases, concern with understanding the many possibilities having distracted us from concern with what the one that actually corresponds to reality for us. Josephson and Pallikari-Viras (1991) suggested that this difference may be important in connection with the understanding of paranormal phenomena” (pp. 43 – 44).

Josephson (2002) notes that “the observer *poses questions of nature*, which in the process of answering them becomes better defined” (p. 44, author’s italics). But quantum mechanics does not indicate what questions are asked. However, for the observer “who may be asking a question (or wanting to know something)...it is not a convenient fiction but reality” (p. 45). The alternative is to focus on the *observer*, which means “paving the way to a new science” (p. 45). The new science is biological quantum physics, of which psi research is part. Appendix 1 has an outline of the development of physics from Newtonian physics to biological quantum physics. The present paper is an attempt to apply biological quantum physics to specific findings in psi research.

4. Psi Entanglement Between Objects in the Present

There are two ways to study ESP and PK, studies of cases that appear spontaneously in everyday life, and experimental research. While experiments are needed for reliable evidence, the meaning of the phenomena for most people is when they turn up in their lives.

Studies of Spontaneous Telepathy: Three surveys of spontaneous cases of telepathy have been made (Persinger, 1974, Pt. 1; Sannwald, 1963; Stevenson, 1970a). The findings are summarized in Table 2.

Table 2. Relation Between Agent-Percipient Pairs in Spontaneous Telepathic Experiences (% Cases)

Survey	N Cases	Close Family	Parent-Child*	Spouses*	Siblings*	Distant Family	Friends	Strangers	Owner-Animal	Females	Males
Persinger (1974)	164	53	61	25	14	16	14	9	8	76	24
Sannwald (1963)**	500	50	56	29	15	10	28	3	-	70	30
Stevenson (1970a)**	160	63	54	22	24	7	27	11	-	53	47

* Sub-categories of the “Close Family” cases

** Based on values cited by Persinger (1974, Pt. 1, pp. 82 – 83). By these values, the combined percentage for the Sannwald cases is 91%. The combined percentage for the Stevenson cases is 108%.

Persinger’s case collection consists of 164 telepathic experience reports published in *Fate* magazine from 1965 to 1969. Sannwald’s approximately 500 telepathic cases were personally collected from people responding to a 1950s German newspaper survey, and Stevenson had examined 160 cases collected by the British, American, and Boston Societies for Psychical Research from the late 1800s to the early 1900s.

There is a notable consistency across the three studies with respect to the large amount of cases involving close family. When further divided into three sub-categories (marked by single asterisks in Table 1), parent-child pairs are found to make up the largest amount of close family cases. The findings are consistent with a more recent survey of spontaneous ESP by Feather and Schmicker (2005), according to which 40% of their cases involved close family, 33% involved the percipient’s own self, 14% involved bonded pairs, and 13% involved strangers (p. 37). It appears that shared genes and/or shared reinforcement history facilitate ESP. At the same time, the pairs are conjugate.

Parent-child pairs represent different generations, and the spousal pairs are of opposite gender (but not necessarily in the population as a whole). Strangers share genes to a lesser degree and, insofar as they belong to the same social group, share reinforcement history, but again to a lesser degree.

A very small amount (8%) of Persinger's cases involved instances of apparent telepathy between a non-human animal and a human owner. Cases of animal psi are not unheard of, but they tend to be less common than human psi. Animal ESP studies have been reviewed by Morris (1977) and Sheldrake (1999), and studies of possible PK influences on animal behavior have been reviewed by Braud (2003, Ch. 4). One may note that humans do share some genes in common with other animal species, so the possibility that cross-species psi entanglement could occur from time-to-time is not ruled out.

There are many more cases with female than male percipients in the studies of Persinger and Sannwald, which, as Persinger suggests for his own cases, may in part be due to a greater willingness of women to communicate their experiences than men. Stevenson's cases show a more even distribution of gender. There is a peculiarity in the studies of Persinger and Sannwald, insofar as the sibling pairs and the stranger pairs are roughly equivalent, while in Stevenson's study, there are decidedly more sibling pairs than stranger pairs. However, not too much should be made of these differences unless they are repeated by other studies. With respect to the sex differences, it should be noted that in the three studies the information was volunteered by the participants, which may have contributed to the substantially larger reports by female than by male participants.

Table 3 shows the findings of the three studies in relation to the circumstances in which the experience occurred.

Table 3. Event Circumstances in Spontaneous Telepathic Experiences (% Cases)

Survey	N Cases	Circumstance		
		Death	Crisis	Trivial
Persinger (1974)	164	54	25	21
Sannwald (1963)*	500	43	36	21
Stevenson (1970a)*	160	41	41	18

* Based on values cited by Persinger (1974, Pt. 1, pp. 83 – 85)

The figures show a clear preponderance of death and crisis cases, the combined percentages being 79, 79, and 82 percent, respectively. "Crisis" in this context means "physical crisis." In contrast, an average of 20% ($(21+21+18)/3$) of the cases are about trivial, non-serious events.

Summary: The surveys of telepathy cases show little, if any, difference between the percentages of close versus distant family pairs, However, with respect to close pairs, the percentage for parent-child pairs are considerably larger than those for spousal and sibling pairs. This seems consistent with a biological theory of ESP because the survival of the family and species depend more on parent-child pairs than the other two. With respect to the events perceived, the percentages for death and crisis overshadow trivial events, probably because death and crisis are the most significant events a person may face. The percentages again seem consistent with a biological theory.

Experimental Results: The experimental tests are of two types, studies of ESP correlations between subject pairs, and tests that examine brain correlations between distant pairs without conventional ESP testing. In an early study of the former type, Stuart (1946) reported significant ESP scoring ($.001 \leq p \leq .05$) in a series of card tests with a pair of identical twins and four couples who were married or engaged. Similarly, Rice and Townsend (1962) obtained a 26% hit rate (chance: 20%; $p = .00002$) with four married or engaged pairs. When compared to the hit rate (14%) of subject pairs composed of strangers, there was a highly significant difference ($p = 7 \times 10^{-9}$).

The idea was further explored in telepathy studies with the ganzfeld, a procedure used to induce a non-ordinary state of awareness.⁶ In an examination of 17 non-automated ganzfeld studies conducted from 1974 to 1981, Bem and Honorton (1994) found that agent-percipient pairs who were friends achieved a significantly higher hit rate than pairs composed of strangers (44% vs. 26%; $p = .025$). In a later series (1983 – 1989), this time composed of 11 automated ganzfeld studies, Bem and Honorton (1994) also found that friend pairs had higher hit rates than stranger pairs (35% vs. 29%), but the difference was insignificant.

Hyman (1985), a well-known critic of psi research, dismissed the ganzfeld work, citing several methodological shortcomings, while Honorton (1985) upheld the findings. Instead of remaining in opposed camps, Hyman and Honorton (1986) got together and ironed out their differences. They concluded, “We agree that there is an overall significant effect...that cannot reasonably be explained by selective reporting or multiple analysis” (p. 351). At the same time, they developed a stringent set of methodological guidelines for new ganzfeld research.

Following the Hyman-Honorton guidelines, Broughton and Alexander (1997) and Alexander and Broughton (2001) did two automated ganzfeld studies with genetically and emotionally related subject pairs. The results are shown in Table 4.

Table 4. Average Hit Rates for Subject Pairs in Broughton & Alexander (1997) and Alexander & Broughton (2001)

Study	Parent-Child			Siblings			Spouses			Friends			Strangers		
	Trials	Hits	% Hits	Trials	Hits	% Hits	Trials	Hits	% Hits	Trials	Hits	% Hits	Trials	Hits	% Hits
B&A 97	23	10	43.5	7	5	71.4	21	4	19.0	64	10	15.6	36	11	30.6
A&B 01	9	4	44.4	1	1	100	4	1	25.0	12	2	16.7	11	4	36.4

The table suggests that genetically-related pairs tend to produce the highest hit rates, with sibling pairs the most notable at 71.4% (chance: 25%), followed by parent-child pairs at around 44% (it is important to note that the sibling hit rate is based on a relatively small amount of trials, which suggests that it could be an inflated value resulting from small sample size). When combining the results of the genetically-related pairs in their first study, Broughton and Alexander (1997) found a significant hit rate of 50% (15 hits out of 30 trials; $p = .006$). The finding that stranger pairs did better than spousal and friend pairs is inconsistent with the other studies and difficult to interpret.

In general, ganzfeld studies indicate the importance of pre-established connections within subject pairs for psi. This led Dalton (1997, p. 74) to regard prior relationship between subjects as a predictor of ESP success in the ganzfeld. In summary, the experimental results are largely consistent with the findings from the studies of spontaneous cases.

Brain Correlation Studies: At the present time, correlation studies rarely employ ESP tests but focus directly on brain correlates between subject pairs that are spatially separated and out of sensory contact.⁷

In the first study of this type, Duane and Behrendt (1965) tested 15 pairs of identical twins, using simultaneous EEG monitoring. While one twin opened and closed their eyes in a lighted room to evoke the alpha wave (8 – 12 Hz), the other twin, sitting relaxed with eyes open in a room six meters away, was monitored for the presence of alpha. Two of the 15 pairs were found to display similar alpha activity. However, this correlation was based on visual inspection of the EEG records, and not on statistical evaluation. Nevertheless, the study was published in *Science*, and is one of the few psi studies to appear in that journal. The remaining research in this section is based on statistical assessment.

In a study that looked for EEG correlations between genetically-related subject pairs, Persinger et al. (2003) collected simultaneous EEGs from four pairs of siblings who were blindfolded and wore earplugs. Significant brain wave changes ($p < .01$) in the theta range (4 – 7 Hz) were recorded from the frontal and occipital lobes of the percipient's brain while the agent, who was located in a separate electromagnetically (EM) and acoustically shielded room, was stimulated with 1 micro-Tesla magnetic pulses around the head.

The remaining brain wave studies focus on emotionally connected subjects or on subjects who were connected emotionally as well as genetically. Grinberg-Zylberbaum et al. (1994) divided their subjects, who were unknown to each other, into two groups. One group spent 20 minutes together in silent meditation to form an empathetic bond, while the other group did not. The members of each pair were then separated and placed in EM-shielded rooms 14.5 meters apart. At random intervals, the agent was stimulated with a train of bright light-flashes to induce EEG voltage changes while the percipient rested in the other room, their EEG being monitored. For 25% of the bonded pairs, voltage changes were noted in the percipient's EEG that were significantly correlated with those occurring in the agent's EEG from the light-flashes ($p < .009$). Because this finding applies to only one-fourth of the subjects, the probability value needs to be multiplied by four, reducing it to $4p = .036$.

In a study that also compared emotionally close pairs with stranger pairs, Kittenis et al. (2004) found that, for the emotionally-close pairs, significant increases in alpha rhythm were observed in the EEGs of both the agent and the percipient during the times when the agent was visually stimulated with light-flashes ($p < .023$). This effect was not observed in the EEG data for the stranger pairs. Examination of brain maps derived from the subjects' EEG data indicated that the pattern of activation in the occipito-parietal region (involved in visual processing) of the percipient's brain had followed, in close temporal sequence, the pattern of activity observed in the agent's brain during light-flash stimulation.

Two studies employed functional magnetic resonance imaging (fMRI) to look for concurrent brain correlations between emotionally-bonded pairs. In the first study (Standish et al., 2003), a male and female pair, who had known each other for two years, spent ten minutes together in silent meditation before going through blood-oxygen level dependent (BOLD) fMRI scanning, alternating as agent and percipient. While the percipient relaxed in the scanner, the agent viewed a flashing checkerboard stimulus at random intervals on a monitor in the adjacent control room. To prevent visual cues, the

percipient's eyes were covered with opaque goggles and the window to the scanning room was covered with an opaque shield. When the female was percipient, her fMRI scan showed significant activation in her visual cortex ($p < .001$) when the male agent was exposed to the flashing stimulus. No such activation was noted in the male's fMRI scan when he was percipient. In the second study (Richards et al., 2005), a male-female pair who had known each other for six years went through BOLD fMRI scanning. In contrast to Standish et al.'s (2003) result, the female's fMRI scan showed a significant decrease in activation in the visual cortex ($p < .017$) when the male agent was visually stimulated. When the roles were reversed and the female was stimulated, the male's fMRI scan showed no significant change.

Two EEG correlation tests have been done with subject pairs who were related genetically and also bonded emotionally. Wackermann et al. (2003) tested related-bonded pairs, unrelated pairs, and control pairs, with the latter receiving no light-flash stimulation. Voltage changes were found in the EEGs of both the related-bonded pairs and the unrelated pairs during flash stimulation, and both were significantly different from the EEGs of the unstimulated control pairs ($p < .01$). Similarly, Radin (2004b) tested 11 pairs who were genetically and emotionally related. The pairs were separated by 20 meters, with the percipient in an EM- and acoustically-shielded room. At random intervals, the agent was shown a live video image of the percipient on a monitor, as a means to provide a visual stimulus and to encourage mental connection. Voltage changes in the percipient's EEG were found to significantly correlate ($p = .0005$) with those occurring in the agent's EEG when the agent was stimulated with the percipient's video image. No such correlations were found during control sessions, when the experiment was run without subjects.

Although all of these brain studies may be described as telepathic, there is no evidence that the agents transmitted anything to the percipients. The only thing that is apparent from them is that there are significant correlations between the brains of two spatially isolated subjects. Grinberg-Zylberbaum et al. (1994) suggest that EEG correlations within subject pairs are akin to the correlation between two parts of a particle that have been separated as in the EPR thought experiment (Section 2). Wackermann et al. (2003) also recognize the similarity of the EEG correlations to quantum entanglement.

Summary: An ESP correlation study (Stuart, 1946) with a pair of twins and four married or engaged couples was significant but lacked a control group. In a later study (Rice & Townsend, 1962), also with four couples, the result was significant and the difference in scoring between the couples and pairs of strangers was also significant. The two studies, which involved subjects in an ordinary state of consciousness, were followed by more extensive work with the ganzfeld (Bem & Honorton, 1994). This work indicated that pairs composed of friends achieved higher scores than pairs who were strangers. On the other hand, two later ganzfeld studies (Alexander & Broughton, 2001; Broughton & Alexander, 1997) found that stranger pairs did better than spousal and friend pairs, but sibling and parent-child pairs did best of all. The remaining research dispensed with ESP tests, and instead examined direct brain correlations, either of genetically related pairs (Duane & Behrendt, 1965; Persinger et al., 2003), emotionally-related pairs (Grinberg-Zylberbaum et al., 1994; Kittenis et al., 2004; Richards et al., 2005; Standish et al., 2003), or of pairs who were related emotionally and genetically (Radin, 2004b; Wackermann et al., 2003). Combining the eight brain studies, genetically-related pairs

show more EEG correlations than the unrelated pairs, the emotionally connected pairs show more correlations than pairs who lacked this feature, and the genetically and emotionally connected pairs show more correlations than the controls. In general, the experiments were consistent with the spontaneous case studies.

When the eight studies are divided according to brain conditions, one study (Persinger et al., 2003) showed theta activity, which is often seen in sleeping subjects and in waking subjects in an altered state of awareness. The theta rhythm was intentionally induced in the agent's brain by magnetic pulse exposure. Two studies (Duane & Behrendt, 1965; Kittenis et al., 2004) showed alpha activity, which is often associated with a relaxed state of awareness, and is easily affected by light exposure. The other three EEG studies (Grinberg-Zylberbaum et al., 1994; Radin, 2004b; Wackermann et al., 2003) were concerned with event-related voltage changes in the brain. The remaining two studies looked into the brains of the percipients using fMRI, revealing activation of the visual cortex during the times that the agent received light-flash stimulation, a brain response consistent with a visual stimulus. For ESP studies of psychics, see Section 8.

5. Psi Entanglement with Objects in the Future

Precognition appears to entail perception of something in the future that does not yet exist, and therefore cannot be perceived. This contradiction may be resolved by recourse to EPR. In EPR, an observer detects one of the two halves of a particle and thereby terminates its superposed state, allowing the second half to be observed. To apply the model to precognition, it may be noted that a perceived event is composed of a conjugate pair, the physical event and the perception of the event. The two parts coalesce in the specious present, thereby forming the observed environment. However, an event in the future is in superposition and thereby only a possibility unless and until it is observed. In other words, the percipient would not inspect a pre-existing physical event, but would observe one of the many events in superposition, thereby transforming a potential event to an observed event. From this point of view, the precognitive experience itself would create the event that is subsequently observed, thereby "verifying" the precognition. According to this scenario, precognition is, literally, self-fulfilling prophesy. Which of the possible events is chosen, we may surmise, depends on the needs of the percipient and perhaps also on other factors.

Spontaneous Cases: Surveys of precognitive experiences found in spontaneous case collections suggest that the majority of such experiences manifest as dreams. In a study of 349 experiences authenticated and published in the *Journal of the Society for Psychical Research*, Saltmarsh (1934) found that 68.1% were dreams. Similarly, Louisa Rhine's (1954) survey of her 1,324 precognition cases indicated that 68% were dreams. A similar trend has been found in other surveys (Stevenson, 1970b, pp. 197 – 198; Van de Castle, 1977, pp. 473 – 481).

Four investigators (Persinger, 1974, Pt. 1; Saltmarsh, 1934; Sannwald, 1963; Stevenson, 1970b) have explored the relationship between pairs where precognitions reportedly occur (Table 5) and the themes of the experiences (Table 6).

Table 5. Percipient's Own Self & Others Involved in Spontaneous Precognitive Experiences (% Cases)

Study	N Cases	Self	Others	Close Relatives*	Distant Relatives*	Friends/Acquaintances*	Strangers*
Persinger (1974)	128	23	77	67	18	14	1
Stevenson (1970b)**	125	49	51	61	-	22	17

* Sub-categories of the "Others" cases

** Based on recalculated values given by Persinger (1974, Pt. 1, p. 145)

Persinger's cases show more precognitive experiences involving others, whereas Stevenson's self and other cases are roughly even. When further sub-divided into four sub-categories (marked by single asterisks in Table 5), the precognitive experiences involving others are found to be most often about close relatives in both studies. Like telepathic experiences, this may suggest the importance of genetic similarity for psi.

