# Extended Consciousness–Electron Interaction

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Using electrons as examples, I recall how quantum mechanics cannot predict which wave packet created by a double slit will excite a detector, which direction of spin a Stern-Gerlach apparatus will detect, or how two widely separated but "entangled" particles exchange information when the spin of one of them is measured. I speculate that the electron "decides" and attribute to it a primitive conscious wavefunction. Quarks likewise. Since the human body is composed of these particles, it certainly has a (very complex) wavefunction, but conscious as well by this line of reasoning.

Experiments at the Princeton Experimental Anomalies Research laboratory appear to show that the conscious intent of a human observer can alter the output of a random number generator. I propose an experiment for the observer requiring far less energy: flipping the spin of an electron in a weak magnetic field. For convenience, the electron is bound to a closed-shell $^{138}Ba^{++}$ core. The combined $^{138}Ba^{+}$ ion is confined in a Paul trap at very low pressure. Blue-violet laser-induced fluorescence (LIF) allows the observer to see the ion directly. If he or she succeeds in flipping the electron's spin, then LIF ceases. Flipping it again will restore LIF. By causing the ion to fluoresce for appropriate short and long intervals, a message in Morse Code can be sent.

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## 1. INTRODUCTION

Consider an electron's wavepacket passing through a double slit. It turns into an array of packets, such as the two that I have sketched in Fig. 1.

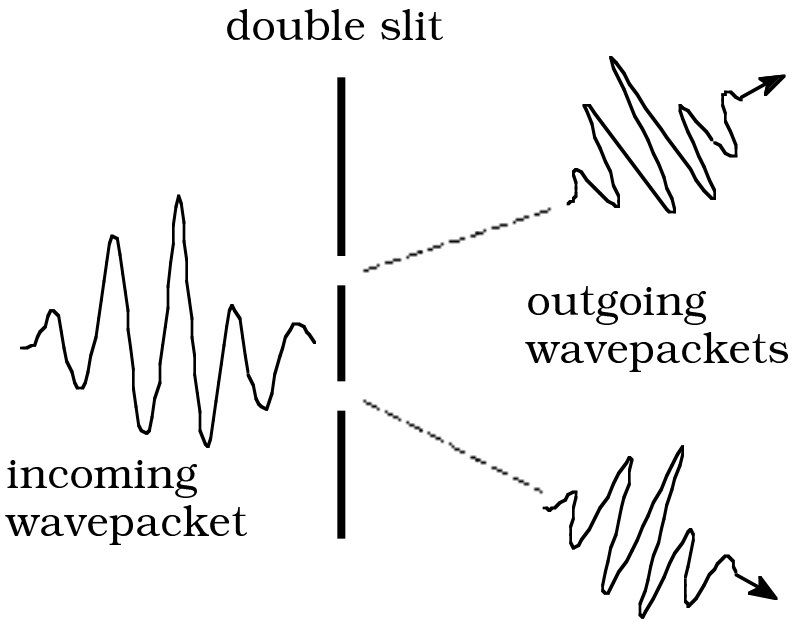


Fig. 1. Wavepacket passing through double slit and undergoing diffraction. Two of the many outgoing wavepackets are sketched.

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If an array of detectors is placed to intercept the wavepackets, then only one detector will be activated. According to the Copenhagen School, an observer brings this about. Quantum mechanics cannot say which detector will be energized. However I will speculate that the electron itself "chooses" which detector to activate. The electron might have some kind of elementary consciousness unit, or ECU.

Next consider an electron with its spin in the $x$-direction approaching a Stern-Gerlach device whose highly divergent magnetic field is oriented in the $z$-direction. If the electron's wavefunction is expanded in terms of spin "up" and "down" states in the $z$-direction, *i. e.*,

$$\psi = \frac{1}{\sqrt{2}}\left|\uparrow\right\rangle + \frac{1}{\sqrt{2}}\left|\downarrow\right\rangle,$$

then upon passing through the detector, either the electron will be deflected upward with spin up or deflected downward with spin down, as sketched in Fig. 2. As before, quantum mechanics cannot say which spin-direction the electron will assume; I will speculate that the electron chooses.

