A POSSIBLE MECHANISM FOR ESP AT THE INITIAL PERCEPTUAL STAGE

By Yung-Jong Shiah

ABSTRACT: An underlying mechanism for ESP at the initial perceptual stage has not been fully proposed and the mode of transduction for paranormal information remains unknown. This paper is based on the reasonable assumption that ESP is a kind of normal perception. Recently discovered photoreceptors called cryptochromes, which are present in all tissues, are ideal candidates for ESP transduction at the initial perceptual stage. It is proposed that ESP information triggers chemical reactions in the cryptochromes, influencing the spin states of paired radical ions. This process activates the cryptochromes and then spreads their summed signal throughout the brain, creating a meaningful synthesis. Because cryptochromes are highly concentrated in the inner retina and the pineal gland, the chemical reactions that mediate ESP should be most active in these locations. This new concept also might explain certain mystical, transcendental, or paranormal phenomena such as seeing gods or ghosts and distant healing, assuming they are energy-based. Further studies to prove or disprove this hypothesis are suggested.

Keywords: cryptochromes, extrasensory perception (ESP), inner retina, mystical, paranormal, pineal gland

General theories of psi have been proposed at the levels of both psychology (e.g., Broughton, 2006; Carpenter, 2004; Stanford, 1990) and physics (e.g., Lee, 1999; Walker, 1984; Whiteman, 1973). However, with the exception of a proposal more than one hundred years ago by Gurney, Myers, and Frank (1886), a theoretical account of the possible neural and biophysical mechanisms that underlie ESP at the initial perceptual stage has never been fully proposed. The mode of transformation for any ESP signal remains unknown, and the primary receptors involved in detecting paranormal information have not been identified.

During ESP performance, participants seemingly perceive information about an objective target or one's thought processes. ESP information might not be a specific signal, but a variety of signals within an unknown range (Stevens, 2002). Under this assumption, a key feature of ESP is the ability to integrate many aspects of normal/paranormal information into a single perception (Stevens, 2002). For example, it might be an ability to filter abundant, variably perceived information and integrate it into a meaningful representation. This process might involve combining perceived information gathered from sensory inputs and thoughts in associated cortical areas, finally reaching a meaningful perception (Shiah, 2011).

Following is an account of how certain underlying physical mechanisms could constrain ESP processes. First, the basic types of ESP information that we can extract from targets are discussed. A possible initial perceptual route for ESP signals is then suggested.

A Possible Mechanism for ESP

ESP information is considered very weak and below the sensory threshold (Schmeidler, 1991; Stevens, 2000, 2002). An equally plausible assumption is that ESP information is so weak that it might not be detected by existing equipment.

Another possible important characteristic of ESP information is related to magnetic fields. Biological cells in all bodily organs, as well as the components of nonbiological systems such as the random electronic-noise generators and radioactive decay detectors commonly used in ESP research, are capable of emitting electromagnetic radiation (Stevens, 1997). In addition, we all are affected by the earth's magnetic field, called the geomagnetic field, which is created primarily by flowing liquid iron in the earth's inner core. There are two distinct types of information from the earth's magnetic field (Johnsen & Lohmann, 2005). The first is directional or compass information (e.g., north vs. south orientation). The second, the more complex one, involves magnetic features that are influenced by several geomagnetic parameters, such as inclination angle and field intensity at the earth's surface. The magnetic field is formed by electrical charges, including the very weak ones that are present in the human body.

ESP information can be considered as falling below thresholds defined in terms of magnetic waves, radiation, gravity, or some unknown properties. ESP signals might be changes in the flow of charges from the psi source, traveling at light-speed (Stevens, 1997). If ESP does occur in this way, the proposed mechanism for the initial ESP perception must account for the above properties. It must be sensitive to very weak electromagnetic signals or some other very weak energy force.