Table 6. Themes in Spontaneous Precognitive Experiences (% Cases)

Study	N Cases	Death	Crisis	Trivial Events
Saltmarsh (1934)*	349	35	26	39
Sannwald (1963)**	500	43	37	20
Persinger (1974)	128	48	41	11
Stevenson (1970b)	125	47	21	32

* Based on values cited by Stevenson (1970b, p. 201)

** Based on values cited by Persinger (1974, Pt. 1, pp. 141 – 142)

Saltmarsh's cases come from precognitive reports published in the *Journal and Proceedings* of the Society for Psychological Research from the late 1800s to the early 1900s.

As with telepathic experiences (Section 3), spontaneous precognition is mostly about death and crisis, the combined percentages being 61%, 80%, 89%, and 68%, respectively for the four studies. A reading of the cases of Feather and Schmicker (2005) reveals that they reflect the same trend (Ch. 7 & 8). In contrast, an average of 25.5% $(39+20+11+32/4)$ of precognitive cases are about trivial, non-serious events.

Experimental Studies: The first precognition tests were attempts to predict the future order of ESP cards or the die-faces that would turn up by rolling dice, but it is now standard to use computer-based, truly random event generators (REGs) to select targets. A meta-analysis by Honorton and Ferrari (1989) of the three types of precognition test conducted from 1935 to 1987 (309 studies by 62 researchers) gave a highly significant p -value of 6.3×10^{-25} .

The studies of "presentiment" by Radin (1997, 2004a) introduce a new paradigm. Instead of having his subjects predict the event outcomes on an REG, Radin monitored their physiological responses *prior to* viewing the target images, hence the term *presentiment*. The images were of two types, emotional (e.g., sexual and violent scenes) and neutral (e.g., landscapes and household items). Immediately before an REG selected an image to be shown on a monitor, the subject's electrodermal response was recorded by means of a finger electrode. The monitor in front of the subject then randomly displayed either an emotional image or a neutral image, with the latter acting as a control. Radin reports that about three seconds prior to viewing the emotional images, his subjects showed a significantly larger ($p = .008$) electrodermal response than before

viewing a neutral image, a sign of unconscious emotion. Bierman and Radin (1997, 1999), and Spottiswoode and May (2003) successfully replicated the results.

Bierman and Scholte (2002) made a preliminary attempt to explore the functional brain correlates of presentiment using fMRI. Brain scans with BOLD contrast were collected from each of their ten subjects while they viewed random sequences of emotional and neutral pictures. The combined brain scans of the subjects indicated increased functional activation of the entire visual cortex. For female subjects, significantly higher activation ($p < .05$) was observed in the four seconds *before* emotional pictures were shown, as compared to neutral pictures. For male subjects, significantly higher activation ($p < .05$) was observed prior to viewing erotic pictures only. When Bierman himself was the subject, his fMRI scan also showed significantly higher activation ($p < .01$) in his visual cortex prior to viewing the erotic pictures.

Summary: Spontaneous precognition usually takes place in dreams, the experiences mostly occur within family pairs, and the experiences are often about death, followed by physical crisis. The indication that emotion is an important factor in spontaneous precognition is supported by presentiment experiments. Two of the experiments showed activation of the visual cortex at the time the presentiment occurred, which is consistent with the fact that the targets used were pictures.

6. Psi Entanglement with Objects in the Past

When you have a vivid experience, the experience persists in your brain as a memory. There are also place memories as when you visit a place where you have been before and remember things that happened there, things that may have been entirely forgotten until your return. This is a well-known kind of memory. But there is a form of place memory that is less well known, probably because it seems to be reserved for psychics. It turns out that if you visit a place you have never been, but where someone else has been and experienced something there, you may “recall” his or her experience, especially if it was important to the person. This procedure is known as *psychometry* and is a form of *retrocognition*, that is, perception of past events.

Retrocognition is regarded as a form of ESP, but it is also an everyday occurrence. When you see the sun, this is retrocognition because the sun you see is not the sun as it is now but the sun as it was about eight minutes ago, the time it takes for light to travel from the sun to the earth. The moon is closer and therefore only a few seconds into the past, but even things right in front of us are not sensed precisely when they happen but a miniscule fraction of a second before. In other words, everything we perceive is retrocognition.

Psychometry differs from ordinary retrocognition, which is really sense perception because in psychometry information about something in the past is acquired without the eyes and the other senses, that is, psychometry is extrasensory perception. The process is somewhat similar to precognition insofar as both entail information about something that does not now exist. In another respect the two are very different; a precognized event is not real before it happens; until then it is in superposition, but in psychometry, the event has already happened and therefore cannot be altered.

Bohm (1980) discusses brain memory vis-à-vis memory in inanimate objects in terms of enfoldment, his word for entanglement. Memories, he says, are part of the brain’s “implicate” order that is “enfolded” within the “explicate” brain structures. He

then adds, “the world of familiar physical structures has room in it for something like memory in the sense that previous moments may leave a trace though this trace may change and transform almost without limit. From this trace (e.g., in the rocks) it is in principle possible for us to unfold an image of past moments, similar in certain ways to what actually happened” (pp. 207 – 208). From this it follows that “the explicate and manifest order of consciousness is not ultimately distinct from matter and that the two may only be different aspects of one overall order” (p. 208). A pair that is composed of consciousness and matter is conjugate, that is, a case of “pairs that epistemologically exclude each other” (Polkinghorne, p. 33) and thereby may exhibit quantum entanglement. But before quantum entanglement appeared on the scene, it was difficult to suppose that an inanimate physical object could give rise to mental images of the past, and few experimenters have paid attention to the phenomenon. There is also the problem that psychometry seems to be reserved for psychics while present-day researchers prefer unselected subjects.

As performed by psychics, psychometry is an especially interesting kind of ESP because the impressions are often detailed and because the ability does not seem to weaken with repetition. The cases where the police asked Noreen Renier (2008) to help them solve crimes are examples of psychometry that cannot easily be explained away either in terms of cheating, chance coincidence, or sensory cues because the police would only ask her help if they did not know the appearance or circumstances of the perpetrator and hoped she might help them. A detective, Tom Atkinson, sent Renier a bloodstained earring from a woman who had been stabbed to death (pp. 103 – 108). No clue about the murder had been found, and the woman’s mother had asked Atkinson to contact the psychic. With the earring in one hand and the phone in the other, Renier “closed my eyes, targeted my mind on the earring, and all of a sudden, it was like I was looking in a mirror. I could see the murderer washing his hands and combing his hair. I could see him perfectly. I saw the tattoos on his arm, I saw his whole face, and I described him over the phone” (p. 104). The detective asked if Renier could see what was happening to the woman. This brought her back, “and this time I was being murdered by the tattooed man. He was holding me tight by the wrists...as the razor-sharp knife tore into my body over and over and over” (p. 104). Atkinson said he first thought Renier had learnt about the crime, “then I realized that the information she had, no one knew” (p. 107). Speaking of the murderer, he said, “his physical appearance was as she described. His social background was as she described. The tattoos she described were accurate” (p. 107).⁸ Renier chose the better cases for her book, but it would take an immense number of trivial cases to overshadow the published cases because the events she perceived were so specific.

As reported by Tenhaeff (1955, 1972), the police in Holland often used the psychic, Gerard Croiset, to help them solve crimes and find missing persons. Johnson (1984) did a brief test with Croiset to see if he could distinguish between identical cards associated with four of his patients (Croiset was also a psychic healer). Each patient was given a polyethylene bag with six blank cards and asked to carry this for a period of time. In preparation for the experiment, Johnson placed the four sets of six cards in identical envelopes together with strips of audiotape with different frequencies, in order to make later identification of the cards possible. One envelope with its card and tape was removed from each set of six envelopes and used as a key. After the remaining 20 envelopes had been randomized, Croiset tried to match them against the four keys. He

obtained a score of 11, whereas five is expected by chance, a statistically significant result ($p < .01$). It seemed that Croiset responded to differences between the cards from their having been carried by different people.

LeShan (1968), who had been asked by the family of a missing man to help find him, obtained his pen and handed it to the medium, Eileen Garrett. She reported several correct impressions about the man, including his present location. The description of crisis, sudden death, and other violent events was a main theme for Senora de Zierold (Pagenstecher, 1922; Prince, 1921). For the subjects of Osty (1923), the easiest retrocognition is death, and the one where they make the fewest mistakes. Björkhem (1943) said that his subjects tended to focus on emotionally significant events, followed by recent events (p. 57). The most outstanding psychometrist of all time may be the Polish industrialist and psychic, Stefan Ossowiecki, whose ability was confirmed in tests by several renowned researchers between the two World Wars (Barrington et al., 2005; Schwartz, 1978/2001, Ch. 2).

Over the past 50 years, there have been four studies of psychics using standard methods of statistical assessment, the brief test by Johnson (1984) of Croiset, which was significant, and three tests by Roll (1966b, 1966c) of two supposed psychics, the total score being insignificant. There have also been four tests of unselected subjects. Marsh (1958) compared ESP scores of subjects who were provided with personal items from the target person, with the scores of a control group who received items from others, and found improved scoring by the experimental group after they received the objects and none by the control. Similarly, Kirby (1959) obtained significant ESP results when the subject knew the target and his location, and none when the persons and places were unknown. On the other hand, Osis (1966), who compared close with remote connections, found no significant difference between the two.

Parra and Argibay (2006) did a series of experiments where they compared the results of standard ESP tests with the results for psychometry. Their 71 subjects were non-psychic, but most had reported psi experiences. The objects were 100 identical leather-and-metal key rings that had been acquired by four assistant experimenters in a gift shop and carried by them for 15 days (i.e., each had 25 key rings). The 71 subjects each did four sessions where they handled four key rings in each, recording their impressions about the assistants, who then scored them for accuracy. The targets in the ESP tests were pictures concealed by cardboard and placed in front of the subjects. The result of the psychometry test was insignificant, while the ESP tests gave a significant result ($p = .005$), the difference between the psychometry and ESP results also being significant ($p = .008$).

Summary: Psychometric impressions by psychics are usually about events that are emotionally significant, in particular death, violent occurrences, and the distress due to someone close being missing.

7. Psychokinesis and Psi Entanglement

There are two types of PK, micro-PK and macro-PK, both consisting of action on non-local objects. Micro-PK probably occurs in nature, but can only be demonstrated by experiments that are based on the statistical analysis of sequences of random physical events. At first these sequences were produced by die throws, but now random event generators (REGs) are commonly used to produce targets for PK. To test for PK, a

sequence of random numbers is automatically produced by an REG while a subject attempts to influence the random distribution of these numbers through mental intention, such that they begin to be distributed in apparent non-random patterns. If the REG data show a significant correlation with the subject's intention, then this is taken as evidence of micro-PK (Bösch et al., 2006). Like quantum mechanics, micro-PK is about averages, not individual events.

In contrast, macro-PK consists of observable events, such as movements of objects, which do not require probability statistics to be detected. Both types of PK represent purposeful behavior. In tests of micro-PK, the purpose is set by the experimenter (e.g., Jahn and Dunne, 1987, pp. 87 – 148; Schmidt, 1976, 1987, 1993). This is also true for tests of macro-PK (see below), but in spontaneous macro-PK, the purpose is internal to the person and has to be inferred.

Spontaneous Macro-PK: Reports of spontaneous macro-PK are divided into two types, one consisting of single incidents, the other of repeated incident. The latter are called recurrent spontaneous psychokinesis (RSPK), or “poltergeist,” and are described below. Louisa Rhine (1963) thought that this division was artificial, and that only one process is involved. Her study consisted of analyses of (usually) single spontaneous macro-PK events reported in letters sent to the Duke University Parapsychology Laboratory. At the time, the only previous study was by Flammarion (1922), a French astronomer and psychical researcher.⁹

Rhine's criterion for accepting a report was that it be provided by an apparently sane and serious person. This enabled her to include a wider range of experiences than had been possible for earlier researchers, such as Flammarion, who required that the reports be corroborated by a person other than the one to whom the events happened.

Rhine was cautious about making conclusions based on spontaneous cases of psi, and she was especially cautious about PK because she had so few cases. By 1963, she had only 178 PK cases, whereas there were more than 10,000 cases of ESP. A summary of Rhine's cases is shown in Table 7.

Table 7. Summary of L. E. Rhine's (1963) Natural PK Cases

<i>PK Event</i>	<i>Person Dying</i>	<i>Person Deceased</i>	<i>Person Living</i>	<i>Total</i>
Clock suddenly stops or starts	37	3	9	49
Object falls off shelf, wall, or mantle	30	13	22	65
Object breaks or explodes	14	5	2	21
Lights turn on or off	4	11	2	17
Doors open/shut, lock/unlock	6	7	1	14
Object rocks or shakes	4	7	1	12
	95	46	37	178

Note: “Person” refers to the person at a distance to whom the PK event is attributed, who Rhine referred to as the “target person.” The “Person Living” category also includes the five cases in which there was no apparent target person involved. Adapted from Table 1 in Rhine (1963).

The largest number of Rhine's PK cases consisted of pictures, vases, statues, and other objects falling from walls or shelves. This is followed by a large number of clocks stopping or starting, an event not typically reported in cases of RSPK. Rhine's cases also differ from RSPK cases in that there is an absence of sounds in the former, while the latter sometimes include reports of percussive or explosive noises. The lack of sound effects in Rhine's survey is simply due to her exclusion of sounds; she left them out

because the reports did not enable her to determine their source, and therefore, whether they were physical or purely subjective. In contrast, nearly all (18 out of 23) of Flammarion's (1922) cases were sound incidents. He thought that these sounds were physical because they were often heard by more than one person, and because they were usually loud.

In 141 (79%) of Rhine's 178 cases, the distant person was either dying (95%) or deceased (46%) at the time of the event. In 30 of Rhine's clock cases, the clock had a meaningful significance to the distant person, and in 20 cases, the stopping of the clock coincided with the distant person's death. In our culture, the stopping of a clock is a common symbol for death. A symbolic significance is also evident for about half (31) of the 65 falling object cases; the objects were either pictures of the distant person in crisis (18 cases), or the object were relevant to him or her (13 cases). In the 21 cases where an object broke or exploded, three of the objects were associatively linked to the distant person (and one to the person who observed the event). Finally, in the 12 cases where an object rocked or shook, six of the cases involved a chair, bed, or some other object connected with the distant person. In all, nearly half (47.6%) of the 147 objects disturbed in these cases was significant to the distant person and sometimes symbolic of the crisis befalling him or her.

This symbolic or meaningful aspect of events is also seen in RSPK. In one case (Roll, 1968), bottles which suddenly lost their screw caps with explosive sounds seemed suggestive of the bombers and rockets that the ostensible agent saw in the Rorschach cards presented to him. In another case (Roll, 1970), where the incidents seemed to reflect a conflict between the agent and her mother, the first occurrence was the breaking of the mother's coffee cup. In brief, reports of recurrent, as well as non-recurrent, cases often include events that may be symbolic or meaningful to the people involved, but in both kinds of cases, there are also incidents that seem to have no particular significance.

An issue of special interest to Rhine was whether the PK agent was the observer of the distant event or the distant person. In 46 (26%) of her 178 cases, the distant person was deceased. If this person were the PK agent, this could mean that he or she had survived death and was announcing that fact by producing a PK event for the observer, a possibility that would be consistent with the close emotional bond between the two. But in two cases, the emotional bonds were one-sided; in one case the distant person was the Pope, in the other a movie actress, neither of whom knew the observers and therefore would not be expected to send them a message. There are also cases in which no one was involved other than the observer (Rhine, 1963, p. 95). One was a woman who had just finished reading an article on a crippled orphan who was turned away from a hospital, when a book on surgery for children fell from its shelf in the next room (pp. 95 – 96). She wrote: "I don't know when my mind has ever been so stirred and perhaps that is why it happened. At any rate, as I put my magazine down and got up from my kitchen chair, we heard a sound in the living room. There was no one there – not even the dog or cat, for I looked. The sound had been made by a book's falling out of the bookcase by itself. When I picked it up, I could hardly believe my eyes; for it was a book on surgery for children" (p. 96). In three of the five cases where only the observer was involved, this person "...was definitely in an emotional state when the effect occurred" (p. 95); in the other two, the psychological conditions were not mentioned. Although Rhine leaves the door open to the survival hypothesis, she is more inclined toward the theory that the causes are due to the PK of the observer.

Rhine's collection includes 19 cases where her informants describe two or more occurrences, a typical feature of RSPK. Seven of her recurrent cases show another feature that is often found in RSPK, the tendency for the same object to be repeatedly involved. For instance, a grandfather clock stopped at the death of a man's father, and then again several years later at the death of his mother.

Like single cases of PK, RSPK is a rare phenomenon; a survey by Roll (1977) found only 116 cases going back to 1612. But on the other hand, a single case of RSPK may consist of more than 100 incidents. The cases in Roll's survey were limited to reports in serious journals or books, and to cases with witnesses of the events in addition to the people around whom they happened. A comparative analysis by Gauld and Cornell (1979) of cases of RSPK and haunting is not restricted in these ways, and has many more RSPK reports.

RSPK and haunting are often confused, but are entirely different, as Gauld and Cornell (1979) conclude. RSPK is associated with people, haunting with places; RSPK is primarily diurnal, while haunting is primarily nocturnal. RSPK is characterized by physical occurrences, hauntings by sounds that imitate human activity, such as footsteps and moving furniture without anything being disturbed (p. 178). It now appears that the reason haunting occurs in special areas is the presence of anomalous geomagnetic and other physical fields (Persinger, 1974, Part II, pp. 179 – 185; Radin & Roll, 1994, 1996; Roll et al., 1992, 1996; Roll & Nichols, 2000; Roll & Persinger, 2001). The fields may affect the brain functioning of occupants to produce apparitional experiences, and may also produce the electrical disturbances and temperature changes often experienced at such sites. Haunting may be a physical phenomenon without psi components.