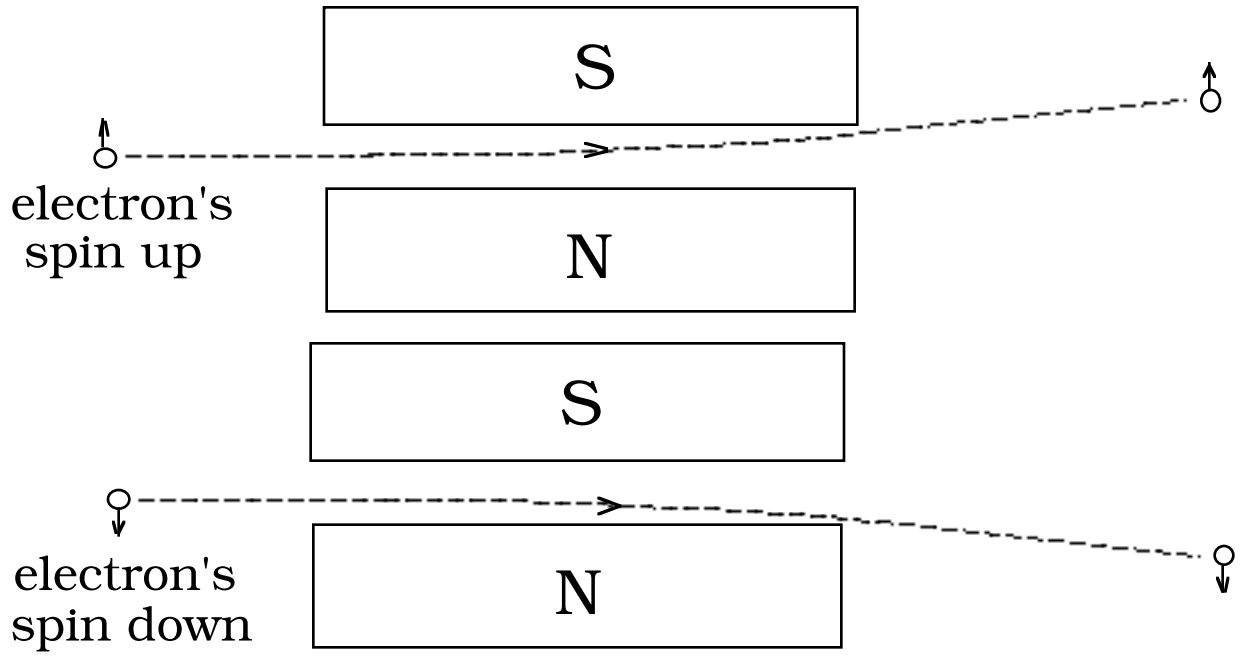


Fig. 2. Highly divergent magnetic field between poles of a Stern-Gerlach device causing electron with spin "up" to be deflected upward, and electron with spin "down" to be deflected downward.

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Finally consider two electrons A and B "entangled" in a state of total spin angular momentum $S = 0$ with wavefunction

$$\psi = \frac{1}{\sqrt{2}} \left| A\uparrow, B\downarrow \right\rangle - \frac{1}{\sqrt{2}} \left| A\downarrow, B\uparrow \right\rangle,$$

where $\left| A\uparrow, B\downarrow \right\rangle$ denotes electron A with spin up and electron B with spin down, and $\left| A\downarrow, B\uparrow \right\rangle$ denotes the opposite assignments. If electron A's spin is measured in a Stern-Gerlach device and found to be pointing up, then according to most physicists' interpretation of quantum mechanics, this immediately cancels the second term in the wavefunction so that electron B's spin must instantly point down. Similarly, if electron A's spin is measured and found to be pointing down, then this immediately cancels the first term in the wavefunction so that electron B's spin must instantly point up[2]. It is as if the electrons were aware of each other, consistent with my conjecture that the electron possesses some kind of elementary consciousness.