One of the most likely possibilities is that ESP information has an influence on biological molecules (Stevens, 1997), which, in turn, might induce chemical reactions. One possibility is that cryptochromes play a functional role in the detection of weak magnetic radiation or photons, the process being based on a hypothetical radical-pair mechanism (Gegear, Foley, Casselman, & Reppert, 2010; Johnsen & Lohmann, 2005; Maeda et al., 2008; Ritz, Ahmad, Mouritsen, Wiltschko, & Wiltschko, 2010; Rodgers & Hore, 2009). There is empirical evidence supporting the idea that the photoexcitatory mechanism in cryptochromes is activated in the presence of magnetic fields even in the absence of light (Gegear et al., 2010; Li et al., 2011; Liu, Liu, Zhong, & Lin, 2010).

Cryptochromes are blue photoreceptors, which respond to 400 to 500 nm signals. They exist in plants, bacteria, animals, and humans, and they are involved in the organism's growth and circadian rhythms (Cashmore, Jarillo, Wu, & Liu, 1999; Foley, Gegear, & Reppert, 2011; Li et al., 2011; Liu et al., 2010; Partch, Clarkson, Ozgur, Lee, & Sancar, 2005; Ritz, Adem, & Schulten, 2000). Any protein that has a DNA sequence 25–50% similar to that of photolysis, but that lacks photolysis' ability to use blue light to repair UV-induced DNA damage, is called a cryptochrome (Lin & Todo, 2005; Sancar, 2004). Another reason why cryptochromes are a good candidate for an ESP receptor is that they are distributed in all tissues of the body, but especially in the inner retina (Sancar, 2004; Thompson et al., 2003) and pineal gland (Ackermann, Dehghani, Bux, Kauert, & Stehle, 2007; Foley et al., 2011). It is reasonable to assume that ESP information penetrates bodily tissues and thus can be received by the cryptochromes located in these tissues. The process by which a protein's information is converted into the structures and function of a cell in response to environmental stimuli and perturbations can be considered a form of gene or protein expression; or it might imply an abundance of messenger RNA (Lockhart & Winzeler, 2000).

Chemical reactions that involve transitions between different spin states can be influenced by magnetic fields or light. According to the proposed radical-pair mechanism, even a weak magnetic field alters the dynamics of the transition between spin states (Johnsen & Lohmann, 2005). In other words, the radical-pair system acts as a switch that can be triggered by an external magnetic field, resulting in changes in chemical reaction rates (Ritz, Thalau, Phillips, Wiltschko, & Wiltschko, 2004).

Likewise, there is evidence that energy signals generated by radio frequencies within the ELF range can affect radical-pair reactions (Brocklehurst & McLauchlan, 1996; Henbest, Kukura, Rodgers, Hore, & Timmel, 2004; Ritz et al., 2004). More broadly, it has been suggested that chemical reactions are sensitive to weak—< 1 mTesla (T)—static energy or ELF fields. Specifically, it has been suggested that a 5–50 MHz ELF field or a ~300 μT radio-frequency magnetic field in the presence of a 0–4 mT static magnetic field can affect the radical-pair mechanism (Henbest et al., 2004). (Note that 1 m T [T = Weber/m^2] equals 10^{-3} T, and 1μT equals 10^{-7} T.)

Putting matters simply, a key to producing chemical reactions in cryptochromes is to influence the correlated spin states of paired radical ions (Johnsen & Lohmann, 2005). The important point is that a certain number of paired radicals must be activated if the differential energy threshold is to be detected. The number of chemical reactions needed to detect this differential threshold for magnetic fields has been calculated by Weaver, Vaughan, and Astumian (2000): at least 4×10^{10} radical pairs in a volume of 0.4 mm^3 are required to detect a difference of 10^{-6} T (2% of the Earth's magnetic field). Similarly, it is logical to infer that weak information carried by magnetic fields, ELF fields, or certain other kinds of energy might be detected if a sufficient number of radical pairs are involved.