Although RSPK is spontaneous, this does not preclude observation under controlled conditions. In two cases, investigators on the scene set up experiments, using objects of the type that had previously moved as targets; one was the case of Julio Vasquez (Roll, 1972/2004, Ch. 9 & 10; Roll & Pratt, 1971), the other was the Tina Resch case (Roll, 1993; Roll & Storey, 2004, pp. 200 – 204). The method was possible because Julio and Tina tended to produce occurrences when they were being observed, apparent examples of attention-seeking behavior (see below). The same was true for the case of Roger Callihan (Roll, 1972/2004, Ch. 11; Roll & Stump, 1969), but the investigation of the latter was cut short by his mother. The three cases are summarized in Appendix 2.

Summary: Rhine's PK cases are mostly associated with distant individuals who are dying or deceased, highly emotional events both to these individuals and also to the connected persons in whose presence the apparent PK incidents occur, and who therefore may be their source. In this respect, Rhine's cases resemble those for spontaneous telepathy (Section 4) and precognition (Section 5).

RSPK as Escape Behavior or Attention-Seeking Behavior: Like single cases of macro-PK, RSPK always happens in proximity to someone, a fact that immediately makes one think of fraud. Some cases are in fact found to be fraudulent (e.g., Roll, 1969; Roll, 1972/2004, Ch. 4), and others include fraudulent events along with occurrences that seem genuine (Roll, 1993, pp. 474 – 481; Roll & Storey, 2004, pp. 97 – 99), while still others seem to be due to an overactive imagination (Roll, 1972/2004, Ch. 8). Barrett (1911) may have been the first to propose that poltergeist occurrences are due to the person at their center. This person is now known as the RSPK agent, and is often a child. The median age, in the seven cases investigated by Roll and colleagues, is 14 years, the same as in a survey of older reports (Roll, 1977, pp. 386 – 387). However, the

phenomena are not restricted to children. In one case (Roll, 1970), the agent was a 32-year-old woman, and in a case in Iceland (Roll, 1972/2004, pp. 88 – 93), the agent must have been in her 70s. There may be no age limit to RSPK, but there does seem to be a lower limit; there are no known reports of RSPK around children under the age of five. There are also no reports of occurrences that center around animals. RSPK may take a developed brain, as well as an awake brain because there are few, if any, occurrences when the agent is known to be asleep (also see Owen, 1964).

Behavioral Aspects of RSPK: Under ordinary circumstances (Cooper et al., 2007, Ch. 1), a child shows escape behavior, for instance, by throwing a tantrum when told to go to bed, and shows attention-seeking when drawing attention to him or her self by noticeable behavior. It usually begins with events that disrupt family life and destroy its possessions, in other words, escape behavior. If RSPK is escape behavior, then there must be something from which to escape. Psychological studies of the RSPK agents, which were done in five cases, indicated extreme conflict between the agents and the members of the households whose objects were disturbed or destroyed. In one case (Pratt & Roll, 1958; Roll, 1968), the conflict was between a boy and his parents; in another between a girl and her parents (Roll & Storey, 2004, pp. 52 – 95); in a third between a boy and his grandmother (Roll, 1969); in a fourth between a grown woman and her mother (Roll, 1970), and in the fifth case (Roll & Pratt, 1971), between a 19-year-old male and the head of the firm where the destruction took place.

If visitors, including investigators, arrive on the scene and remain for a while, escape behavior may be replaced by attention-seeking behavior because the events tend to occur when the visitors are watching the agent and may be a response to being viewed (cf. Vasquez, Callihan, and Resch cases in Appendix 2). In other words, escape behavior has been replaced by attention-seeking behavior. But when the visitors leave, there may be a return to escape behavior; the events are again destructive.

Physical Aspects of RSPK: Before Roll began his exploration of RSPK, older cases (Roll, 1977) had indicated that the number of occurrences diminishes with increased distance from the agent. To check this observation and do it more accurately, Roll (1968, 1969, 1971; Roll et al., 1973, 1974; Roll & Storey, 2004, p. 222) used a tape measure to measure the distances between the agents and the objects prior to their movements, whenever this was known. There were six such cases, all showing a statistically significant reduction in the number of occurrences with increased distance. Such declines may be due to the inverse square function or the exponential decay function. The inverse square function describes the dispersal of energy, such as light, from a point source into the environment, while the exponential decay function describes the attenuation of the energy by the medium through which it travels. Since both functions may apply to RSPK, Joines constructed a formula that combines the two functions and applied it to the three cases for which the evidence for RSPK was best. The data from the Vasquez and Resch cases (Figs. 1 & 2 in Roll & Joines, 2001) fit exactly the same equation with the same constants while the Callihan data (Fig. 3 in Roll & Joines, 2001) fit the equation with different constants.⁹

Light is converted into heat, that is, to kinetic energy when it travels through air and water, and thereby conforms to the exponential decay function. Because RSPK also represents kinetic energy, it seemed possible that the energy was generated by light, but this light would have to be in the invisible spectrum and its source would have to be the agent. It seems that special individuals may generate light. In an unpublished test in the

1970s, Joines and Roll found that psychic healer Karen Getsla had built up electrical charge on her body and emitted photons from her hands when she brought them up to the photomultiplier tube and concentrated on sending healing energy. This resulted in a wave with a wavelength peak of 385 nanometers, which dropped off to progressively lower values. Since the visible spectrum consists of wavelengths between 700 and 400 nanometers (red to violet), 385 nanometers is just beyond visible in the violet to ultra-violet range. This is close to visible, and there were occasions when a faint light was seen to emanate from the psychic in a darkened room. Several years later, Baumann, Joines, Kim, and Zile (2005) discovered a young yoga devotee who was able on two occasions to emit photons from his hands by a method said to awaken the body's *kundalini* energy. During the two sessions, he produced two large spikes on the photomultiplier, the first of 205,535 counts per half-second, the second of 42,411 counts, with the baseline being less than 20 counts. Each count corresponds to 4 to 5 photons of ultraviolet light at 385 nanometers, the same frequency Joines and Roll had measured from Karen Getsla. The spikes were accompanied each time by a negative voltage surge of more than -1.0 volts from an electrode fitted to the man's upper left arm, which caused the controlling program to freeze. Prior to this, the highest negative voltage had been -0.074 volts. The study then had to be terminated because the effort resulted in the spitting up of blood by the subject and an "unbelievable burning inside" (p. 221), although an infrared camera showed his body temperature to be only 98 degrees Fahrenheit.

This research led Joines and Roll (2007) to a theory according to which the source of RSPK is infrared waves from nerve cells in the skin. Activation of dermal nerve cells is known to cause the electrodermal response, an unconscious emotional response that may register ESP (Braud, 2003; Radin, 1997, 2004a). In RSPK, dermal nerve cells would act as transmitters of energy rather than receivers.

Electromagnetism generated by the body is far too weak to make an object move, but a quantum mechanical process exists that may allow this to happen. According to Blanchard et al. (1959, p. 188), the state of an object, including its location, is determined by four quantum numbers, one of which refers to the spin of an electron. In principle, all four numbers may be changed by the delivery of the proper message from the agent to object, but changing the direction of an electron's spin only requires a very small amount of energy for an interaction to occur. If an interaction does occur, the object may become unstable in its present location and may immediately move to another location where it is again stable. This change may be brought on by applying a magnetic field (*op cit.*, p. 182). It has been found that the onset of RSPK tends to occur during increased geomagnetic disturbances (Gearhart & Persinger, 1986; Roll & Gearhart, 1974), and that RSPK agents often show symptoms of complex partial epilepsy (CPE) (Roll, 1977, pp. 400 – 401), which can produce involuntary surges of electric power in brain cells that are communicated to other parts of the body. The RSPK of Tina Resch (Appendix 2) may be a case in point. She did not have CPE but showed symptoms of Tourette's syndrome (Persinger & Roll, 1993), which also consists of bodily symptoms due to electrical discharges in brain neurons. Further discussion of the possible neurobiological correlates of Tina's RSPK is presented in Section 9.

Summary: Several pieces of the RSPK puzzle have come together for a meaningful picture. The pieces are of two kinds, behavioral and physical. Psychological studies of the agents indicate that the occurrences reflect two familiar features of behavior, escape behavior and attention-seeking behavior. The physical features of the occurrences also

point to known processes. The finding that there is a gradual decline of incidents with distance from the agent, and that this decline conforms to the inverse square function and the exponential decay function, is seen with many other natural phenomena. Studies of two gifted subjects indicate that some people may generate streams of photons, and a theory from quantum physics indicates that such streams may cause large-scale objects to move. Finally, there is evidence that an RSPK agent produced such streams, thereby supplying energy for escape and attention-seeking behavior in her environment.

Experimental Macro-PK: Four gifted subjects have shown experimental evidence for macro-PK. The first is Daniel Dunglas Home, born 1833 in Scotland. At nine he was brought to America by an aunt. His mother died when he was 17, and shortly afterwards poltergeist-like raps were heard and pieces of furniture were seen to move about. When exorcism by local clergy failed, his aunt turned him out of the house, and he was taken in by neighbors. The phenomena continued, and he learnt to turn them on by entering a dissociative state, thereby becoming a trance medium. He and his “spirits” became widely known, and he held séances for Napoleon III, the Tsar of Russia, and other dignitaries, who reported the sliding about of chairs, the tilting of tables, the playing of an accordion without anyone touching the keyboard, and the levitation of furniture and even the medium himself. The phenomena brought Home to the attention of Sir William Crookes (1839 – 1890, 1974), a renowned physicist who discovered thallium and invented the radiometer. The events usually happened in full light, with Crookes witnessing several of them, but he focused on Home’s supposed ability to affect the weight of objects, presumably because it was fairly easy to test scientifically. Crookes constructed an apparatus that consisted of a mahogany board (36 x 9.5 x 1 inches), one end of which was suspended from a spring balance that was attached to an automatic recorder. The other end of the board rested on a fulcrum that allowed the end with the spring balance to move either up or down, indicating respectively a reduction or increase in the force of gravity. Immediately above the fulcrum Crookes attached a large water-filled container. Finally, he positioned a perforated copper vessel, independently supported, at the top of the container and 5.5 inches above the bottom. The experiment called for Home to dip the fingers of his right hand in the copper vessel to affect the weight of the board, which means that he was connected to the board only by the water. In a test for an increase in gravity, there was a downward movement of six pounds.

The second subject is Rudi Schneider, born 1908 in Austria. He became a medium, producing physical phenomena when in trance and controlled by “Olga,” who was thought to be a dissociated part of Schneider, but which he experienced as a separate entity. Schneider was investigated by von Schrenck-Notzing in Germany, but it was left to Osty, a French physician and psi researcher, and his son, an engineer, to conduct scientific experiments (Osty & Osty, 1931 – 1932; Gregory, 1985, Ch. 5). In 1930, when Schneider arrived at Osty’s laboratory in Paris, his ability had waned to the point that “Olga” could only affect light objects, such as handkerchiefs. To prevent interference from the medium, Osty placed a handkerchief on a table, which was protected by an infrared beam. If the beam was interrupted, an alarm would ring and a flash camera would take a photo. The alarm rang on several occasions and the flash came on, but the photos showed nothing and the handkerchief stayed in place. Instead of having Schneider try to move the handkerchief, Osty asked him to send “Olga” into the infrared beam. This resulted in repeated occultation, when Schneider indicated that “Olga” was moving through the beam. The occultation reached a maximum of 75, but was usually 5

to 35 percent. Osty concluded three things, 1) the substance that materialized was transparent to white light because it could not be photographed; 2) it was under the medium's control because he announced its materialization beforehand; and 3) it dissipated in white light because the occultation ceased when the camera flash came on. The flash did not disturb the medium, and the substance was recovered shortly afterwards.¹⁰

Osty then discovered that the substance was preceded by a striking increase in breathing from Schneider's normal breath rate of 17 cycles per second to more than 400 per second, but the amplitude of his respiratory movements was not corresponding shallower (a polygraph, which was connected to a belt fastened around his chest, recording the frequency and amplitude of his breathing). Then "...the entirely surprising fact emerged that the oscillations of the absorptions of the infrared were twice as numerous as the respiratory cycles; in other words, each oscillation of the absorption corresponded with an exhalation and an inhalation" (Gregory, 1985, p. 196). However, the fast breathing was not associated with a change in pulse or blood pressure, nor did it always occur when the substance materialized. Osty speculated that the medium had earlier discovered an association between rapid breathing and the phenomena, and that he used the procedure more often, when his ability waned.

The third subject was Nina Kulagina, who was discovered by the Russian physiologist and parapsychologist Leonid Vasiliev. With help from Vasiliev, Kulagina was able to develop PK ability that was limited to moving small objects, such as plastic boxes or bottles, and rotating a compass needle. Keil et al. (1976) summarized the experiments by Russian and Western researchers. A test by Keil and Fahler (1975, 1976), which they filmed, involved a 10-cm Plexiglas cube with an open side. They suspended a ping-pong ball inside by a spring, so that it hung about 22 mm. from the bottom. Kulagina, who had not been told about the device, was seated with the open side of the box facing her and caused the ball to move to the bottom and remain in contact with it while sliding toward the open edge.

The fourth subject was Felicia Parise, a New York medical technician who saw a filmed demonstration of Kulagina's PK and was inspired to try moving small objects. After several weeks, she was able to do so, and was also able to rotate a compass needle. She then went to the Institute of Parapsychology in Durham, NC, where Watkins and Watkins (1974) had constructed a device consisting of a compass mounted inside an electronic metal detector. Sealed packets of photographic film were placed underneath the detector, and at distances of up to three meters away. While Parise was seated in front of the compass, the needle slowly turned 15 degrees and stopped, while the signal from the detector responded as if it contained several pounds of metal. Parise then moved to a far corner of the room, but the deflection of the needle did not change, even when a magnet was brought near. When removed 1.2 meters from its initial test location, the compass needle slowly returned to normal, but again deflected 15 degrees when the compass was replaced in that location, becoming insensitive to a magnet once more. It took about 25 minutes for the needle to go back to normal. The film was strongly exposed at the test location, and decreased at successive distances.

Summary: The tests of Home by Crookes demonstrated that the medium could affect the weight of the target, a wooden plank, and an experiment by Keil and Fahler supported the observations by other researchers that Kulagina could cause the movement of small objects. The focus of Osty's test of Schneider was a kind of burglar

alarm that would go off when he touched the target. When the alarm went off and the simultaneous photo showed nothing, the infrared beam that protected the target became the target. This was repeatedly occulted by an unknown substance controlled by Schneider. The test of Parise by the Watkins seemed to indicate that the deflection of the compass needle was caused by electromagnetism because the metal detector responded as if metal was placed in it, and because a charge remained in the area where Parise initially applied the energy. The exposure of the film was also consistent with an electromagnetic energy directed at the compass.

Experimental Micro-PK: The most revealing tests of micro-PK have to be the REG experiments by Schmidt. In an early test (Schmidt, 1976), he generated and recorded REG data with no one being present to observe the data until the actual experiment, when they would be played back to the subject either as auditory clicks through headphones, movements of a needle, or a combination of the two. The subject would then attempt to influence the data such that they produced the desired outcome, for instance, more frequent or louder clicks, or more frequent needle movements to the right than to the left. Schmidt (1976) found non-random displays in the pre-recorded data in three experiments, ranging in significance from $p = .05$ to $p = .001$. In other tests, Schmidt (1987) found that when subjects attempted to influence the outcome of pre-recorded REG data that had been first been shown to another person, they were unable to do so because the wave function had collapsed for these data, as predicted by quantum theory, and the outcome was therefore already determined. In another test, Schmidt (1987) first made a copy of the magnetic tape that held the REG data, then locked the original tape into a safe and gave the copy to the subject, who attempted to affect it while playing it back. After receiving back the subject's copy of the tape, Schmidt retrieved the original from the safe, compared their outcomes, and found that they were exactly the same, both showing a non-random pattern in the desired direction. Because the two tapes were duplicates, they would be expected to show a non-local correlation or entanglement according to the Bell theorem (Section 2). The theorem says that if a quantum system is divided, the two parts will continue to interact in spite of obstacles or distance in space-time. Because the REG data had already been collected, it seemed that if successful, the subjects would have had to direct their influence *backwards* to the time when the data were generated, that is, they would show evidence of retroactive psychokinesis (retro-PK).

In some of the experiments, the pre-recorded data were mixed with data being collected and displayed in real time to allow for a comparison of the two; there was no significant difference between them. Schmidt (1993) arranged to replicate the retro-PK results in five experiments that were supervised by independent observers to preclude error; the combined result was significant at $p = .0001$. Replications by others followed, and a meta-analysis by Bierman (1998) of all retro-PK experiments since the 1970s gave a highly significant result at the $p = 10^{-8}$ level.

Quantum theory provides an alternative to the apparent "backwards in time" effects of retro-PK. According to quantum mechanics, the behavior of subatomic matter is governed by probability. According to the Heisenberg uncertainty principle, subatomic particles do not have definitive location in space-time until detected; in other words, before detection, the particles are in superposition. Which location a particle will occupy when observed, can only be determined at the moment of observation, at which time the particle occupies the point that is most probable based on prevailing conditions. As an

analogy, imagine the particle as a coin; a coin has two possible states when flipped, heads or tails. Before being flipped, the coin is in superposition insofar that as it is both heads and tails, with both outcomes being equally probable. When the coin is observed after it is flipped, it is now either heads or tails, which is equivalent to the situation in quantum mechanics. Schmidt (1987) suggests that when a system is in superposition, it may be affected by PK and enter reality. By this interpretation, retro-PK is not PK acting backwards in time, but delayed PK on unobserved data (Schmidt, 1987, Stapp, 1994).