Although such entanglement has not been measured for electrons, it has been measured for pairs of *photons* in laboratories over short distances and also over several miles as reported by Weihs *et al.* [12] and Gisin[4] and references cited therein. Indications are that indeed, upon measurement of A's spin, B's spin is instantly determined, or at least far sooner than speed of light would allow.

In the three electron examples cited, quantum mechanics cannot predict in which wavepacket the electron will materialize, in which direction the electron's spin will point, or how the signal gets from electron A to electron B. If an electron's consciousness indeed plays a role in quantum mechanics, then consciousness must be an aspect of the electron's wavefunction. I will refer to it as the *conscious electron wavefunction*[3].

## 2. CONSCIOUS HUMAN WAVEFUNCTION

If electrons have some kind of primitive conscious wavefunction, then presumably the other elementary particles do too. This will include the other first-generation particles: the up and down quarks and the electron-neutrino. Since protons and neutrons are composed of (up, up, down) and (down, down, up) quark triplets, they should also have primitive conscious wavefunctions. Atoms and molecules, being composed of quarks and electrons, will likewise exhibit some kind of elementary consciousness, and so on up the chain until we reach human beings.

Human beings, being composed of atoms and molecules, of course have a (highly complex) wavefunction. If such a thing as a conscious elementary particle exists, then the human wavefunction will embody consciousness too. Is this wavefunction where human consciousness resides? Could it be that the human wavefunction and human consciousness are but two aspects of the same thing? I will speculate in the affirmative and call it the *conscious human wavefunction*[4].

If the human wavefunction is conscious, then presumably it can be directed by one's consciousness. Can it be directed beyond the physical body? Perhaps so.

Consider the work of Robert Jahn, Brenda Dunne, Roger Nelson and their collaborators in the Princeton Experimental Anomalies Research (PEAR) laboratory[6,7]. For over twelve years they have carefully tested human volunteers to see whether these people can, by mental intent alone, alter the output of a random number generator (RNG). The generator consists of a noisy diode whose output is amplified and clipped to produce a random series of positive and negative pulses. These are converted to 1s and 0s, usually in sets of 200 numbers; a typical set might look like 0, 1, 0, 0, 1, 1, 0, and so on for the total of 200 1s and 0s. In 839,800 sets, volunteers tried to increase the number of 1s, and in 836,650 sets they tried to increase the number of 0s. Although they were only able to change about 1 number in 10,000, the possibility that this occurred by chance alone is less than 1 in 14,000, since the total number[5,6] of 1s and 0 was 335,290,000.

The electromagnetic fields generated by the physical body are extremely weak and not likely to propagate far enough to affect the electronics of a RNG. Furthermore Jahn and Dunne have reported that the distance of the volunteer from the RNG does not appear to play a role. *Wavefunctions*, on the other hand, can leap large distances, as when collapsing after entanglement. They are more like an idea than physical reality. Therefore I speculate that the volunteers' conscious wavefunctions,

not their electromagnetic fields, interacted with the RNG. This is sketched in Fig. 3.