One might then ask a basic but important question: Can ESP information activate radical pairs in cryptochromes such as to allow its detection? As noted earlier, ESP information might be carried by many different kinds of energy. This assumption leads us to hypothesize that ESP signals might trigger chemical reactions in cryptochromes, influencing the spin states of paired radical ions. Because this influence is weak, the detectable differential threshold of the ESP signals must be summed from chemical reactions over a large area. For example, the ESP process might activate cryptochromes in all the tissues of the body, after which the summed signals spread to all parts of the brain. Because cryptochromes are highly concentrated in the inner retina and pineal gland, this is where ESP information is most likely to originate in the body.

The Evidence

Given this new conception, the idea that magnetic fields can affect ESP performance is not radical. Many studies have provided experimental evidence that the human brain responds to magnetic fields (Carrubba, Frilot Ii, Chesson, & Marino, 2007; Marino, Nilsen, Chesson, & Frilot, 2004; Marino, Nilsen, & Frilot, 2002). Some investigators have discovered that geomagnetic activity can affect memory retrieval (Persinger, 2002) and complex perceptions, such as presences, fears, and odd smells (Booth, Koren, & Persinger, 2005; Persinger & Healey, 2002). Moreover, ESP performance might be less effective when geomagnetic activity is high (Dalton & Stevens, 1996; Spottiswoode, 1990). A positive relationship has been found between ESP success and low geomagnetic activity (Berger & Persinger, 1991; Persinger & Krippner, 1989) and quiet geomagnetic activity (Persinger, 1985, 1989).

Finger-reading refers to successful identification by touch of apparently flat target numbers, words, or symbols on paper, under conditions where the participant is unable to see, or feel, or have any normal sensory cues to assist tactile identification (Shiah & Tam, 2005). In a preliminary finger-reading study (Lee, Tang, & Kuo, 2004), participants reported that visual images were affected by a magnet placed near targets as well as the participants' hands, without the participants knowing the magnet's pole. The results showed that a north pole enhanced reported visual images but a south pole had no effect on them. Too much magnetic activity might act as noise to interfere with ESP (Stevens, 2000); such an excess would be expected at the south pole of a magnet. On the other hand, low magnetic activity or the north pole of a magnet might enhance ESP.

To the best of our knowledge, magnetic waves, the gravity field, radiation, ELF fields (3–300 Hz), and ultra-low-frequency (ULF) magnetic waves (< 3 Hz) can penetrate a Faraday cage (electrically shielded room). In some ESP studies (Targ & Puthoff, 1974; Tart, 1988), participants were tested inside a Faraday cage and the results were significantly positive. These results indicate that ESP information can penetrate an electrically shielded cover, which implies that ESP information can easily penetrate bodily tissues. Because cryptochromes are present in all tissues, they are thus ideal alternatives to the five standard senses as ESP receptors.

There is evidence that altering the state of one's brain by applying a magnetic field or presenting a visual stimulus can cause predictable EEG waves in a distant brain to be detected. These effects have been considered to be genetically related (Persinger, Koren, & Tsang, 2003) and not genetically related (Standish, Kozak, Johnson, & Richards, 2004; Wackermann, Seiter, Keibel, & Walach, 2003). In another study, altering the EEG in one person caused predictable brainwaves to be related to the mood or emotional state (positive, negative, calm, or neutral) of a distant person (Radin & Schlitz, 2005). When 5 Hz, 8 Hz, 10 Hz, or 15 Hz flashing lights were presented to one of a pair of unrelated people, correlated EEG patterns over the right parietal region were found in response to yoked circumcerebral magnetic fields (Persinger et al., 2010). However, it has not been firmly established that a magnetic field generated by a human can affect another person's behaviour.