Summary: Schmidt has demonstrated a basic quantum mechanical principle by the relatively simple procedure of using observed versus unobserved REG data sequences as targets. His results suggest that the mind plays a central role in defining physical reality, an idea consistent with Josephson's (2002) suggestion, following the ideas of Stapp (1982, 1985), that "...reality evolves by a mind-like process, decisions made by this process being apparent in...physics as the collapse of the wave function" (p. 43). In other words, the observer plays an active role in defining reality (Section 2).

8. Neurobiological Correlates of ESP

Like the Roman god Janus, the brain has two hemispheres that face in opposite directions. Cerebral lateralization studies suggest that the left hemisphere is the principal seat of language production and comprehension (Geschwind, 1990), and that it deals with local objects accessible to the body's sensory-motor system. In contrast, the right hemisphere may be specialized for processes that are concerned with broader spatial and temporal features, such as visuospatial processing (Vogel et al., 2003) and the mental tracking of time (Battelli et al., 2007; Lewis & Miall, 2006; Morin et al., 2005). This specialization in spatial and temporal processing may allow the right hemisphere to access nonlocal objects outside the reach of the body's sensory-motor system, as in ESP. The association of the right hemisphere with ESP is weakly indicated by a few studies with unselected subjects.¹¹

Studies also suggest that ESP is associated with the alpha brain wave. In a review of ESP-EEG studies, Morris (1977, pp. 705 – 707) found that "The most consistent finding was that alpha abundance tended to be positively correlated with high ESP scores, especially for subjects preselected for expertise at the production of one or both" (p. 706). Given that the alpha wave is usually associated with a state of relaxed awareness, this finding would be consistent with the observation that relaxation is often an ESP-conducive state (Braud, 1975; Honorton, 1977, pp. 451 – 457).

Studies of people adept at ESP (i.e., psychics) may be more revealing about the roles of the right hemisphere and alpha activity. In depth studies have been done with two psychics, Lalsingh Harribance and Ingo Swann (Alexander et al., 1998; Persinger, 2001; Persinger et al., 2002; Roll & Persinger, 1998; Roll et al., 2002).

Lalsingh Harribance was born on the island of Trinidad in the West Indies, to a Hindu family, but he converted to Christianity and took the name Sean. He had difficulties with language acquisition as a child, which delayed his public education until he was seven years. While in school, he said he did not memorize the lessons, but instead "knew" them simply by feeling or touching the texts, an ability that brought him to the head of his class when he was eleven. He had his first conscious psi experience at about the same time. Throughout his career, Harribance has had notable success in a number of experimental tests for ESP, most of which involved identification of cards hidden from

view (Child & Kelly, 1973; Morris et al., 1972; Palmer, 1998; Roll & Klein, 1972; Stump et al., 1970).

The subjective features of Harribance's ESP experiences are interesting. He says that his experiences are often marked by a series of images that move rapidly across his upper left visual field (which is controlled by the right hemisphere). He often hears a voice in his right ear when giving a psychic reading, which he attributes to Christ. Because the left hemisphere (which controls the right side of the body) is specialized for language, this experience makes good sense and is consistent with his Christian belief.

In an exploratory study using quantitative electroencephalography (QEEG), Alexander et al. (1998) collected data from 19 electrode sites on Harribance's scalp while he engaged in five ESP tasks (two photo-based psychic readings, two ESP card-calling tests, and a remote viewing trial). Topographic brain maps based on the QEEG data indicated that alpha activity was present in the paraoccipital region of both brain hemispheres during the tasks, with the most alpha appearing in the right parietal region (electrode site P4).¹² The presence of alpha during ESP was consistent with a previous ESP-EEG study with Harribance (Morris et al., 1972), in which significantly more alpha activity was found in the occipital region during high-scoring test runs as compared to chance runs ($p < .005$). A comparison of Harribance's resting baseline QEEG data with a reference EEG database of age-matched control individuals further indicated that his brain showed deviations in the frontal, temporal, and occipital regions of both hemispheres.

In 1997, Harribance was invited to Laurentian University in Canada for a full neuropsychological assessment, additional EEG monitoring, and a neurometabolic examination using single-photon emission computed tomography (SPECT). The neuropsychological tests indicated mild hypofunction in his left prefrontal region, left superior temporal gyrus, and right occipito-parietal region. A neurological screening showed no signs of clinical pathology or complex partial epilepsy (Roll & Persinger, 1998; Roll et al., 2002).

Rather than being associated with any kind of trauma or damage, these mild functional anomalies may be more consistent with structural changes occurring in the area around these brain regions. This is suggested by the fact that Harribance is currently able to read and speak English at a level exceeding his education, despite the hypofunctioning of his left prefrontal lobe and left superior temporal gyrus. A structural change in the left superior temporal gyrus would also be consistent with Harribance's reports of hearing a voice in his right ear. In addition, Harribance shows above average finger gnosis (the ability to tell which finger is being stimulated) for a man his age, an ability that may be relevant to the use of his fingers in receiving impressions from photographs and other objects. The cortical area that usually represents finger gnosis is the occipito-parietal region (Roll & Persinger, 1998, p. 205), which also showed hypofunction. In the case of trauma or damage, these abilities would likely be greatly impaired or completely absent.

EEG monitoring was done while Harribance performed psychic readings for ten people by touching their photographs inside opaque envelopes. The reading statements that were judged to be moderately to very accurate for the people in the photographs were associated with more alpha activity than inaccurate statements ($p < .0001$). The statements that were judged moderately accurate were associated with the highest increase in alpha activity, whereas the inaccurate statements were associated with the

lowest amount of alpha (Roll & Persinger, 1998, pp. 206 – 207; Roll et al., 2002, pp. 209 – 211).

A SPECT scan following a 45-minute psychic reading showed increased uptake of the injected tracer in the medial parietal (paracentral) lobule of Harribance's right hemisphere, which extended into his right superior parietal lobule. No such increase was observed in a SPECT scan of the resting baseline condition. In addition, the scan showed a small localized anomaly in the right hemisphere at Brodmann's area 44 (Alexander et al., 1998, p. 10; Roll et al., 2002, p. 211). The functional significance of this small area, located adjacent to the Sylvian fissure, is currently unknown.

To test the sensitivity of his brain to external physical stimuli, the temporal-parietal region of Harribance's right hemisphere was exposed to 1-microTesla complex magnetic fields while he rested in a shielded chamber. When he was exposed to a magnetic field pattern that simulates the "burst-firing" pattern of neurons, Harribance reported experiencing the same Christ-like presence he associates with his ESP (Roll & Persinger, 1998; Roll et al., 2002).

Ingo Swann is best known for his success in tests of remote viewing (Puthoff & Targ, 1976; Targ & Puthoff, 1977). In 1998, he was invited to Laurentian University for a neuropsychological assessment, EEG monitoring, and fMRI scanning. Most of Swann's neuropsychological test results were in the average to above average range, although he produced below average scores for toe gnosis, haptic (sense) discrimination and manipulative dexterity in his left hand, conditional spatial association, and spatial reasoning. Toe gnosis is considered a possible indicator of the functioning of the medial parietal lobe (Persinger & Richards, 1995), and a deficit in this ability, coupled with the left manual deficits, would suggest a functional anomaly in the medial parietal (paracentral) region of the right hemisphere. As with Harribance, such an anomaly would be more suggestive of structural change in this region rather than trauma or damage, given that Swann showed average or above average scores for other abilities associated with the hands and feet. In addition, deficits in spatial association and reasoning would suggest an anomaly in the right prefrontal cortex (Persinger et al., 2002, p. 943). Swann also showed no clear signs of clinical pathology or complex partial epilepsy.

Swann's EEG, which was monitored during his attempts at remote viewing, showed an unusual 7-Hz spike pattern and slow wave activity in the occipital lobe that was not present during his rest periods, and that was significantly correlated with the rated accuracy of his viewing ($0.5 < rho < 0.6$; $p < .05$). Although the 7-Hz spike activity was present over both sides of the occipital lobe, there were indications that it originated in the right hemisphere. The spike activity seems consistent with Swann's experience of mental images during his remote viewing. According to Persinger et al. (2002), the reproduction of his mental images through words and drawings seems analogous to that of a person copying complex shapes from a blackboard, based on his facial expressions and eye movements (pp. 934 – 935).

Resting fMRI scans of Swann's brain revealed no overt signs of trauma or damage. However, a cluster of four anomalous signals was detected in the subcortical white matter of the right occipital lobe, immediately below the sulcus that separates the parietal and occipital lobes (Persinger, 2001, p. 522; Persinger et al., 2002, pp. 940 – 941).

In comparing the studies of Harribance and Swann, two notable findings emerge. First, both psychics show indications that the right paracentral lobule and the adjacent right superior parietal lobule may be brain regions of interest (ROIs) in their ESP. SPECT scans showed both of these regions to be active in Harribance's brain during psi tasks (Alexander et al., 1998, p. 10; Roll et al., 2002, p. 211), and Swann's neuropsychological tests indicate structural anomalies in the right paracentral lobule and right prefrontal cortex, with the superior parietal lobule being anatomically and functionally associated with the latter (Persinger et al., 2002, p. 943). Studies suggest that the paracentral lobule is functionally associated with the processing of somatosensory stimuli, and electrical stimulation of the region can elicit small motor responses (Allison et al., 1996; Lim et al., 1994; Richer et al., 1993). The right superior parietal lobule may be involved in the spatial processing of objects presented to the left visual field, as suggested by imaging studies (Haxby et al., 1991; Sack et al., 2002) and by lesion studies (Husain & Nachev, 2007, pp. 30 – 31; Kolb & Whishaw, 1990, pp. 423 – 432). Other imaging studies indicate that the superior parietal lobule is involved in visual imagery (Ganis et al., 2004; Knauff et al., 2000; Kosslyn et al., 1997; Vanlierde et al., 2003). Given these functional roles, we might speculate that minor cortical restructuring within these lobules could allow access to latent neural processing pathways that expand the psychics' visuospatial and somatosensory abilities beyond those of non-psychics, such that they are able to perceive and process a wider range of external stimuli in the environment than most people.

Second, both psychics show evidence of a possible structural and functional anomaly in the right occipito-parietal region, suggesting that this may be another ROI in the functioning of their ESP. Harribance's QEEG data revealed this region to be active while he was engaged in ESP tasks (Alexander et al., 1998), and his neuropsychological tests indicated hypofunctioning in the region (Roll & Persinger, 1998; Roll et al., 2002). Similarly, resting fMRI scans of Swann's brain revealed a cluster of anomalous signals localized around this same region (Persinger et al., 2002). With its close proximity to the occipital lobe, where alpha activity is often recorded, we may speculate that this particular ROI may be significant for the relation between ESP and alpha activity. In this connection, it is relevant that Harribance has shown increased alpha during successful ESP (Alexander et al., 1998; Morris et al., 1972; Roll & Persinger, 1998), suggesting that it plays a major role in his ESP functioning. On a different note, 7 Hz spike activity was observed in the occipital region of Swann's brain during successful remote viewing (Persinger et al., 2002). Since the occipital lobe is known to be involved in vision, and the right parietal lobe is involved in visuospatial processing (Vanlierde et al., 2003), we speculate that the regions perform similar functions for the ESP of Harribance and Swann. The indications of structural change in the occipito-parietal region in these two psychics may suggest that they possess an altered cortical organization within this region that may allow a wider sensitivity to external visual stimuli, which may be represented mentally as spontaneous images of visual gestalt. Harribance's experience of seeing images in his upper left visual field, as well as the suggestions from Swann's remote viewing behavior that he is copying a mental image (which take the form of simple gestalts; see Figs. 1, 2, & 4 in Persinger et al., 2002), would be consistent with this suggestion.

The possibility that the ESP abilities of psychics may be related to changes in brain structure and function is further indicated by a study of 17 psychics at the College

of Psychic Studies in London by Fenwick et al. (1985). Compared to an age-, gender-, and intellectually-matched control group on neuropsychological questionnaires, Fenwick et al. found that the psychics reported significantly more signs of having suffered serious illness ($p = .02$), serious head injury ($p = .01$), and blackouts ($p = .04$) than did the controls. In particular, clairvoyant and precognitive abilities were significantly more associated with serious head injuries than without ($p = .04$ for both), a finding that would be consistent with the idea that these abilities may develop in association with structural reorganization in the brain following injury. Of possible relevance in this regard, Harribance and Swann both exhibit marked clairvoyant abilities, and Harribance is noted to have sustained at least two brain traumas during his childhood and adolescence (Persinger, 2001, p. 521).

9. Neurobiological Correlates of PK

Relative to ESP, few studies have been done to explore the brain correlates of PK. However, the limited number of studies available appears to provide results consistent with those for ESP, in that PK also appears to be associated more with the right brain hemisphere, and with alpha wave activity.¹³

As with psychics, studies of people adept at PK may be most revealing about the possible brain structures and functions involved in PK. In depth study has been done with one gifted PK subject, Tina Resch (Baumann, 1995; Persinger & Roll, 1993; Roll, 2007; Roll & Storey, 2004, Ch. 19), the 14-year-old girl at the focus of the Columbus RSPK case (Section 7).

Prior to his arrival in Columbus to investigate the RSPK occurrences, Roll had asked Mrs. Resch to have Tina undergo neurological testing to determine if there were signs of seizure activity in her brain. The neurologist suspected that Tina might have a lesion in the left side of her upper brainstem in the area surrounding the pons, based on the observations that Tina: 1) exhibited intermittent twitching in her left eyelid, 2) showed below normal saccadic movements in her eyes when she looked to the left, and 3) showed lower sensitivity to pain on the lower left side of her face. In addition to being involved in the sleep-wake cycle, the pons also helps to coordinate muscle movements through its neural connections to the cerebellum and the trigeminal nerves, with the latter helping to control mandible movement (Schneider & Tarshis, 1995, p. 63).

Based on the theory that RSPK is due to a diversion of neural impulses from the body to the environment, Montagno and Roll (1983) predicted that an obstruction in the brainstem may be responsible for the occurrences since the reticular formation, located within the brainstem, is where the ascending and descending neural pathways between the brain and the spinal cord are found. Here, the obstruction causes neural energy to be deflected from the body to the environment, bringing on the movement of objects. An opportunity to test this hypothesis arose when Tina was brought to the neurology laboratory at the University of North Carolina at Chapel Hill for PK testing and counseling. A “brainstem auditory evoked potentials” (BAEP)¹⁴ test administered to Tina by Baumann (1995; Roll & Storey, 2004, Ch. 19) had indicated abnormally fast transmissions of electrical impulses in the pons area of her brainstem. According to Baumann, the pons may be involved in arousal where “attention is temporarily locked onto specific aspects of the environment,” (Roll & Storey, 2004, p. 218), which in Tina’s case may have been objects that moved. The faster streams of electric pulses may have

amplified Tina's capacity to focus on such objects. The cause of the abnormality could be a head injury that Tina had sustained when she was 12; she had been pushed off the school bus, hit her head, and lost consciousness.

Upon examining Tina's neurological tests, Persinger (in Persinger & Roll, 1993) concluded that she suffered from a mild case of Tourette's syndrome, a condition characterized by involuntary tics, such as eye blinks and shoulder jerks, and by compulsions to vocally curse and utter profanities. These tics and vocalizations are thought to be due to irregular and recurrent electrical discharges within brain neurons. A diagnosis of Tourette's would be consistent with Tina's frequent urges to express herself verbally to her parents despite the risk of physical punishment, and her hyperactive and often disruptive behavior in class (for which she was taken out of public school and was being home schooled at the time of Roll's investigation; this is a common course of action for parents of children diagnosed with Tourette's).

Roll (in Roll & Storey, 2004, Ch. 19) has speculated that Tina's RSPK may be a form of Tourette's in which the tics and explosive behavior occur outside the body in the form of object movements and banging sounds. Tourette tics frequently disappear when the child is asleep. Similarly, Tina's RSPK never occurred while she slept. The excitement of being exposed to a different environment also appears to have a psychologically inhibiting effect on tic displays in children with Tourette's. Similarly, Tina's RSPK was not known to have occurred outside her home. The reason why Tina displays RSPK while other children with Tourette's do not is unclear, although the most plausible explanation may be that people with RSPK may have different neural wiring than other people.

Often when her RSPK occurred, Tina would complain of experiencing aches or fluttering feelings in her stomach. These sensations may point toward another neural aspect of her RSPK. The gastrointestinal tract is served by afferent and efferent neural fibers from the vagus nerve, which help to regulate the muscles controlling this tract. It is tempting to speculate that, for Tina, discharges by efferent neurons may overshoot their target in the body and impact objects in the environment instead, following the theory in which RSPK may be due to electromagnetic waves discharged from nerve cells (Section 7). The vagus nerve originates near the pons and may have been affected by the electrical anomaly detected by Baumann (1995), offering a possible source for the EM wave discharges.

Tina Resch is now an adult and her symptoms have developed into complex partial epilepsy, for which she is being medicated. She still reports instances of PK from time to time, usually at times when she is stressed.

10. The Temporal Lobes, the Limbic Structures, and Psi

The history of the organism is encompassed by four-dimensional space-time, the brain's interpretation of reality. This space is accessed by long-term memory. Based on a survey of ESP studies, Roll (1966a) proposed that the ESP response is composed of long-term memories that match the ESP target in the same way that long-term implicit memories are part of sensory perception. Other studies reviewing the relation between memory and ESP performance (Broughton, 2006; Palmer, 2006; Stanford, 2006) support the idea that long-term memory is a part of the ESP response. In addition, Broughton (2006) suggests that emotion may operate in conjunction with memory to select those memory aspects that will compose the ESP response, similar to the way

emotion seems to modulate response behaviors such as visual search attention, conditioned fear, and decision-making (Dolan, 2002; LeDoux, 1998). Assuming that long-term emotional memory is incorporated into the ESP response, it is to be expected that the structures within the medial temporal lobe that are most closely associated with memory and emotion, namely the hippocampus and the amygdala, will be active in ESP.