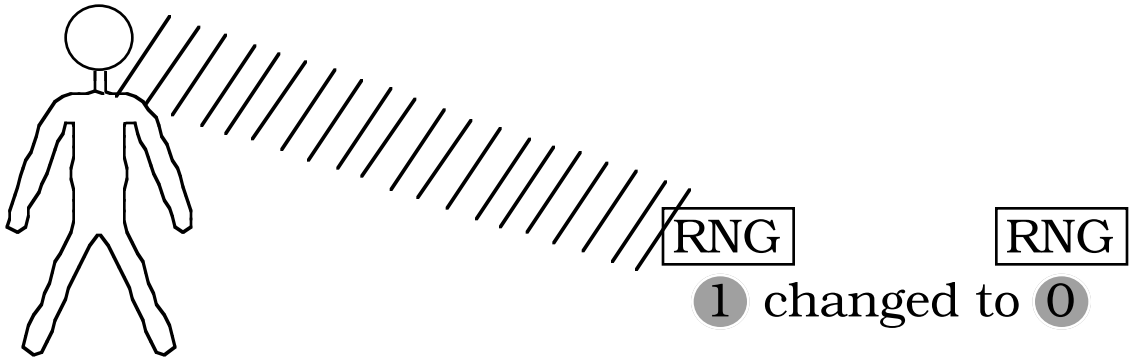


Fig. 3. Conjectured conscious human wavefunction interacting with an electronic Random Number Generator to alter a single digit.

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I estimate that altering a single digit might have called for an amount of energy $\sim\left(10^{-6}\,\mathrm{V}\right)\left(10^{-6}\,\mathrm{A}\right)\left(10^{-6}\,\mathrm{s}\right) = 10^{-18}\,\mathrm{J} = 6\,\mathrm{eV}$, plus or minus a couple orders of magnitude[7].

This suggests an experiment. If volunteers could direct $6\,\mathrm{eV}$ to alter a RNG digit one time in $10{,}000$ tries, then could they flip the spin of an electron every time if this only required directing $\sim 0.6\cdot 10^{-6}\,\mathrm{eV}$? This is the energy that would be required if the electron were immersed in a $50$-gauss magnetic field.

## 3. AN EXPERIMENT

If we want to flip the spin of an electron, then we need to know where the electron is and which way its spin is pointing. To see where it is, we can bind the electron as a spherically symmetric $s$-wave enclosing the closed-shell core of a $^{138}\mathrm{Ba}^{++}$ ion and then confine the combined $^{138}\mathrm{Ba}^{+}$ ion in a Paul trap in a volume of $\sim 1\,\mathrm{cm}^3$ at a pressure of about $10^{-10}\,\mathrm{torr}$. If we bathe the ion in a magnetic field and shine light from a tunable dye laser on it, then when the right frequency is reached, the ion will light up, emitting about $10^8$ blue-violet photons/sec. The human eye can accept about $10^4$ of these photons/sec, so the ion should be visible.

Technically, laser light of wavelength $\lambda_1 = 455\,\mathrm{nm}$ and circular polarization $\sigma^+$ excites the electron from the $6s_{1/2}, m_j = 1/2$ state to the $6p_{3/2}, m_j = 3/2$ state. The excited electron returns to its original state emitting another photon of wavelength $\lambda_1$. This cycle is repeated about $10^8$ times/sec. This is termed laser-induced fluorescence (LIF). See Fig. 4.

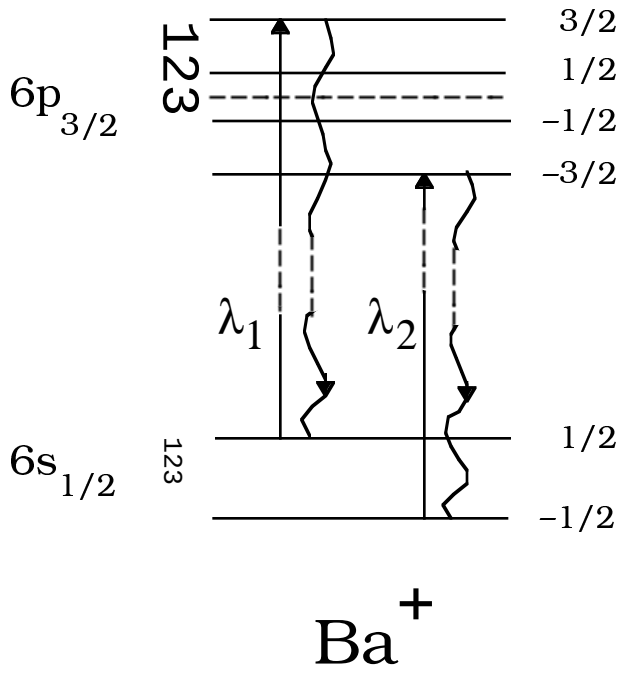


Fig. 4. Relevant energy spectrum of the valence electron of $Ba^+$ immersed in magnetic field. Laser-induced fluorescence is indicated for laser beams of wavelength $\lambda_1$ and $\lambda_2$. Data from Moore[11].