ESP performance occurs best when the participant is in a quiet or drowsy state of consciousness (Irwin, 1994; Rao, 2001). These findings suggest that a quiet mental state has a functional role in facilitating ESP performance. One common explanation for this functional role is that it serves to reduce internal somatic noise and increase the ESP signal-noise ratio, which is considered to enhance a person's ESP performance (Honorton, 1977). In terms of the cryptochromes hypothesis, there are two possible explanations for why a quiet or drowsy mind might be helpful for ESP. First, it is suggested that a quiet state of mind is beneficial to the radical-pairs mechanism because it reduces thermal noise (Weaver et al., 2000; Weaver, Vaughan, & Martin, 1999). The other explanation is that there is a positive relationship between a quiet state of mind, such as meditation, and a low core body temperature (CBT; George, 2002). CBT is a measure of small momentary changes in blood temperature, unaffected by environmental conditions. It is generally taken at the esophagus, rectum, mouth, or external auditory meatus membrane (Byrne & Lim, 2007). Clearly, a lower CBT reduces thermal noise in the body (Weaver et al., 1999).

Concluding Remarks and Future Research

In this paper, I have suggested that cryptochromes generated by a radical-pair mechanism are crucial for the ESP process. Radical pairs are sensitive to ESP information. Specifically, they detect the differential threshold of this information, which is accompanied by summed chemical reactions. This mechanism might be able to identify ESP target information at the initial perceptual stage. One possible way to test this hypothesis would be to show if ELF waves disturb radical pair reactions, especially in the pineal gland and the inner retina where cryptochromes are highly concentrated.

Nevertheless, many basic but important questions remain. How cryptochromes function has not been fully explicated (Lin & Todo, 2005; Liu et al., 2010). For example, although they are present in all tissues, it is not clear if cryptochromes in the skin have the same function as cryptochromes in the inner retina, where they have a role in the perception of weak magnetic fields and light. Their function may be suspended in some tissues. Thus, their role in ESP perception may not be the same in all tissues under all conditions. In addition, it is very difficult to identify the radical-pairs process in complex systems (Henbest et al., 2004). The reaction time of the radical-pairs mechanism could be in microseconds or milliseconds (Johnsen & Lohmann, 2005; Ritz et al., 2010), suggesting very high resolution. Thus, we need machines capable of monitoring very weak energy fields during an ESP task. If ESP occurs, the very weak magnetic field, ELF field, or an unknown energy in the body might be associated with the radical-pairs mechanism having a particular spin pattern. Although modern devices can measure magnetic fields below 10^{-17} T (Kominis, Kornack, Allred, & Romalis, 2003; Savukov, Seltzer, Romalis, & Sauer, 2005), this is not good enough for highly complex systems. These devices have insufficient spatial resolution and field sensitivity (Wildermuth et al., 2005). If better technology can be developed in the future, a more detailed understanding of the radical-pairs process might be achieved. Given that we have no idea how radical pairs transduce magnetic information in cryptochromes (Ritz et al., 2010), another question is how the information in an electromagnetically mediated ESP signal could survive transformation via a radical-pair induced chemical reaction. Taken together, the critical questions of how radical-pair reactions are actually generated and how they are transduced into neural signals remain to be fully answered (Gegear et al., 2010).

One might also ask whether the detection of electromagnetic signals by radical pairs is strong enough to be biologically relevant, given that the chemical reaction must overcome thermal noise. Weaver et al. (1999) proposed that biological sensory systems can escape temperature variations in two ways. First, evolutionary pressure may result in biochemical temperature compensation. This could be accomplished, for example, by utilizing two biochemical rates in series, each with nearly the same temperature coefficient. This procedure is analogous to providing electrical circuit temperature compensation by using a voltage divider with matched elements. Second, neural processing may correct for sensed temperature variations. Again, these assumptions need to be tested.

In summary, the present paper describes a possible mechanism for ESP at the initial perceptual stage. This new hypothesis also has potential for explaining some mystical or transcendental experiences (e.g., such as seeing gods or ghosts) or paranormal effects such as distant healing, insofar as they are energy-based. Further studies are needed before we can begin to prove or disprove this hypothesis.