Some support for the idea that the temporal lobe may be active in ESP comes from studies that found a correlation between measures of temporal lobe lability and the frequency of psi experiences among the general population. In a survey of members of a South African psychical research organization, Neppe (1983) found that members who reported several psi experiences displayed significantly more symptoms of temporal lobe dysfunction than members who reported few or no psi experiences ($p < .01$). In a survey of three groups of normal college students, Persinger (1984), Persinger and Valliant (1985), and Persinger and Makarec (1987) reported positive correlations between higher numbers of temporal lobe signs and numbers of reported psi experiences ($.50 < r < .72$; $p < .001$). In an extension of this type of survey to a neuropsychiatric population, Palmer and Neppe (2003) found that patients diagnosed with temporal lobe dysfunction reported more psi experiences than patients without this diagnosis to a marginally significant degree ($p = .049$). The term “temporal lobe dysfunction” has a negative connotation, but translated to mean “extreme sensitivity by the temporal lobe,” it may increase a person’s sensitivity to ESP input. The same with “temporal lobe signs” and “temporal lobe lability.”

The findings of Persinger and Makarec (1987), Persinger and Richards (1994), and Roberts et al. (1990) suggest that people may be distributed across a continuum of temporal lobe lability. There are some indications that psychics and mediums may be found along the upper end of this continuum: Eleven (66 percent) of the 17 psychics studied by Fenwick et al. (1985) had shown signs of temporal lobe dysfunction in their right hemisphere. Persinger and Fisher (1990) found that females who regularly participated in a psychic study group showed elevated temporal lobe signs, and also reported significantly more psi experiences than an age- and gender-matched control group ($p < .001$). Some mediums have exhibited temporal lobe signs, as indicated by the EEG (Nelson, 1970), or by their responses to a survey of temporal lobe lability (Reinsel, 2003).

The possible involvement of the temporal lobe in PK has been suggested by neuropsychological studies of individuals at the center of RSPK occurrences (Section 6). Roll (2007) found that two subjects who displayed current RSPK activity also showed evidence that their brains were prone to seizure (epilepsy in one case, Tourette’s syndrome in the other), while a third subject, who was currently RSPK inactive, showed a brief period of 14 Hz EEG spikes while resting. In a survey of 92 documented RSPK agents, Roll (1977, pp. 400 – 401) previously found that 22 had either been diagnosed with epilepsy, or had displayed symptoms of complex partial seizure (one of the 22 was the active subject diagnosed with epilepsy).

11. Complementarity and Consciousness

Bohr (1961) regarded the wave and particle behavior of fundamental particles as complementary rather than merely contradictory, and then dealt with consciousness in the same way, “the nature of our consciousness brings about a complementary

relationship between...the psychological and the physical aspects of existence...which it is not possible to thoroughly understand by one-sided application either of physical or psychological laws” (p. 20, 24). In his discussion of Bohr’s principle of complementarity, Jahn (1991) suggests that the source of complementarity may be consciousness¹⁵ itself. He quotes James Jeans (1943): “There is no longer a dualism of mind and matter, but of waves and particles; these seem to be the direct, although almost unrecognizable, descendents of the older mind and matter, the waves replacing mind and the particles matter” (p. 204). Jeans’ observation lends support to Jahn’s contention that “it may not be the physical world...that presents these wave-particle complementarities, but rather the perspective of the consciousness observing it...From his beginnings, man has clearly possessed the capacity to think in both particulate and wave-like terms: allusions to sharply localized objects and to broadly diffuse undulatory effects share prominence in the art, language, and science of all cultures and all ages” (pp. 6 – 7). This enables Jahn (1991) to extend Bohr’s complementarity principle to pairs of “consciousness conjugates” that are antithetical and also complementary. Examples of such conjugate pairs include observation and participation, logic and intuition, objectivity and subjectivity, mind and matter, left brain hemisphere and right brain hemisphere, and structure and function. Jahn notes that although the members of such pairs involve different processes and concepts, together they make up consciousness; consciousness in turn sees the same double aspect in things it faces, whether they be animate or inanimate.

Jahn and Dunne (1987) develop this theme in their concept of “waves of consciousness” (pp. 193 – 287). Consciousness waves may result in “consciousness charges” in objects (pp. 235 – 237). Such charges may store energy in objects “for later release, either gradual or cataclysmic, constructive or destructive, when triggered by some subsequent event” (p. 237). The “linger effect,” reported by Watkins and associates¹⁶, and the “conditioned space” of Tiller and others¹⁷, may be examples of gradual and constructive charges, while object and area “focusing” in RSPK, together with delayed-action RSPK¹⁸ (i.e., disturbances when the agent is absent), may be examples of cataclysmic and destructive charges.

12. Conclusion

Psychic phenomena have been problematic for science because of the apparent absence of physical stimuli between the people and objects involved. This problem may be overcome by regarding psi as a form of biological quantum physics as proposed by Josephson (2002) and Josephson and Pallikari-Viras (1991).

We have examined evidence to the effect that psi experiences are most common among genetically-related pairs of people, and that the experiences occur most often at times of death and crisis to one member of the pair, conditions that are highly meaningful from a biological perspective.

We have also examined evidence that suggests psi functioning is correlated with neurobiological processes. Research suggests that successful ESP is associated with brain wave activity in the alpha range, and that ESP is more associated with the right brain hemisphere, which seems to be more functionally specialized for spatial and temporal processing than the left hemisphere. Both of these correlations were observed in neuropsychological studies of two psychics, Lalsingh Harribance and Ingo Swann. Their results indicate small-scale structural changes within the occipital and parietal regions of

their right hemispheres, which we hypothesize allow these psychics more access to neural pathways that may be sensitive to, and capable of processing, a wider range of external stimuli in the environment than is possible for non-psychics. Looked at from this perspective, ESP would not be a “paranormal” process, but rather an expanded form of ordinary sense perception resulting from differing brain structure, allowing access to objects that are nonlocal with respect to the body’s sensory-motor system. Currently, the findings of Harribance and Swann are limited only to these two psychics, and additional brain imaging studies with other psychics are needed in order to determine their degree of generalizability. A neurological study of a gifted PK subject, Tina Resch, suggests that her PK may also be associated with altered brain structure, such that abnormal electric discharges in the brain, in this case resulting from mild Tourette’s syndrome and an electrical anomaly in the pons, may underlie her RSPK.

Based on the evidence that the ESP response is comprised of long-term emotional memories, we hypothesize that the limbic structures of the medial temporal lobe are engaged in ESP functioning. Studies finding a correlation between measures of temporal lobe lability and the number of psi experiences among the general population offer preliminary support for this hypothesis, although EEG and brain imaging studies are needed to further test it.

J. Gaither Pratt (1974) wrote, “acceptance of the findings of parapsychology by other scientists will not occur until a theory is available that ‘makes sense’ of psi” (p. 134). Such a theory has become available thanks to Jahn, Josephson, and Walker. This means that the physical and the behavioral aspects of psi are also no mystery; the “paranormal” has become normal.

J. B. Rhine (1962) said, “When psi capacities transcend space or time...they are revealing fundamental properties of the human mind as a whole” (p. 153), a view with which many quantum physicists would agree. As d’Espagnat (1979) stated, “The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment” (p. 158).

Because the universe began with a Big Bang, where a miniscule particle bloomed into all that exists, everything is fundamentally entangled. Although the theoreticians to whom we refer do not bring up this fact, Josephson (2002) perhaps does so implicitly. He writes approvingly about Capra, who spoke about the “...deep parallels that appear to exist between patterns found in objective reality as revealed by modern science, and patterns found in deeper personal experiences as revealed by meditation or mystical experience and reported by the mystics” (p. 44).

Notes

1. Wiseman’s quote is a response to the viewpoint of statistician Jessica Utts (1996), who, after evaluating the U.S. government-funded research on remote viewing, wrote, “Using the standards applied to any other area of science it is concluded that psychic functioning has been well established. The statistical results of the studies examined are far beyond what is expected by chance. Arguments that these results could be due to methodological flaws in the experiments are soundly refuted” (p. 3). It is beyond the scope of this paper to provide a review of the studies to which Utts refers. Adequate reviews of these and other psi studies may be found in Bem and Honorton (1994), Bösch et al. (2006), Jahn and Dunne (1987, 2005), Radin (2006), Targ and Puthoff (1977), Targ et al. (2000), and Utts (1991, 1996, 1999).

2. For experiments on remote viewing, see Bisaha and Dunne (1979/2002), Dunne and Jahn (2003), Lantz et al. (1994), Puthoff and Targ (1976), Targ and Puthoff (1977), and Targ et al. (1979/2002).

3. Adopted from the 23rd letter of the Greek alphabet, the term “psi” was introduced by Thouless and Wiesner (1948) for psychic phenomena in general.

4. Josephson shared the 1973 Nobel Prize in physics for his theoretical prediction that electrons flowing through a superconducting circuit may quantum mechanically pass, or “tunnel,” through insulating barriers placed in the middle of the circuit, an effect that was later experimentally verified by the two other physicists who shared the prize with him. These circuits, now known as Josephson junctions, have been put to technological use in high-speed switches and computers.

5. Some attempt has been made to apply quantum theory to biological processes by adopting quantum concepts in the effort to better understand the workings behind conscious experience. For an overview, see Atmanspacher (2004).

6. The *ganzfeld* (German for “total field”) is a sensory reduction technique in which the percipient’s vision and hearing are reduced by placing translucent goggles (usually halved ping-pong balls) over the eyes and playing soft static “pink noise” in the ears through headphones. The uniform sensory field that results is thought to produce an altered state of consciousness that may allow subtle ESP information to enter awareness. For a detailed description of the ganzfeld and its use in ESP experiments, see Bem and Honorton (1994).

7. For detailed reviews of these and other brain correlation studies, see Charman (2006) and Wackermann (2004).

8. The impressions of Renier are not always on target; sometimes she gets only a partial picture or latches onto the wrong person. Other psychics have been commended by the police for their help in solving crimes, including Marinus Dykshom, whose autobiography, *My Passport Says Clairvoyant*, describes some of his cases.

9. Physical constants such as the speed of light depend on laboratory measurement and are thought to be changeless over time.

10. A clue about the nature of the substance came during a session in which Osty and others saw the curtain of the cabinet bulge out, followed by the appearance of a thick grayish mist coming out from under the curtain and moving towards the table. When the mist reached the table, the latter moved 20 cm, and the mist disappeared. The phenomenon is reminiscent of an observation by Radin (in Radin & Roll, 1994).

11. For in-depth reviews of the studies that suggest right hemispheric involvement in ESP, see Ehrenwald (1977), Roll and Montagno (1983), Roll et al. (2006), and Williams and Roll (2008).

12. References to electrode sites reflect the layout of the International 10-20 electrode placement system.

13. For studies that suggest involvement of the right hemisphere and alpha wave activity in PK, see Andrew (1975), Braud et al. (1976), and Williams and Roll (2008).

14. In the BAEP test, clicking sounds are fed into the ears, one ear at a time, while electrical responses by the auditory nerve that serves the ear in question are recorded. The BAEP is ordinarily used to detect hearing problems, multiple sclerosis, and tumors adjacent to the auditory pathway, with scalp electrodes being used to record the responses from the auditory nerves.

15. In Jahn’s usage, the term “consciousness” includes perception, cognition, intuition, instinct, and emotion, whether they seem conscious, subconscious, superconscious, or unconscious (Jahn & Dunne, 1987, p. 203).

16. Studies by Watkins and associates (see Wells and Watkins, 1975, for a review) found that anesthetized mice, serving as targets for bio-PK, had revived sooner if treated by psychics rather than by non-psychics. They also found that the healing ability “lingered” in the spot where a mouse had been revived, such that a new mouse placed there would revive sooner than controls. In a study by Watkins and Watkins (1974) of apparent PK by Felicia Parise on a compass needle, the needle would gradually return to standard north as it was slowly moved away, but would again deflect when replaced in the spot where Parise had produced the initial PK effect; the linger effect lasted about 25 minutes.

Bengston and Moga (2007) reported linger effects in studies of the healing effect of the “laying on of hands” on breast cancer-injected mice. The healing treatment mice had shown anomalous cancer remission, whereas control mice did not. However, 69.2% of the control mice that had been housed in the same lab as the treatment mice and/or been seen by the healer also showed anomalous remission. Only when the control mice were moved to a different, untreated lab did they show normal cancer growth and mortality rates. For additional discussion of linger effects, see Williams and Roll (2006).

17. Tiller and associates (2004) had introduced the concept of “conditioned space” in studies of the anomalous changes observed in the pH level of commercially bottled water (Tiller et al., 2000). The water

had been exposed to physical measuring devices that had been “imprinted” with human intention by deep meditators. When left in a laboratory over a period of three months, a continuous exponential increase in pH was observed in water being measured by an “imprinted” pH device. Moreover, the intention imprinted on the device not only affected other devices near it, but also the surrounding lab space, suggesting that the intention “diffused” into this space and “conditioned” it to produce the same effect as the imprinted device. Some studies of distant healing with REGs have shown similar effects. Crawford et al. (2003) found that the REG data collected in the room where a bioenergy healer regularly treated his patients had shown significantly more non-random patterns than the data collected by a control REG running in a library ($p < .0005$). Radin et al. (2004) had collected data from three REGs in a room that was being treated by Johrei healers to create a healing space. On the third day of data collection, the three REGs had each shown a non-random deviation at nearly the same time (combined $p = .00009$). Similarly, Blasband (2000) observed non-random REG behavior in a room where psychotherapy was taking place ($p = .0001$). For additional discussion, see Williams and Roll (2006).

18. Object focusing refers to repeated occurrences with the same object or type of object, and area focusing is about repeated occurrences at specific sites within the general location of the phenomena (Roll, 1975). In a survey (Roll, 1977) of 116 historical cases of RSPK, 107 (92%) showed apparent evidence of focusing, but it was not possible to disentangle the focusing from the proximity effect in these cases (e.g., objects might often move from a shelf if the agent was nearby, which might be evidence of the proximity effect and not of area focusing. However, two cases investigated by Roll and his colleagues showed evidence of focusing that could not be attributed to proximity of the agent.

Appendix 1: The Evolution of Physics¹

The beginning of modern physics came in the garden of Isaac Newton when he saw an apple fall from its tree², and conceived the theory of universal gravitation. The theory was published in his *Philosophiae Naturalis Principia Mathematica* in 1687, and resulted in the conviction that nature is comprehensible and deterministic. Newton also explored light and speculated that it consists of beams of tiny particles. More than 200 later Newton was proven right when light was found to consist of quanta, but much water had to flow over the dam before this could be established. To survey the evolution of physics, we have divided it into several steps. The first four steps are mostly consistent with classical physics, while the remaining seven steps represent the radical approach of quantum physics.

Step 1: The first experimentally based discovery about light showed that it comes in waves. In 1801 Thomas Young demonstrated that the alternating patterns of light and dark that results when a beam of light waves passes through a prism, depends on whether the light oscillations are in phase or out of phase. If in phase, the crests of the waves combine and produce bands of brightness, and if out of phase, they cancel each other out, resulting in bands of darkness. The same happens when the light beam passes through a barrier fitted with a pair of slits in it, and the waves encounter each other on the other side as they flare outward (or diffract) through the two slits. Against a smooth surface, this creates a fringed pattern of light and dark bands, often known as a double-slit diffraction or interference pattern.

Step 2 is about electric waves in conductors. In 1819 Hans Christian Oersted discovered that a wire with an electric current causes a suspended magnetic needle, such as a compass needle, to turn at right angles to the wire. This showed that electricity and magnetism, which had been thought to be entirely different, were in fact interlinked. Oersted had thereby laid the foundation for the science of electromagnetism, but it was left for Michael Faraday and James Clerk Maxwell to elucidate the details. Maxwell set forth his equations in the 1873 *Treatise on Electricity and Magnetism*, a work that

remains fundamental to electromagnetic theory. The equations show that electromagnetism comes in waves and that the velocity of the waves is determined by the same physical constant, including the constant of the velocity of light.

Maxwell also thought that waves are oscillations in an all-pervading medium that he called the ether (analogous to the way sound waves travel through a medium we now know as air). However, there was no empirical evidence for the ether, which made Albert Michelson and Edward Morley devise an experiment in 1887 that they hoped would prove its existence. They reasoned that if light is waves traveling through the ether, then the speed of the waves must depend on the location of the observer. They chose the earth as their laboratory because the earth and thereby the observer move in different directions as determined by its orbit around the sun. John Polkinghorne (2002) has come up with an analogy: “Think about waves on the sea. Their apparent velocity as observed from a ship depends on whether the vessel is moving with the waves or against them, appearing less in the former case than in the latter” (p. 4). But Michelson and Morley found no difference at all in the velocity of light whether the earth moved with or against the waves from the sun. Their discovery spelled the end of Maxwell’s ether and the beginning of Einstein’s special theory of relativity. Michelson received the 1907 Nobel Prize in physics, becoming the first American to do so.

Step 3 took place in a grade school in Switzerland where Johann Balmer, a German mathematician and physicist, was teaching. In 1885 Balmer discovered that when light from incandescent hydrogen is split by a prism, the result is a set of colored lines, known as spectral lines, with each color corresponding to a different frequency of the light. But the full importance of Balmer’s finding required further steps.

Step 4 came in 1897 when J. J. Thomson discovered that negative charge is carried by tiny particles, which came to be known as electrons, and he assumed that the balancing positive charge was spread over the atom as a whole. Thomson’s theory became known as “the plum pudding model” of the atom, the electrons being the plums and the positive charge, which supposedly filled the rest of the atom, being the pudding.

The next seven steps bring us to quantum physics. Step 5 is due to a 1900 study of black body radiation by Lord John Rayleigh. A black body is an object that absorbs all radiation that reaches it and then reemits it all. Rayleigh expected to verify the prediction of classical physics that the equilibrium between the two processes would be a function of the temperature in the black body. But his study of radiation within a specially designed oven, showed no relationship at all with temperature. On the other hand, there was a clear relationship to the frequency of the radiation, a fact that made no sense. Max Planck then came to Rayleigh’s rescue. Planck proposed that radiation is not absorbed or emitted in the smooth way of classical physics, but in discrete packets or “quanta” of energy and that the degree of energy in quanta is proportional to the frequency of radiation. Planck would eventually receive the 1918 Nobel Prize for his proposal.