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The person now attempts to flip the electron's spin in its ground state. I conjecture that the person uses his or her conscious wavefunction, as sketched in Fig. 5.

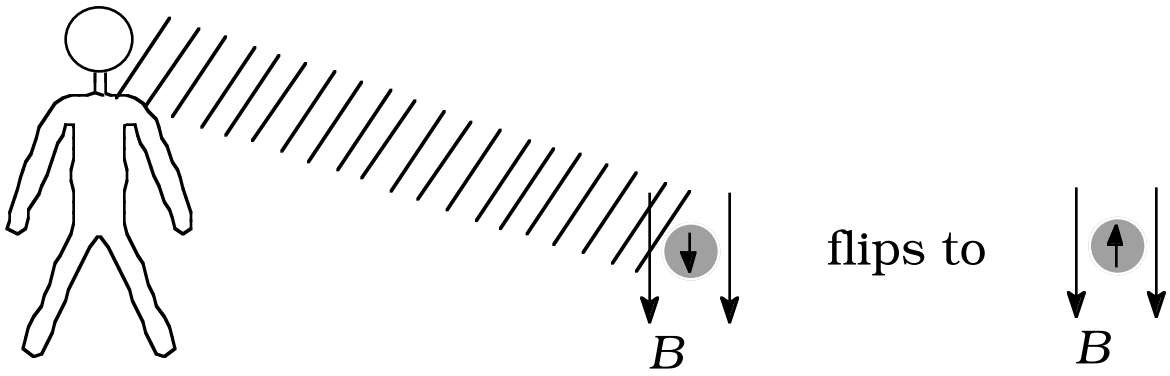


Fig. 5. Conjectured human conscious wavefunction flipping the spin of an electron in a magnetic field $B$.

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If the person succeeds in flipping the electron's spin, then the LIF will cease[8] and the ion will disappear from view. This happens because the electron will now be in the $6s_{1/2}, m_j = -1/2$ lower level, and the $\lambda_1$ laser light

will be trying to excite the electron to an energy where no level exists, namely the energy indicated by the dashed line in the $6p_{3/2}$ spectrum in Fig. 4. If the person succeeds in flipping the electron's spin again, then LIF will resume.

This suggests the possibility of sending a "mental" message. If a person could turn off LIF for a short interval (off), and turn it on for short or long intervals (on) or (oooon), then he or she could send the signals: on, off, on, off, on, off, oooon, off, oooon, off, oooon, off, on, off, on, off, on, off, which is SOS in Morse Code. Anyone watching the ion could read the message. One could send the Preamble of the U. S. Constitution.

We need to make sure that the impressed magnetic field $B$ is strong enough to spread the levels of the $6p_{3/2}$ excited states sufficiently far apart that their natural widths don't overlap. These natural widths are about $15\cdot10^6$ Hz wide, and the laser beam has a width of only about $10^6$ Hz, so separating the $6p_{3/2}$ levels by $100\cdot10^6$ Hz should be sufficient. It can be shown that the shift in the energy of the valence electron in a level of total, orbital, and spin angular momentum $j, l$ and $s$, respectively, and $z$-component of total angular momentum $m_j$ is

$$E = -\frac{e\hbar B}{2m} g m_j \equiv E_{jlsm_j},$$

where $g$ is the Landé g-factor. For the electron in any $p_{3/2}$ state, the Landé $g = 4/3$, so between two adjacent levels the difference in energy

$$E = \frac{4}{3}\left(\frac{e\hbar B}{2m}\right) = 2\pi\hbar\nu.$$

Thus if we want the $6p_{3/2}$ levels to be separated by an energy equivalent to a frequency $\nu = 100\cdot10^6$ Hz, then the impressed magnetic field

$$B = 3\pi m\nu/e = 54 \text{ gauss}.$$

The Landé g-factor $g = 2$ for the $6s_{1/2}$ levels, so with this same field, these levels will be split by $150\cdot10^6$ Hz. This is equivalent to the energy $E = 0.6\times10^{-6}$ eV, the energy difference between the electron with spin up and spin down previously stated.