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Abstracts in Other Languages

Spanish

UN POSIBLE MECANISMO PARA PES
EN LA FASE INICIAL DE PERCEPCIÓN

RESUMEN: Un mecanismo subyacente a la percepción extrasensorial (PES) en la etapa inicial de percepción no ha sido propuesto completamente y el modo de transducción de información paranormal sigue siendo desconocido. Este trabajo se basa en la suposición razonable de que la PES es una especie de percepción normal. Fotorreceptores recientemente descubiertos, llamados criptocromos, están presentes en todos los tejidos y son los candidatos ideales para la transducción de PES en la etapa inicial de percepción. Se propone que la información PES desencadena reacciones químicas en las criptocromos, influyendo los estados de giro de iones radicales apareados. Este proceso activa los criptocromos y luego se extiende su señal sumada por todo el cerebro, creando una síntesis significativa. Debido a que criptocromos están altamente concentrados en la retina interna y la glándula pineal, las reacciones químicas que median la PES deben ser más activas en estos lugares. Este nuevo concepto también podría explicar ciertos fenómenos místicos, trascendentales, o paranormales, tales como ver a dioses o espíritus y la curación a distancia, suponiendo que dependan de la energía. Sugiero estudios para probar o refutar esta hipótesis.

French

UN POSSIBLE MECANISME POUR L'ESP AU NIVEAU PERCEPTUEL INITIAL

Résumé : Un mécanisme sous-jacent à l'ESP au niveau perceptuel initial n'a pas été complètement développé et le mode de transduction de l'information paranormale reste inconnu. Cet article est basé sur une hypothèse raisonnable faisant de l'ESP une sorte de perception normale. Les photorécepteurs récemment découverts, nommés cryptochromes, qui sont présents dans tous les tissus, sont des candidats idéaux pour la transduction de l'ESP au niveau perceptuel initial. Nous proposons que l'information ESP déclenche des réactions chimiques dans les cryptochromes, influençant les états de spin des ions radicaux pairés. Ce processus active les cryptochromes and diffuse ensuite le signal à travers le cerveau, créant une synthèse pleine de sens. Parce que les cryptochromes sont hautement concentrés dans la rétine interne et la glande pinéale, les réactions chimiques qui médiatisent l'ESP devraient être plus actives dans ces espaces. Ce nouveau concept pourrait aussi expliquer certains phénomènes mystiques, transcendants ou paranormaux, tels que la vision de dieux ou de fantômes et la guérison à distance, si on fait l'hypothèse qu'ils sont basés sur une énergie. De futures études pour confirmer ou infirmer cette hypothèse sont proposées.

German

EIN MÖGLICHER ASW-MECHANISMUS ZU BEGINN DER WAHRNEHMUNGSPHASE

Ein der ASW zugrundeliegender Mechanismus zu Beginn der Wahrnehmungsphase ist noch unzureichend verstanden und die Art, wie paranormale Information übermittelt wird, bleibt unbekannt. Diesem Artikel liegt die vernünftige Annahme zugrunde, dass ASW eine Art normaler Wahrnehmung darstellt. Neuerdings entdeckte Photorezeptoren, Cryptochrome genannt, die sich überall im Gewebe nachweisen lassen, stellen ideale Kandidaten für ASW-Übertragung zu Beginn der Wahrnehmungsphase dar. Es wird vorgeschlagen, dass durch die ASW-Information chemische Reaktionen in den Cryptochromen ausgelöst werden, wodurch die Spinzustände zweier gekoppelter Ionenradikale beeinflusst werden. Dieser Prozess aktiviert die Cryptochrome und verbreitet ihr aufsummiertes Signal im gesamten Gehirn, wodurch eine sinnvolle Synthese zustande kommt. Da Cryptochrome in der inneren Retina und in der Zirbeldrüse hoch konzentriert sind, sollten die chemischen Reaktionen, die ASW vermitteln, an diesen Stellen am aktivsten sein. Diese neue Vorstellung könnte bestimmte mystische, transzendente oder paranormale

Phänomene erklären helfen, wie z. B. die Wahrnehmung von Göttern oder Geistern und Fernheilung – vorausgesetzt, diese haben eine energetische Grundlage. Untersuchungen zur Bestätigung oder Widerlegung dieser Hypothese werden vorgeschlagen.