Step 6 came in 1905 and is due to Albert Einstein, “a young man with time on his hands as he worked as a third-class examiner in the Patent Office in Berne (Switzerland)” (Polkinghorne, 2002, p. 8). Einstein, who regarded Planck’s quanta as abiding entities, was interested in something that had emerged in studies of the photoelectric effect, the phenomenon that happens when a beam of light ejects electrons from a metal. It was known that electrons move within metals and that this produces electric current, and it was also known that the radiation of the photoelectric process transfers energy to the electrons so that they sometimes escape their metallic bonds. According to classical

physics, it was the strength of the light waves that agitates some of the electrons to be shaken loose, and the degree to which this happens should depend on the intensity of the light and not on its frequency. But experiments showed the opposite; below a certain frequency, no electrons were emitted regardless of the strength of the beam, but above this frequency even a weak beam would eject some electrons. The results could not be explained by the old physics, but were consistent with Planck's discovery that the amount of energy in a quantum is proportional to its frequency.

Einstein had not only solved the puzzle of the photoelectric effect by his discovery that streams of light are composed of light quanta, or "photons" as they came to be known, but he had also thrown fresh light on man's image of the physical world. Einstein made two other important discoveries in 1905; he discovered special relativity and he demonstrated that the molecule is real, but it was his discovery of the nature of light that earned him a Nobel Prize in 1921.

Step 7 came in 1913 when Niels Bohr showed with his quantum mechanical model of the hydrogen atom that electrons contained within an atom exist only in discrete stationary quantum states. When their energy changes, the electrons "jump" between these individual states and emit light at a wavelength proportional to the energy difference, which helped explain the spectra properties of the light emitted by hydrogen atoms. In addition, Bohr's model helped explain the structure and stability of the atom, and was one of the contributions for which he was awarded the Nobel Prize in 1922.

A decade later, Step 8 was contributed by Louis Victor de Broglie, a physicist who came from a family of French aristocrats. It was becoming clear by this time that light had a dual nature. Young's experiment in 1801 (Step 1) demonstrated that light can behave as a wave. Yet the discovery of light quanta and photons in 1905 (Step 6) suggested that light can also behave as a particle. This implied that photons can have wave-like properties to them. In his 1923 Ph.D. dissertation, de Broglie proposed that this dual wave-particle nature should not be limited to photons alone; it should also carry over to all of the other known types of particles (e.g., protons, electrons, etc.). In other words, all material particles should also display wave-like properties, known as matter waves. He then showed that the momentum of a particle can be associated with a given wavelength, later known as the de Broglie wavelength. The proposal was empirically verified by physicists Clinton Davisson and Lester Germer in 1927, earning de Broglie the 1929 Nobel Prize.

Step 9 came in 1925 when Werner Heisenberg, Max Born, and Pascual Jordan formulated the first mathematical version of quantum mechanics, known as matrix mechanics. A second version came a year later when Erwin Schrödinger formulated wave mechanics. At the heart of the latter was a complex equation derived by Schrödinger, which had solutions (known as wavefunctions) that described the behavior of matter waves. Although they initially seemed incompatible, matrix mechanics and wave mechanics were later found to be equivalent to each other. Heisenberg later received the 1932 Nobel Prize in part for his efforts in developing quantum mechanics, and Schrödinger received the prize a year later.

From the wavefunction, it became possible to calculate the possible values for every observable quantity (e.g., position) associated with subatomic particles. In other words, the behavior of a quantum system could be described by its associated wavefunction. Associated with each possible value in the wavefunction is a given probability that a particle could have that value when observed (based on this, the wave-

like properties of particles are also viewed as “probability waves”). Before it is measured, and thus observed), it is *equally probable* that the particle could have any one of its possible values, which is the principle behind quantum superposition. Thus, in a sense, the particle has all of those values at the same time. When the particle is measured, its wavefunction “collapses” or “breaks down” into a single value that one actually observes.

With probability comes a certain degree of uncertainty in knowing exactly where a particle may be found at a given time, which leads us to Step 10. Although it is possible to measure the position and momentum of a physical object in the macroscopic (visible) world with a high degree of accuracy, in the microscopic (quantum) world it is necessary to replace measured accuracy with probability. Werner Heisenberg demonstrated this in 1927 with his Uncertainty Principle, which roughly states that if one measures the position of a particle with a certain degree of accuracy, then the measure of its momentum will become less accurate (and vice versa); one can never accurately know both values at the same time. This trade-off reflects the dual wave-particle nature of particles, particularly with respect to the concept of probability waves.

Step 11 came in 1935 with the Einstein-Podolsky-Rosen *gedanken* (“thought”) experiment, an illustration of quantum non-locality. It was within the context of this experiment that Schrödinger (1935) proposed the concept of quantum entanglement. The concept of quantum superposition underlies both phenomena.

Step 12 is Josephson’s biological quantum theory, which is the basis for the present paper.

Appendix 1 Notes

1. Most of this outline is due to John Polkinghorne (2002), and to Kleppner and Jackiw (2000).
2. The story is due to Voltaire, who apparently received it from Newton’s step-niece.

Appendix 2: Resch, Vasquez, and Callihan RSPK Case Summaries

Case of Christina (Tina) Resch (Roll, 1993; Roll & Storey, 2004): In March of 1984 Roll and Kelly Powers, a mental health counselor, went to the Columbus, Ohio home of Joan and John Resch, their grown son, four young foster children, and their adopted daughter Tina, who was 14. While in Tina’s room, Roll heard the sound of something falling behind his back and found his teacup on the floor. He had placed the empty cup on Tina’s bedside table moments before; it had moved about 12 feet. When this happened, Roll was looking at the girl who was on the other side of the bed, cleaning up some water she had spilled. Roll’s tape-recorder and then a pair of pliers he had just placed on a dresser moved several feet, Tina having touched neither.

Roll then brought Tina to the laboratory of neuroscientist Stephen Baumann at Spring Creek Institute in Chapel Hill, North Carolina, for further study. Jeannie Stewart, a psychotherapist, participated in the PK research. When Tina was facing Baumann and Stewart, they heard a loud sound from the hallway behind the girl. A 12-inch socket wrench from a table with target objects had hit the open door to a room, several feet behind Tina, and landed inside. An indentation showed the point of impact. It had traveled 18 feet, passing the two experimenters and Tina without notice, and moving another four feet after hitting the door. Dr. William Joines saw the incident from a room adjacent to the hallway, the upper part of which was glass. Hearing voices down the hallway, he looked up and saw something fly by; it was the socket wrench. Roll was

seated at the table with targets when a small plastic level disappeared without his seeing this. It evidently moved down the central hallway, making two turns and traveling about 38 feet to the room where Tina was standing with Stewart. Stewart heard a sound behind them and found the level on the floor. When this happened Tina had both her hands in her purse, searching for her plane ticket. Another time, Roll was seated at the table, watching Tina sit down by the window, when a battery from the table hit the window above her head. Stewart sat opposite Tina and also had her in view. A minute later, when the three of them were in the same positions, an L bracket from the table hit the window. Tina then went to the door and was standing quietly with her back to the room when Roll and Stewart heard a sound and found a drill-bit from the table on the floor about ten feet away. When this happened, Roll was watching Tina and saw her hands resting on either side of the doorframe. He saw none of the pieces as they moved, but there were a total of 21 object movements when Tina was observed, eight of them being targets.

Case of Julio Vasquez (Roll & Pratt, 1971): The occurrences took place in a warehouse for tourist items in Miami, Florida, in proximity to Julio Vasquez, a 19-year-old shipping clerk. As an experiment, Roll and Pratt set out pieces of merchandise in the active areas, keeping Julio and others in the firm away from them. At one point, Roll watched Julio place a toy alligator on a shelf, when a target highball glass four feet behind Julio crashed to the floor. Roll and Pratt had placed the glass on the shelf themselves, and Julio's hands were both occupied; in the right he held the alligator, in the left his clipboard. Two other workers were present but more than 15 feet from the glass. Then a box with ten beer mugs the researchers had placed as a target on the shipping desk crashed to the floor at the same time as Roll was watching Julio walk towards him and away from the desk; the only other employee in the room was behind Roll. The glass and box were among ten targets that moved from an experimental area after Roll and Pratt had checked the area for magical devices, while one of them watched the area from that time until the event, and when one of them checked the area immediately afterwards, before any of the employees entered. The two incidents were among seven that occurred when either Roll or Pratt was looking at Julio.

Case of Roger Callihan (Roll & Stump, 1969; Roll, 1972/2004, Ch. 11): John and Ora Callihan occupied a four-room house in Olive Hill, Kentucky, with their grown daughter. Roger, their 12-year-old grandson, often stayed in the house to help with the chores. John Stump, the first investigator to arrive, saw two bottles and a jar with canned berries on the kitchen counter simultaneously move about two feet and fall into the sink, at the same time as he saw Roger and his grandparents stand quietly by the counter. A little later, Stump was seated in the living room with the family and visitors when the grandfather entered and looked for a place to sit. John pointed to an empty chair when this turned upside down. Roger was sitting three feet away also in view and with no visible contact with the chair. Then Stump was standing in the living room looking at Roger, who was sitting in front of the TV, when there was a loud crack. Roger jumped away and about the same time Stump saw a cloth doily and large plastic bowl fall to the floor behind the TV while the plastic flowers that had been in the bowl remained. Then he saw the flowers slowly move off the TV, also landing behind. Here he found the three objects as they had been before, the flowers in the bowl and the bowl on the doily. At the same time these items moved behind the TV, a clock that had also been on the set moved forward, landing on the floor in front of John and about four feet from the TV. Two plaster of Paris figurines on top of the TV remained in place.

Roll, who arrived a few days later, went with Stump, Roger, his sister and parents to their own home, and was trailing the boy as he walked into the kitchen. He turned around when he reached the sink, facing Roll. At that moment, the kitchen table, which was on Roger's right, jumped into the air, rotated about 45 degrees and fell down on the backs of the chairs that stood around it, all four legs off the floor. Shortly afterwards, Roll watched Roger stand with his back to the coffee table when this flipped upside down. Roll and Stump estimated that it weighed at least 60 pounds. Finally, when Roll was standing in the doorway between the children's bedroom and the living room, a bottle with rose gel from the dresser took off and went about four feet into the bedroom. Roll was facing the dresser and saw the bottle in the air. When it flew, Roger was in the living room to the right of Roll, walking away, and in Roll's peripheral vision. Roger's sister was standing behind Roll, and there was no one else in the room.

Mrs. Callihan was convinced that the occurrences were caused by a demon and that Roll and Stump had brought the demon from the other house, so she asked them to leave, hoping it would follow.

References

- Alexander, C. H., & Broughton, R. S. (2001). Cerebral hemisphere dominance and ESP performance in the autoganzfeld. *Journal of Parapsychology*, *65*, 397 – 416.
- Alexander, C. H., Persinger, M. A., Roll, W. G., & Webster, D. L. (1998). EEG and SPECT data of a selected subject during psi tasks: The discovery of a neurophysiological correlate. *Proceedings of Presented Papers: The Parapsychological Association 41st Annual Convention* (pp. 3 – 13). Durham, NC: Parapsychological Association, Inc.
- Allison, T., McCarthy, G., Luby, M., Puce, A., & Spencer, D. D. (1996). Localization of functional regions of human mesial cortex by somatosensory evoked potential recording and by cortical stimulation. *Electroencephalography and Clinical Neurophysiology*, *100*, 126 – 140.
- Andrew, K. (1975). Psychokinetic influences on an electromechanical random number generator during evocation of "left-hemispheric" vs. "right-hemispheric" functioning. In J. D. Morris, W. G. Roll, & R. L. Morris (Eds.) *Research in Parapsychology 1974* (pp. 58 – 61). Metuchen, NJ: Scarecrow Press.
- Aspect, A., Grainger, P., & Roger, G. (1981). Experimental tests of realistic local theories via Bell's theorem. *Physical Review Letters*, *47*, 460 – 463.
- Aspect, A., Grangier, P., & Roger, G. (1982a). Experimental realization of Einstein-Podolsky-Rosen-Bohm *gedankenexperiment*: A new violation of Bell's inequalities. *Physical Review Letters*, *49*, 91 – 94.
- Aspect, A., Grangier, P., & Roger, G. (1982b). Experimental tests of Bell's inequalities using time-varying analyzers. *Physical Review Letters*, *49*, 1804 – 1807.
- Atmanspacher, H. (2004). Quantum theory and consciousness: An overview with selected examples. *Discrete Dynamics in Nature and Society*, *1*, 51 – 73.
- Barrett, W. F. (1911). Poltergeists, old and new. *Proceedings of the Society for Psychical Research*, *15*, 377 – 412.
- Barrington, M. R., Stevenson, I., & Weaver, Z. (2005). *A World in a Grain of Sand: The Clairvoyance of Stefan Ossowiecki*. Jefferson, NC: McFarland & Company.
- Battelli, L., Pascual-Leone, A., & Cavanagh, P. (2007). The 'when' pathway of the right parietal lobe. *Trends in Cognitive Sciences*, *11*, 204 – 210.
- Baumann, S. B. (1995). An overview with examples including a case study of an RSPK subject. *Proceedings of Presented Papers: The Parapsychological Association 38th Annual Convention* (pp. 11 – 19). Durham, NC: Parapsychological Association, Inc.

- Baumann, S. B., Joines, W. T., Kim, J., & Zile, J. M. (2005). Energy emissions from an exceptional subject. *Proceedings of Presented Papers: The Parapsychological Association 48th Annual Convention* (pp. 219 – 223). Cary, NC: Parapsychological Association, Inc.
- Bell, J. S. (1964). On the Einstein-Podolsky-Rosen paradox. *Physics, 1*, 195 – 200.
- Bem, D. J., & Honorton, C. (1994). Does psi exist? Replicable evidence for an anomalous process of information transfer. *Psychological Bulletin, 115*, 4 – 18.
- Bengston, W. F., & Moga, M. (2007). Resonance, placebo effects, and type II errors: Some implications from healing research for experimental methods. *Journal of Alternative and Complementary Medicine, 13*, 317 – 327.
- Bierman, D. J. (1998). Do psi phenomena suggest radical dualism? In S. R. Hameroff, A. W. Kazniak, & A. C. Scott (Eds.) *Toward a Science of Consciousness II: The Second TUSCON Discussions and Debates* (pp. 709 – 713). Cambridge, MA: MIT Press/Bradford.
- Bierman, D. J., & Radin, D. I. (1997). Anomalous anticipatory response on randomized future conditions. *Perceptual and Motor Skills, 84*, 689 – 690.
- Bierman, D. J., & Radin, D. I. (1999). Conscious and anomalous nonconscious emotional processes: A reversal of the arrow of time? In S. R. Hameroff, A. W. Kazniak, & D. J. Chalmers (Eds.) *Toward a Science of Consciousness III: The Third TUSCON Discussions and Debates* (pp. 367 – 385). Cambridge, MA: MIT Press/Bradford.
- Bierman, D. J., & Scholte, H. S. (2002). Anomalous anticipatory brain activation preceding exposure of emotional and neutral pictures. *Proceedings of Presented Papers: The Parapsychological Association 43rd Annual Convention* (pp. 25 – 36). Raleigh, NC: Parapsychological Association, Inc.
- Bisaha, J. P., & Dunne, B. J. (1979/2002). Multiple subject and long-distance precognitive remote viewing of geographical locations. In C. T. Tart, H. E. Puthoff, & R. Targ (Eds.) *Mind at Large: IEEE Symposia on the Nature of Extrasensory Perception* (pp. 98 – 111). Charlottesville, VA: Hampton Roads Publishing.
- Björkhem, J. (1943). *De Hypnotiska Hallucinationera*. Stockholm: Litteratursförlaget.
- Blanchard, C. H., Burnett, C. R., Stoner, R., & Weber, R. L. (1959). *Introduction to Modern Physics*. New York: Prentice-Hall.
- Blasband, R. A. (2000). The ordering of random events by emotional expression. *Journal of Scientific Exploration, 14*, 195 – 216.
- Bohm, D. (1980). *Wholeness and the Implicate Order*. London: Routledge & Kegan Paul.
- Bohr, N. (1958). Light and life. In *Atomic Physics and Human Knowledge* (pp. 3 – 12). New York: Wiley.
- Bohr, N. (1961). *Atomic Theory and the Description of Nature*. New York: Cambridge University Press.
- Bösch, H., Steinkamp, F., & Boller, E. (2006). Examining psychokinesis: The interaction of human intention with random number generators – a meta-analysis. *Psychological Bulletin, 132*, 497 – 523.
- Braud, W. G. (1975). Psi-conductive states. *Journal of Communication, 25*, 142 – 152.
- Braud, W. (2003). *Distant Mental Influence: Its Contributions to Science, Healing, and Human Interactions*. Charlottesville, VA: Hampton Roads Publishing Company.
- Braud, W. G., & Braud, L. W. (1975). The psi conducive syndrome: Free response GESP performance following evocation of “left-hemispheric” vs. “right-hemispheric” functioning. In J. D. Morris, W. G. Roll, & R. L. Morris (Eds.) *Research in Parapsychology 1974* (pp. 17 – 20). Metuchen, NJ: Scarecrow Press.
- Braud, W. G., Smith, G., Andrew, K., & Willis, S. (1976). Psychokinetic influences on random number generators during evocation of “analytic” vs. “nonanalytic” modes of information processing. In J. D. Morris, W. G. Roll, & R. L. Morris (Eds.) *Research in Parapsychology 1975* (pp. 85 – 88). Metuchen, NJ: Scarecrow Press.