A possible mechanism for this interaction between the conscious human wavefunction (CHW) and the electron's wavefunction is suggested by the Feynman diagram in Fig. 6. Here the CHW exchanges a vector boson with the electron's wavefunction, much as one electron can exchange a photon with another electron. I assume that the CHW is robust; that is, only a portion of it "collapses" when it has flipped the spin of the electron.

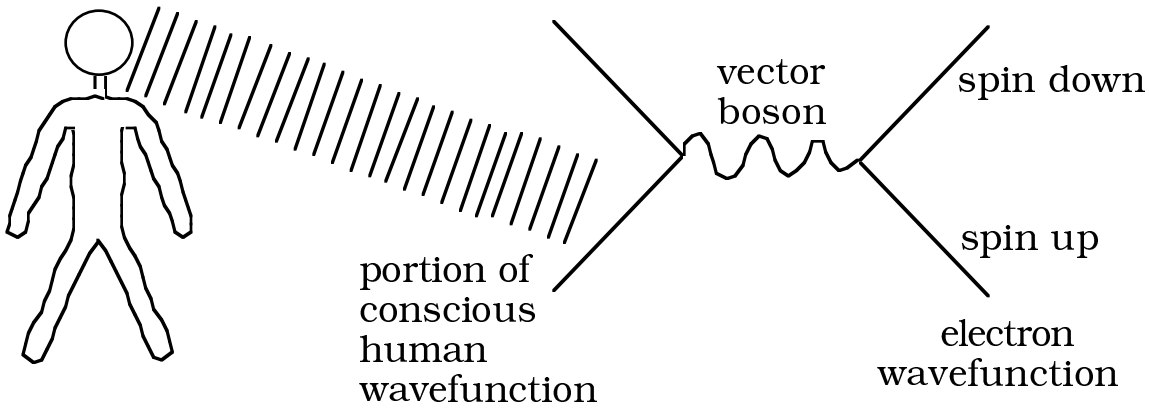


Fig. 6. Portion of conscious human wavefunction exchanging vector boson with electron's wavefunction to flip electron's spin.

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## 4. SUMMARY AND OUTLOOK

I have cited three examples in which an electron rather than an observer may have determined the outcome of a measurement: a wavepacket diffracted by a double slit and activating just one counter, an electron confronting a Stern-Gerlach device, and two well separated but entangled electrons both responding to the detection of the spin of one of them. I speculate that the electron is governed by an elementary conscious wavefunction. By symmetry, quarks and neutrinos will also have primitive conscious wavefunctions.

As humans are composed of electrons and quarks, they will of course have wavefunctions too, but *conscious* wavefunctions by my proposal. This may be the seat of human consciousness.

Conscious human intent may have occasionally altered the output of a random number generator (RNG) in studies by the Princeton Experimental Anomalies Research group. I speculate that such human intent was mediated by the operator's conscious wavefunction, perhaps by acting on the electronics in the RNG.

Very little energy is required to flip the spin of an electron in a weak magnetic field, so I propose an experiment in which a person might learn to flip the electron's spin every time. The electron of interest is bound as the single valence electron in a $Ba^+$ ion, and the ion is confined in a Paul trap at very low air pressure. The ion can be seen with the naked eye through laser induced fluorescence when finely tuned blue-violet laser light is directed to it. If the person succeeds in flipping the electron's spin, then the fluorescence stops and the ion disappears from view. If the person flips the spin again, then LIF will resume.