- Broughton, R. S. (2006). Memory, emotion, and the receptive psi process. *Journal of Parapsychology, 70*, 255 – 274.
- Broughton, R. S., & Alexander, C. H. (1997). Autoganzfeld II: An attempted replication of the PRL ganzfeld research. *Journal of Parapsychology, 61*, 209 – 226.
- Capra, F. (1984). *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* (2nd Ed.). Toronto, Canada: Bantam Books.
- Charman, R. (2006). Has direct brain to brain communication been demonstrated by electroencephalographic monitoring of paired or group subjects? *Journal of the Society for Psychical Research, 70*, 1 – 24.
- Child, I. L., & Kelly, E. F. (1973). ESP with unbalanced decks: A study of the process in an exceptional subject. *Journal of Parapsychology, 37*, 278 – 297.
- Conrad, M., Home, D., & Josephson, B. (1988). Beyond quantum theory: A realist psychobiological interpretation of physical reality. In G. Tarozzi, A. van der Merwe, & F. Selleri (Eds.) *Microphysical Reality and Quantum Formalism, Vol. I* (pp. 285 – 293). Dordrecht: Kluwer Academic.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis (2nd Ed.)*. New Jersey: Pearson Merrill/Prentice-Hall.
- Crawford, C. C., Jonas, W. B., Nelson, R., Wirkus, M., & Wirkus, M. (2003). Alterations in random event measures associated with a healing practice. *Journal of Alternative and Complementary Medicine, 9*, 345 – 353.
- Crookes, W. (1889 – 1890). Notes of séances with D. D. Home. *Proceedings of the Society for Psychical Research, 6*, 98 – 127.
- Crookes, W. (1974). In G. M. Medhurst, K. M. Goldney, & M. R. Barrington (Ed.) *Crookes and the Spirit World: A Collection of Writings by or Concerning the Work of Sir William Crookes, O.M., F.R.S., in the Field of Psychical Research*. New York: Taplinger.
- Dalton, K. (1997). Is there a formula to success in the ganzfeld? Observations on predictors of psi-ganzfeld performance. *European Journal of Parapsychology, 13*, 71 – 82.
- d’Espagnat, B. (1979). The quantum theory and reality. *Scientific American, 241*, 158 – 181.
- Dolan, R. J. (2002). Emotion, cognition, and behavior. *Science, 298*, 1191 – 1194.
- Duane, T. D., & Behrendt, T. (1965). Extrasensory electroencephalographic induction between identical twins. *Science, 150*, 367.
- Dunne, B. J., & Jahn, R. G. (2003). Information and uncertainty in remote perception research. *Journal of Scientific Exploration, 17*, 207 – 241.
- Ehrenwald, J. (1977). Psi phenomena and brain research. In B. B. Wolman (Ed.) *Handbook of Parapsychology* (pp. 716 – 729). New York: Van Nostrand Reinhold.
- Einstein, A. (1949). In P. A. Schilpp (Ed.) *Albert Einstein: Philosopher-Scientist*. Evanston, IL: The Library of Living Philosophers.
- Einstein, A., Podolsky, B., & Rosen, N. (1935). Can quantum-mechanical description of physical reality be considered complete? *Physical Review, 47*, 777 – 780.
- Feather, S. R., & Schmicker, M. (2005). *The Gift: ESP, the Extraordinary Experiences of Ordinary People*. New York: St. Martin’s Press.
- Fenwick, P., Galliano, S., Coate, M. A., Rippere, V., & Brown, D. (1985). ‘Psychic sensitivity’, mystical experience, head injury, and brain pathology. *British Journal of Medical Psychology, 58*, 35 – 44.
- Flammarion, C. (1922). *Death and its Mystery: At the Moment of Death*. New York: Century.
- Friedman, J. R., Patel, V., Chen, W., Tolpygo, S. K., & Lukens, J. E. (2000). Quantum superposition of distinct macroscopic states. *Nature, 406*, 43 – 46.
- Ganis, G., Thompson, W. L., & Kosslyn, S. M. (2004). Brain areas underlying visual mental imagery and visual perception: An fMRI study. *Cognitive Brain Research, 20*, 226 – 241.
- Gauld, A., & Cornell, A. D. (1979). *Poltergeists*. Boston: Routledge & Kegan Paul.

- Gearhart, L., & Persinger, M. A. (1986). Geophysical variables and behavior: XXXIII. Onsets of historical and contemporary poltergeist episodes occurred with sudden increases in geomagnetic activity. *Perceptual and Motor Skills*, *62*, 463 – 466.
- Geschwind, N. (1990). Specializations of the human brain. In R. R. Llinás (Ed.) *The Workings of the Brain: Development, Memory, and Perception* (pp. 105 – 120). New York: W. H. Freeman & Company.
- Green, E. E., Parks, P. A., Guyer, P. M., Fahrion, S. L., & Lolafaye, C. (1991). Anomalous electrostatic phenomena in exceptional subjects. *Subtle Energies*, *2*, 69 – 94.
- Gregory, A. (1985). *The Strange Case of Rudi Schneider*. Metuchen, NJ: Scarecrow Press.
- Grinberg-Zylberbaum, J., Delaflor, M., Attie, L., & Goswami, A. (1994). The Einstein-Podolsky-Rosen paradox in the brain: The transferred potential. *Physics Essays*, *7*, 442 – 448.
- Gurney, E., Myers, F. W. H., & Podmore, F. (1886). *Phantasms of the Living* (2 vols.). London: Trubner.
- Häffner, H., Hänsel, W., Roos, C. F., Benhelm, J., Chek-al-kar, D., Chwalla, M., Körber, T., Rapol, U. D., Riebe, M., Schmidt, P. O., Becher, C., Gühne, O., Dür, W., & Blatt, R. (2005). Scalable multiparticle entanglement of trapped ions. *Nature*, *438*, 643 – 646.
- Haxby, J. V., Grady, C. L., Horwitz, B., Ungerleider, L. G., Mishkin, M., Carson, R. E., Herscovitch, P., Schapiro, M. B., & Rapoport, S. I. (1991). Dissociation of object and spatial visual processing pathways in human extrastriate cortex. *Proceedings of the National Academy of Sciences USA*, *88*, 1621 – 1625.
- Honorton, C. (1977). Psi and internal attention states. In B. B. Wolman (Ed.) *Handbook of Parapsychology* (pp. 435 – 472). New York: Van Nostrand Reinhold.
- Honorton, C. (1985). Meta-analysis of psi ganzfeld research: A response to Hyman. *Journal of Parapsychology*, *49*, 51 – 91.
- Honorton, C., & Ferrari, D. C. (1989). “Future telling”: A meta-analysis of forced-choice precognition experiments, 1935 – 1987. *Journal of Parapsychology*, *53*, 281 – 308.
- Husain, M., & Nachev, P. (2007). Space and the parietal cortex. *Trends in Cognitive Sciences*, *11*, 30 – 36.
- Hyman, R. (1985). The ganzfeld psi experiment: A critical appraisal. *Journal of Parapsychology*, *49*, 3 – 49.
- Hyman, R., & Honorton, C. (1986). A joint communiqué: The psi ganzfeld controversy. *Journal of Parapsychology*, *50*, 351 – 364.
- Jahn, R. G. (1991). The complementarity of consciousness. *Technical Note PEAR 91006*. Princeton, NJ: Princeton Engineering Anomalies Research, School of Engineering/Applied Science, Princeton University. 13 pp.
- Jahn, R. G., & Dunne, B. J. (1987). *Margins of Reality: The Role of Consciousness in the Physical World*. New York: Harcourt Brace Jovanovich.
- Jahn, R. G., & Dunne, B. J. (2005). The PEAR proposition. *Journal of Scientific Exploration*, *19*, 195 – 245.
- J Jeans, J. (1943). *Physics and Philosophy*. New York: Cambridge University Press.
- Johnson, M. (1984). Personal communication to Roll.
- Joines, W. T., & Roll, W. G. (2007). Energetic aspects of RSPK. *Proceedings of Presented Papers: The Parapsychological Association 50th Annual Convention* (pp. 48 – 56). Petaluma, CA: Parapsychological Association, Inc.
- Josephson, B. D. (2002). ‘Beyond quantum theory: A realist psycho-biological interpretation of reality’ revisited. *BioSystems*, *64*, 43 – 45.
- Josephson, B. D., & Pallikari-Viras, F. (1991). Biological utilization of quantum nonlocality. *Foundations of Physics*, *21*, 197 – 207.
- Julsgaard, B., Kozhokin, A., & Polzik, E. S. (2001). Experimental long-lived entanglement of two macroscopic objects. *Nature*, *413*, 400 – 403.

- Keil, H. H. J., & Fahler, J. (1976). Nina S. Kulagina: A strong case for PK involving directly observable movements of objects. *European Journal of Parapsychology, 1*, 36 – 44.
- Keil, H. H. J., Herbert, B., Ullman, M., & Pratt, J. G. (1976). Directly observable voluntary PK effects. *Proceedings of the Society for Psychical Research, 56*, 197 – 235.
- Kirby, B. C. (1959). The “linkage” effect in ESP. *Journal of Parapsychology, 23*, 290.
- Kittensis, M., Caryl, P. G., & Stevens, P. (2004). Distant psychophysiological interaction effects between related and unrelated participants. *Proceedings of Presented Papers: The Parapsychological Association 47th Annual Convention* (pp. 67 – 76). Raleigh, NC: Parapsychological Association, Inc.
- Kleppner, D., & Jackiw, R. (2000). Pathways of discovery: One hundred years of quantum physics. *Science, 289*, 893 – 898.
- Knauff, M., Kassubek, J., Mulack, T., & Greenlee, M. W. (2000). Cortical activation evoked by visual mental imagery as measured by fMRI. *NeuroReport, 11*, 3957 – 3962.
- Kosslyn, S. M., Thompson, W. L., & Alpert, N. M. (1997). Neural systems shared by visual imagery and visual perception: A positron emission tomography study. *NeuroImage, 6*, 320 – 334.
- Lantz, N. D., Luke, W. L. W., & May, E. C. (1994). Target and sender dependencies in anomalous cognition experiments. *Journal of Parapsychology, 58*, 285 – 302.
- LeDoux, J. (1998). *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York: Touchstone/Simon & Schuster.
- LeShan, L. (1968). The vanished man: A psychometry experiment with Mrs. Eileen Garrett. *Journal of the American Society for Psychical Research, 62*, 46 – 62.
- Lewis, P. A., & Miall, R. C. (2006). Remembering the time: A continuous clock. *Trends in Cognitive Sciences, 10*, 401 – 406.
- Lim, S. H., Dinner, D. S., Pillay, P. K., Luders, H., Morris, H. H., Klem, G., Wyllie, E., & Awad, I. A. (1994). Functional anatomy of the human supplementary sensorimotor area: Results of extraoperative electrical stimulation. *Electroencephalography and Clinical Neurophysiology, 91*, 179 – 193.
- Marcikic, I., de Riedmatten, H., Tittel, W., Zbinden, H., Legré, M., & Gisin, N. (2004). Distribution of time-bin entangled qubits over 50 km of optical fiber. *Physical Review Letters, 93*, 180502 – 180503.
- Marsh, M. C. (1958). *Linkage in Extra-Sensory Perception*. Unpublished Ph.D. dissertation, Rhodes University, South Africa.
- Mermin, N. D. (1985). Is the moon there when nobody looks? Reality and the quantum theory. *Physics Today, 38*, 38 – 47.
- Montagno, E. de A., & Roll, W. G. (1983). A neurobiological model for psychokinesis. In W. G. Roll, J. Beloff, & R. A. White (Eds.) *Research in Parapsychology 1982* (pp. 272 – 273). Metuchen, NJ: Scarecrow Press.
- Morin, C., Guigot, J., Manai, R., Vu, P., Guérin, N., Samson, Y., Pradat-Diehl, P., & Touitou, Y. (2005). Impairment in clock time estimation following right hemisphere ischemic damage. *Cognitive Brain Research, 22*, 305 – 307.
- Morris, R. L. (1977). Parapsychology, biology, and ANPSI. In B. B. Wolman (Ed.) *Handbook of Parapsychology* (pp. 687 – 715). New York: Van Nostrand Reinhold.
- Morris, R. L., Roll, W. G., Klein, J., & Wheeler, G. (1972). EEG patterns and ESP results in forced-choice experiments with Lalsingh Harribance. *Journal of the American Society for Psychical Research, 66*, 253 – 268.
- Nelson, G. R. (1970). Preliminary study of the electroencephalograms of mediums. *Parapsychologia, 4*, 30 – 35.
- Neppe, V. M. (1983). Temporal lobe symptomatology in subjective paranormal experiences. *Journal of the American Society for Psychical Research, 77*, 1 – 28.

- Osis, K. (1966). Linkage experiments with mediums. *Journal of the American Society for Psychical Research*, *60*, 91 – 124.
- Osty, E. (1923). *Supernormal Faculties in Man*. London: Methuen.
- Osty, E., & Osty, M. (1931 – 1932). Les pouvoirs inconnus de l'esprit sur la matiere. *Revue Metaphysique*,
- Owen, A. R. G. (1964). *Can We Explain the Poltergeist?* New York: Garrett.
- Pagenstecher, G. (1922). Past events seership: A study in psychometry. *Proceedings of the American Society for Psychical Research*, *16*, 1 – 136.
- Palmer, J. (1998). ESP and REG PK with Sean Harribance: Three new studies. *Proceedings of Presented Papers: The Parapsychological Association 41st Annual Convention* (pp. 124 – 134). Durham, NC: Parapsychological Association, Inc.
- Palmer, J. (2006). Memory and ESP: A review of the experimental literature. *6^o Simpósio da Fundação Bial: Aquém e Além do Cérebro (6th Symposium of the Bial Foundation: Behind and Beyond the Brain)* (pp. 121 – 147). Porto, Portugal: Fundação Bial.
- Palmer, J., & Neppe, V. M. (2003). A controlled analysis of subjective paranormal experiences in temporal lobe dysfunction in a neuropsychiatric population. *Journal of Parapsychology*, *67*, 75 – 97.
- Pan, J.-W., Bouwmeester, D., Daniell, M., Weinfurter, H., & Zeilinger, A. (2000). Experimental test of quantum nonlocality in three-photon Greenberger-Horne-Zeilinger entanglement. *Nature*, *403*, 515 – 518.
- Parra, A., & Argibay, J. C. (2006). Comparing a free-response test using an object and without object condition: First study exploring the “token-object” effect on an un-gifted sample. *Proceedings of Presented Papers: The Parapsychological Association 49th Annual Convention* (pp. 299 – 307). Petaluma, CA: Parapsychological Association, Inc.
- Penman, D. (2008, January 28). Is this proof we're all psychic? *Daily Mail* (London), Section 1, 28.
- Persinger, M. A. (1974). *The Paranormal* (2 vols.). New York: M.S.S. Information Corporation.
- Persinger, M. A. (1984). Propensity to report paranormal experiences is correlated with temporal lobe signs. *Perceptual and Motor Skills*, *59*, 583 – 586.
- Persinger, M. A. (2001). The neuropsychiatry of paranormal experiences. *Journal of Neuropsychiatry and Clinical Neurosciences*, *13*, 515 – 524.
- Persinger, M. A., & Fisher, S. D. (1990). Elevated, specific temporal lobe signs in a population engaged in psychic studies. *Perceptual and Motor Skills*, *71*, 817 – 818.
- Persinger, M. A., Koren, S. A., & Tsang, E. W. (2003). Enhanced power within a specific band of theta activity in one person while another receives circumcerebral pulsed magnetic fields: A mechanism for cognitive influence at a distance? *Perceptual and Motor Skills*, *97*, 877 – 894.
- Persinger, M. A., & Makarec, K. (1987). Temporal lobe epileptic signs and correlative behaviors displayed by normal populations. *Journal of General Psychology*, *114*, 179 – 195.
- Persinger, M. A., & Richards, P. M. (1994). Quantitative electroencephalographic validation of left and right temporal signs and indicators in normal people. *Perceptual and Motor Skills*, *79*, 1571 – 1578.
- Persinger, M. A., & Richards, P. M. (1995). Foot agility and toe gnosis/graphaesthesia as potential indicators of integrity of the medial cerebral surface: Normative data and comparison with clinical populations. *Perceptual and Motor Skills*, *80*, 1011 – 1024.
- Persinger, M. A. & Roll, W. G. (1993). Potential neurofunctional correlates of the Tina Resch 1984 poltergeist episode. *Proceedings of Presented Papers: The Parapsychological Association 36th Annual Convention* (pp. 483 – 491). Durham, NC: Parapsychological Association, Inc.
- Persinger, M. A., Roll, W. G., Tiller, S. G., Koren, S. A., & Cook, C. M. (2002). Remote viewing with the artist Ingo Swann: Neuropsychological profile, electroencephalographic

- correlates, magnetic resonance imaging (MRI), and possible mechanisms. *Perceptual and Motor Skills*, *94*, 927 – 949.
- Persinger, M. A., & Valliant, P. M. (1985). Temporal lobe signs and reports of subjective paranormal experiences in a normal population: A replication. *Perceptual and Motor Skills*, *60*, 903 – 909.
- Polkinghorne, J. (2002). *Quantum Theory: A Very Short Introduction*. New York: Oxford University Press.
- Pratt, J. G. (1974). Some notes for the future Einstein of parapsychology. *Journal of the American Society for Psychical Research*, *68*, 133 – 155.
- Pratt, J. G. & Roll, W. G. (1958). The Seaford disturbances. *Journal of Parapsychology*, *22*, 79 – 124.
- Prince, W. F. (1921). Psychometric experiments with Senora Maria Reyes de Z. *Proceedings of the American Society for Psychical Research*, *15*, 189 – 314.
- Puthoff, H. E., & Targ, R. (1976). A perceptual channel for information transfer over kilometer distances: Historical perspective and recent research. *Proceedings of the IEEE*, *64*, 329 – 354.
- Radin, D. I. (1997). Unconscious perception of future emotions: An experiment in presentiment. *Journal of Scientific Exploration*, *11*, 163 – 180.
- Radin, D. I. (2004a). Electrodermal presentiments of future emotions. *Journal of Scientific Exploration*, *18*, 253 – 273.
- Radin, D. I. (2004b). Event-related electroencephalographic correlations between isolated human subjects. *Journal of Alternative and Complementary Medicine*, *10*, 315 – 323.
- Radin, D. (2006). *Entangled Minds: Extrasensory Experiences in a Quantum Reality*. New York: Paraview Pocket Books.
- Radin, D. I., & Roll, W. G. (1994). A radioactive ghost in a music hall. *Proceedings of Presented Papers: The Parapsychological Association 37th Annual Convention* (pp. 337 – 346). Durham, NC: Parapsychological Association, Inc.
- Radin, D. I., & Roll, W. G. (1996). Investigation of two haunted castles in Scandinavia. *Proceedings of Presented Papers: The Parapsychological Association 39th Annual Convention* (pp. 271 – 278). Durham, NC: Parapsychological Association, Inc.
- Radin, D. I., Taft, R., & Yount, G. (2004). Effects of healing intention on cultured cells and truly random events. *Journal of Alternative and Complementary Medicine*, *10*, 103 – 112.
- Reinsel, R. (2003). Dissociation and mental health in mediums and sensitives: A pilot survey [Abstract]. *Journal of Parapsychology*, *67*, 261 – 262.
- Renier, N., with Lucks, N. (2008). *A Mind for Murder: The Real-Life Case Files of a Psychic Investigator*. Charlottesville, VA: Hampton Roads Publishing.
- Rhine, J. B. (1937). *New Frontiers of the Mind*. New York: Farrar & Rinehart, Inc.
- Rhine, J. B. (1962). *The Reach of the Mind*. New York: William Sloane Associates, Inc.
- Rhine, J. B. (1974). Telepathy and other untestable hypotheses. *Journal of Parapsychology*, *38*, 137 – 153.
- Rhine, L. E. (1954). Frequency of types of experiences in spontaneous precognition. *Journal of Parapsychology*, *18*, 93 – 123.
- Rhine, L. E. (1963). Spontaneous physical effects and the psi process. *Journal of Parapsychology*, *27*, 84 – 122.
- Rice, G. E., & Townsend, J. (1962). Agent-percipient relationship and GESP performance. *Journal of Parapsychology*, *26*, 211 – 217.
- Richards, T. L., Kozak, L., Johnson, L. C., & Standish, L. J. (2005). Replicable functional magnetic resonance imaging evidence of correlated brain signals between physically and sensory isolated subjects. *Journal of Alternative and Complementary Medicine*, *11*, 955 – 963.