This suggests the possibility of sending a “mental” message. If a person could produce LIF in suitable long and short intervals, then he or she

could send a message in Morse Code. Anyone observing the blinking ion could read the text.

If a person can flip an electron's spin near the experimental setup, then research by Jahn & Dunne, and others, suggests that he or she can also flip the spin from across the street, or from another state. This experiment could be duplicated in well-equipped atomic physics laboratories.

Further studies of such a human-electron interaction might enable scientists to replace the human end of the link with purely electronic circuitry. This is reminiscent of the late eighteenth century experiments of Volta who discovered that the muscles of a frog's leg could be activated by electric current. Later of course we learned that electricity could excite inanimate devices as well.

Learning tapes put out by The Monroe Institute[10] indicate that a person attempting action at a distance will have a much better chance of success if he or she first of all believes that he or she *can* do it. Entering into a meditative state with no cares or external distractions is very helpful. The meditator might also imagine that he or she is extending an “energy bar” into a long “tube” which reaches over to the object with which he or she wants to interact. It might also help to “ask permission” of the object to interact with it. Finally, in this meditative state, he or she might ask for insight on how to perform the task, in this case to flip the spin.

Monroe's instructions appear to be consistent with the model that I have proposed. Extending the “tube” to the object sounds a lot like extending one's conscious wavefunction over to the electron. And asking permission of the object to interact with it seems to grant a certain parity to the object, just as supposing that the electron has an elementary conscious wavefunction gives it a certain parity with the volunteer's conscious wavefunction.

Further background and motivation for this research can be found in reference[2].

## ACKNOWLEDGMENTS

I want to commend Bill Groom for a talk that he gave at a gathering of grantees of the Lifebridge Foundation in Rye, NY (2000), as this prompted the idea of a conscious human wavefunction. Thanks are also due Brenda Dunne for explaining the statistics of the PEAR lab findings. I want to thank David Church and Hans Schuessler for carefully explaining how one might measure the spin of an electron. I also profited from in-depth discussions with experimental colleagues Nelson Duller and Robert Kenefick. Keli Lindelien gave essential insight on adapting Robert Monroe's taped instructions to flipping the electron's spin. I would also like to thank Swejen Salter and Maggie and Jules Harsch-Fischbach for insight and strong support in this research. Finally I would like to take this opportunity to thank Andreas Mershin and Michael Manson for constructive criticism and helpful suggestions.

## FOOTNOTES

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[2] This is David Bohm's version[1] of the Einstein-Podolsky-Rosen experiment[3]

[3] In this context, *wavefunction* seems like a poor choice of words to describe the phenomenon. Instead of electron wavefunction, it might be more meaningful to refer to it as the electron's *waveform*, since the wave exists whether or not we choose to parameterize it with a mathematical function.

[4] Robert Jahn and Brenda Dunne have used a quantum wavefunction as a metaphor to picture the interaction of the human consciousness with its environment[5,6].

[5]However these results were not replicated[8], when the PEAR group in coordination with groups at Freiburg and Giessen, Germany, repeated the PEAR experiments[7].

[6]The Princeton group also investigated whether volunteers could alter the paths of small balls cascading down a peg board, and found similar results although on a smaller data base. They also tested volunteers' ability to remote-view, *i. e.*, using just their minds, describe details of the locale where a scout was standing. Taken all together, Jahn *et al.* [7] report that the probability that all of these results occurred by chance alone was of the order of $10^{-13}$.

[7] Edwin C. May, Jessica M. Utts and S. James P. Spottiswoode[9] have argued that the PEAR volunteers did not alter the random distribution of 1s and 0s in the sets; rather they altered the random distribution of the run start times, where a run might consist of 50, 100, or 1000 sets.

[8]As it happens, the excited electron can also drop to the $5d_{5/2}$ or $5d_{3/2}$ level, ending LIF. This can be avoided by simultaneously shining diode laser light on the ion to excite the electron back to the $6p_{3/2}$ level.

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