- Richer, F., Martinez, M., Robert, M., Bouvier, G., & Saint-Hilaire, J. M. (1993). Stimulation of the human somatosensory cortex: Tactile and body displacement perceptions in medial regions. *Experimental Brain Research*, *93*, 173 – 176.
- Roberts, R. J., Varney, N. R., Hulbert, J. R., Paulson, J. S., Springer, J., Sheperd, J., Swan, C., Legrand, J., Harvey, J., & Steuben, M. (1990). The neuropathology of everyday life: The frequency of partial seizure symptoms among normals. *Neuropsychology*, *4*, 65 – 85.
- Roll, W. G. (1966a). ESP and memory. *International Journal of Neuropsychiatry*, *2*, 505 – 521.
- Roll, W. G. (1966b). Further token object tests with a “sensitive.” *Journal of the American Society for Psychological Research*, *60*, 270 – 280.
- Roll, W. G. (1966c). Token object matching tests: A third series. *Journal of the American Society for Psychological Research*, *60*, 363 – 379.
- Roll, W. G. (1968). Some physical and psychological aspects of a series of poltergeist phenomena. *Journal of the American Society for Psychological Research*, *62*, 263 – 308.
- Roll, W. G. (1969). The Newark disturbances. *Journal of the American Society for Psychological Research*, *63*, 123 – 174.
- Roll, W. G. (1970). Poltergeist phenomena and interpersonal relations. *Journal of the American Society for Psychological Research*, *64*, 66 – 99.
- Roll, W. G. (1972/2004). *The Poltergeist*. New York: Nelson Doubleday, Inc. (Reprinted by Paraview Special Editions)
- Roll, W. G. (1975). Earlier RSPK cases. In J. D. Morris, W. G. Roll, & R. L. Morris (Eds.) *Research in Parapsychology 1974* (pp. 134 – 139). Metuchen, NJ: Scarecrow Press.
- Roll, W. G. (1977). Poltergeists. In B. B. Wolman (Ed.) *Handbook of Parapsychology* (pp. 382 – 413). New York: Van Nostrand Reinhold.
- Roll, W. G. (1993). The question of RSPK vs. fraud in the case of Tina Resch. *Proceedings of Presented Papers: The Parapsychological Association 36th Annual Convention* (pp. 456 – 482). Durham, NC: Parapsychological Association, Inc.
- Roll, W. G. (2004). Early studies on psychometry. *Journal of Scientific Exploration*, *18*, 711 – 720.
- Roll, W. G. (2007). Psychological and neuropsychological aspects of RSPK. *Proceedings of Presented Papers: The Parapsychological Association 50th Annual Convention* (pp. 114 – 130). Petaluma, CA: Parapsychological Association, Inc.
- Roll, W. G., & Gearhart, L. (1974). Geomagnetic perturbations and RSPK. In W. G. Roll, R. L. Morris & J. D. Morris (Eds.) *Research in Parapsychology 1973* (pp. 44 – 46). Metuchen, NJ: Scarecrow.
- Roll, W. G. & Joines, W. T. (2001). RSPK and consciousness. *Proceedings of Presented Papers the Parapsychological Association 44th Annual Convention* (pp. 267 – 284). Cary, NC: Parapsychological Association, Inc.
- Roll, W. G., & Klein, J. (1972). Further forced-choice experiments with Lalsingh Harribance. *Journal of the American Society for Psychological Research*, *66*, 103 – 112.
- Roll, W. G., Maher, M. C., & Brown, B. (1992). An investigation of reported haunting occurrences in a Japanese restaurant in Georgia. *Proceedings of Presented Papers: The Parapsychological Association 35th Annual Convention* (pp. 151 – 166). Durham, NC: Parapsychological Association, Inc.
- Roll, W. G., & Montagno, E. de A. (1983). Neurophysical aspects of psi. In C. B. S. Jones (Ed.) *Proceedings: Symposium on Applications of Anomalous Phenomena* (pp. 281 – 364). Santa Barbara, CA: Kaman Tempo.
- Roll, W. G., & Nichols, A. (2000). Psychological and electromagnetic aspects of haunts. *Proceedings of the Parapsychological Association 43rd Annual Convention* (pp. 364 – 378). Cary, NC: Parapsychological Association, Inc.
- Roll, W. G., & Persinger, M. A. (1998). Is ESP a form of perception? Contributions from a study of Sean Harribance. *Proceedings of Presented Papers: The Parapsychological Association*

- 41st Annual Convention* (pp. 199 – 209). Durham, NC: Parapsychological Association, Inc.
- Roll, W. G., & Persinger, M. A. (2001). Investigations of poltergeists and haunts: A review and interpretation. In J. Houran & R. Lange (Eds.) *Hauntings and Poltergeists: Multidisciplinary Perspectives* (pp. 123 – 163). Jefferson, NC: McFarland & Company, Inc.
- Roll, W. G., Persinger, M. A., Alexander, C. H., & Williams, B. J. (2006). Psi and the brain. *Advances in Parapsychological Research 9*, in preparation.
- Roll, W. G., Persinger, M. A., Webster, D. L., Tiller, S. G., & Cook, C. M. (2002). Neurobehavioral and neurometabolic (SPECT) correlates of paranormal information: Involvement of the right hemisphere and its sensitivity to weak complex magnetic fields. *International Journal of Neuroscience*, *112*, 197 – 224.
- Roll, W. G., & Pratt, J. G. (1971). The Miami disturbances. *Journal of the American Society for Psychical Research*, *65*, 409 – 454.
- Roll, W. G., Sheehan, L. C., Persinger, M. A., & Glass, A. Y. (1996). The haunting of White Ranch. *Proceedings of Presented Papers: The Parapsychological Association 39th Annual Convention* (pp. 279 – 294). Durham, NC: Parapsychological Association, Inc.
- Roll, W. G. & Storey, V. (2004). *Unleashed – Of Poltergeists and Murder: The Curious Story of Tina Resch*. New York: Paraview Pocket Books.
- Roll, W. G., & Stump, J. (1969). The Olive Hill poltergeist. *Proceedings of the Parapsychological Association*, *6*, 57 – 58.
- Sack, A. T., Hubl, D., Prvulovic, D., Formisano, E., Jandl, M., Zanella, F. E., Maurer, K., Goebel, R., Dierks, T., & Linden, D. E. J. (2002). The experimental combination of rTMS and fMRI reveals the functional relevance of parietal cortex for visuospatial functions. *Cognitive Brain Research*, *13*, 85 – 93.
- Sackett, C. A., Kielpinski, D., King, B. E., Langer, C., Meyer, V., Myatt, C. J., Rowe, M., Turchette, Q. A., Itano, W. M., Wineland, D. J., & Monroe, C. (2000). Experimental entanglement of four particles. *Nature*, *404*, 256 – 259.
- Saltmarsh, H. F. (1934). Report on cases of apparent precognition. *Proceedings of the Society for Psychical Research*, *42*, 49 – 103.
- Sannwald, G. (1963). On the psychology of spontaneous paranormal phenomena. *International Journal of Parapsychology*, *5*, 274 – 292.
- Schmidt, H. (1976). PK effect on pre-recorded targets. *Journal of the American Society for Psychical Research*, *70*, 267 – 271.
- Schmidt, H. (1987). The strange properties of psychokinesis. *Journal of Scientific Exploration*, *1*, 103 – 118.
- Schmidt, H. (1993). Observation of a psychokinetic effect under highly controlled conditions. *Journal of Parapsychology*, *57*, 351 – 372.
- Schneider, A. M., & Tarshis, B. (1995). *Elements of Physiological Psychology*. New York: McGraw-Hill.
- Schrödinger, E. (1935). Die gegenwärtige Situation in der Quantenmechanik. *Naturwissenschaften*, *23*, 807 – 812, 823 – 828, 844 – 849.
- Schwartz, S. A. (1978/2001). *The Secret Vaults of Time: Psychic Archeology and the Quest for Man's Beginnings*. Charlottesville, VA: Hampton Roads Publishing Company.
- Sheldrake, R. (1999). *Dogs That Know When Their Owners Are Coming Home and Other Unexplained Powers of Animals*. New York: Crown Publishers.
- Spottiswoode, S. J. P., & May, E. C. (2003). Skin conductance prestimulus response: Analyses, artifacts, and a pilot study. *Journal of Scientific Exploration*, *17*, 617 – 641.
- Standish, L. J., Johnson, L. C., Kozak, L., & Richards, T. (2003). Evidence of correlated functional magnetic resonance imaging signals between distant human brains. *Alternative Therapies in Health and Medicine*, *9*, 122 – 125, 128.

- Standish, L. J., Kozak, L., Johnson, L. C., & Richards, T. (2004). Electroencephalographic evidence of correlated event-related signals between the brains of spatially and sensory isolated human subjects. *Journal of Alternative and Complementary Medicine*, *10*, 307 – 314.
- Stanford, R. (2006). Making sense of the “extrasensory”: Modeling receptive psi using memory-related concepts. *6^o Simpósio da Fundação Bial: Aquém e Além do Cérebro (Behind and Beyond the Brain)* (pp. 169 – 197). Porto, Portugal: Fundação Bial.
- Stapp, H. P. (1982). Mind, matter, and quantum mechanics. *Foundations of Physics*, *12*, 363 – 399.
- Stapp, H. P. (1985). Consciousness and values in the quantum universe. *Foundations of Physics*, *15*, 35 – 47.
- Stapp, H. P. (1994). Theoretical model of a purported empirical violation of the predictions of quantum theory. *Physical Review A*, *50*, 18 – 22.
- Stuart, C. E. (1946). GESP experiments with the free response method. *Journal of Parapsychology*, *10*, 21 – 35.
- Stevenson, I. (1970a). *Telepathic Impressions: A Review and Report of Thirty-five New Cases*. Charlottesville, VA: University Press of Virginia.
- Stevenson, I. (1970b). Precognition of disasters. *Journal of the American Society for Psychological Research*, *64*, 187 – 210.
- Stump, J. P., Roll, W. G., & Roll, M. (1970). Some exploratory forced-choice ESP experiments with Lalsingh Harribance. *Journal of the American Society for Psychological Research*, *64*, 421 – 431.
- Targ, E., Schlitz, M., & Irwin, H. J. (2000). Psi-related experiences. In E. Cardeña, S. J. Lynn, & S. Krippner (Eds.) *Varieties of Anomalous Experience: Examining the Scientific Evidence* (pp. 219 – 252). Washington, D.C.: American Psychological Association, Inc.
- Targ, R., & Puthoff, H. E. (1977). *Mind-Reach: Scientists Look at Psychic Ability*. New York: Delacorte Press.
- Targ, R., Puthoff, H. E., & May, E. C. (1979/2002). Direct perception of remote geographical locations. In C. T. Tart, H. E. Puthoff, & R. Targ (Eds.) *Mind at Large: IEEE Symposia on the Nature of Extrasensory Perception* (pp. 71 – 95). Charlottesville, VA: Hampton Roads Publishing.
- Tenhaeff, W. H. C. (1955). Psychoscopic experiments on behalf of the police. In *Proceedings of the First International Conference of Parapsychological Studies* (pp. 107 – 109). New York: Parapsychology Foundation, Inc.
- Tenhaeff, W. H. C. (1972). *Telepathy and Clairvoyance: Views of Some Little Investigated Capabilities of Man*. Springfield, IL: Charles C. Thomas.
- Thouless, R. H., & Wiesner, B. P. (1948). The psi process in normal and “paranormal” psychology. *Journal of Parapsychology*, *12*, 192 – 212.
- Tiller, W. A., Dibble, W. E., Nunley, R., & Shealy, C. N. (2004). Toward general experimentation and discovery in conditioned laboratory spaces: Part I. Experimental pH change findings at some remote sites. *Journal of Alternative and Complementary Medicine*, *10*, 145 – 157.
- Tiller, W. A., Kohane, M. J., & Dibble, W. E. (2000). Can an aspect of consciousness be imprinted into an electronic device? *Integrative Physiological and Behavioral Science*, *35*, 142 – 163.
- Tittel, W., Brendel, J., Zbinden, H., & Gisin, N. (1998). Violation of Bell inequalities by photons more than 10 km apart. *Physical Review Letters*, *81*, 3563 – 3567.
- Utts, J. (1991). Replication and meta-analysis in parapsychology. *Statistical Science*, *6*, 363 – 403.
- Utts, J. (1996). An assessment of the evidence for psychic functioning. *Journal of Scientific Exploration*, *10*, 3 – 30.

- Utts, J. (1999). The significance of statistics in mind-matter research. *Journal of Scientific Exploration, 13*, 615 – 638.
- Van de Castle, R. L. (1977). Sleep and dreams. In B. B. Wolman (Ed.) *Handbook of Parapsychology* (pp. 473 – 499). New York: Van Nostrand Reinhold.
- Vanlierde, A., De Volder, A. G., Wanet-Defalque, M.-C., & Veraart, C. (2003). Occipito-parietal cortex activation during visuo-spatial imagery in early blind humans. *NeuroImage, 19*, 698 – 709.
- Vedral, V. (2008). Quantifying entanglement in macroscopic systems. *Nature, 453*, 1004 – 1007.
- Vogel, J. J., Bowers, C. A., & Vogel, D. S. (2003). Cerebral lateralization of spatial abilities: A meta-analysis. *Brain and Cognition, 52*, 197 – 204.
- Wackermann, J. (2004). Dyadic correlations between brain functional states: Present facts and future perspectives. *Mind and Matter, 2*, 105 – 122.
- Wackermann, J., Seiter, C., Keibel, H., & Walach, H. (2003). Correlations between brain electrical activities of two spatially separated human subjects. *Neuroscience Letters, 336*, 60 – 64.
- Walker, E. H. (1974). Consciousness and quantum theory. In E. D. Mitchell & J. White (Eds.) *Psychic Exploration: A Challenge for Science* (pp. 544 – 568). New York: G. P. Putnam's Sons.
- Walker, E. H. (1975). Foundations of parapsychical and parapsychological phenomena. In L. Oteri (Ed.) *Proceedings of an International Conference: Quantum Physics and Parapsychology* (pp. 1 – 44). New York: Parapsychology Foundation, Inc.
- Walker, E. H. (1979). Comments on the quantum theory of psi phenomena. In W. G. Roll (Ed.) *Research in Parapsychology 1978* (pp.). Metuchen, NJ: Scarecrow Press.
- Walker, E. H. (1985). Quantum mechanics and consciousness. *Indian Journal of Psychology, 4*, 21 – 26.
- Watkins, G. K., & Watkins, A. M. (1974). Apparent psychokinesis on static objects by a “gifted” subject: A laboratory demonstration. In W. G. Roll, R. L. Morris, & J. D. Morris (Eds.) *Research in Parapsychology 1973* (pp. 132 – 134). Metuchen, NJ: Scarecrow Press.
- Wells, R., & Watkins, G. K. (1975). Linger effects in several PK experiments. In J. D. Morris, W. G. Roll, & R. L. Morris (Eds.). *Research in Parapsychology 1974* (pp. 143 – 147). Metuchen, NJ: Scarecrow Press.
- Williams, B. J., & Roll, W. G. (2006). Psi, place memory, & laboratory space. *Proceedings of Presented Papers: The Parapsychological Association 49th Annual Convention* (pp. 248 – 258). Petaluma, CA: Parapsychological Association, Inc.
- Williams, B. J., & Roll, W. G. (2008). Neuropsychological correlates of psi phenomena. *Proceedings of Presented Papers: The Parapsychological Association 51st Annual Convention* (pp. 264 – 287). Petaluma, CA: Parapsychological Association, Inc.