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**INTUITION:  
WHAT SCIENCE SAYS (SO FAR)  
ABOUT HOW AND WHY INTUITION WORKS**

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**Abstract:** Intuition is defined for the purposes of this analysis as: the appearance in the mind of accurate information about the external world, which can be shown to have come not through the five senses, nor through a rearrangement of stored memory contents. Forms of intuition obeying this definition have been explored scientifically under such labels as telepathy, precognition, presentiment, and remote viewing. This paper summarizes those scientific findings, and presents a few theories which have been hypothesized to explain them. Those theories are largely based in theoretical physics, including quantum non-locality, holography, and complex space-time. Related biological theories are also cited, which propose to explain how information might move from the subatomic level up into waking consciousness, for example through DNA structures or neuronal microtubules.

**Keywords:** Telepathy – Precognition – Quantum – Hologram – Space-time

## 1 Introduction

Probably all of us can recall occasions when we've had a strong "hunch" or intuition about some person or event. Most often it came as a quick "flash" of information — perhaps about a person's trustworthiness, or about an impending event's danger or success. This morsel of information was not a conclusion we'd arrived at after lengthy, rational cogitation, assessing evidence we'd gathered deliberately over a long period of time. Nevertheless, the "flash" turned out to be true — which, ironically, may then have engendered a conflict of feelings within us.

For on the one hand, we were pleased to find ourselves "right" about the person or the future event. But on the other hand, we may have felt troubled, because we didn't know how we'd gotten that accurate information, and therefore we weren't sure how to summon up the ability again in the future or even, whether to trust it. Consequently, we may have decided to dismiss the episode as a chance coincidence, and decided that it did not really constitute a reliable way to acquire accurate information.

But what if science were to study such occasions of 'hunches', monitoring them under controlled laboratory conditions, counting the number of accurate and

inaccurate ‘flashes’? Would the results equal chance — thereby demonstrating that indeed, such occasions of accuracy are merely coincidence? Or would the experiments reveal that persons experience such accuracy at rates significantly greater or less than chance? And if they occur more often than chance, could the scientific method help us learn how and why they occur?

## 2 Findings

For at least 100 years, scientists have in fact been studying forms of intuition under controlled, laboratory conditions [1]. By ‘intuition’, for the purposes of scientific study, we mean:

the appearance of accurate information in the mind of an individual, concerning events, persons or locales outside that individual, which can be shown to have come not through the five senses, nor through a rearrangement of the individual’s stored memory contents.

This definition is faithful both to our common subjective experience of intuition and to our scientific need for ‘operationalizing’ a phenomenon in order to subject it to controlled research [2].<sup>a</sup>

In practice, this definition includes three types of intuition that scientists have tried to study:

- (i) information which we gain from another *person* (informally called ‘telepathy’)
- (ii) information which we gain about another *place or object* (sometimes called ‘remote viewing’ or ‘clairvoyance’)
- (iii) information which we gain about *the future* (which for scientific purposes is divided into ‘precognition’ [thoughts] and ‘presentiment’ [feelings]).

The next three sections review the research that has been attempted in each of these areas (and has been published in the English language).

### 2.1 Research on ‘telepathy’ (*person-to-person transmission*)

Beginning in 1927, Prof. Joseph Rhine conducted laboratory experiments at Duke University in North Carolina (USA), in which one person would select a card from a well-shuffled deck and would mentally concentrate on its image while another person some distance away would note down the image that

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<sup>a</sup> Broader than this definition is the common usage of ‘intuition’ to mean realizations that *do come from stored memory contents* — as when an artist or scientist at first gives up consciously trying to solve a particular creative problem and then a day or two later, thinks of a solution while doing something else — taking a walk, a shower, or in a dream. That is a process of *creativity*, and is worthy of scientific study in its own right. But it is distinct from the acquisition of information that exists originally outside the individual’s mind, such as items perceived through forms of intuition known as precognition or remote viewing.

appeared in his or her mind. Dr. Rhine and his colleagues used a set of 25 cards designed especially for this purpose. Each card contained a simple symbol: circle, square, star, etc. In a series of experiments spreading over the following 13 years, they accomplished almost one million trials. Twenty-seven of those 33 studies produced statistically significant results; that is, the ‘receiver’ or ‘guesser’ correctly identified the card being viewed by the ‘sender’ at rates greater than chance. Colleagues at other institutions began to replicate Rhine’s procedure, and 61% of those other laboratories’ replication experiments also yielded statistically significant results — whereas only 5% would have been expected by chance [3].

A different laboratory method for testing person-to-person transmission was created by Dr. Charles Tart working at the Massachusetts Institute of Technology (USA) in 1963. Instead of asking a ‘receiver’ to record an image appearing in his mind while a ‘sender’ gazed at a card, Tart measured the *bodily reactions* of the receiver when a stimulus was applied to the body of the sender. (Let us recall that the root meaning of tele-pathology is “*feeling* [pathos] at a distance [tele]”). The two individuals were located in separate rooms. To ascertain the receivers’ bodily responses, Tart monitored their brain waves, finger pulse blood volume, and skin electrical conductance, and found that the first two, brain waves and peripheral blood volume, changed significantly when the stimulus was engaged at or near the sender (Table 1) [4]. (The table’s bottom row reports the statistical significance of each physiological indicator’s data: the smaller the  $p$  value [the probability that the data would have occurred by mere chance], the greater the possible causal link).

Table 1. Body-to-body telepathy trials [4].

Distribution of Finger Pulse Volume, GSR, and EEG Responses							
Type of Trial	Finger Pulse Volume		Galvanic Skin Response		EEG Complexity (Sums of Ranks for Wilcoxon Matched-Pair Signed-Ranks Tests)		
	Stimulus	No Stimulus	Stimulus	No Stimulus	Stimulus	No Stimulus	Number of Paired Comparisons
<b>Shock</b>	35	25	60	57	21,508.5	14,808.5	269*
<b>Nonshock</b>	47	12	77	49	19,756.5	14,434.5	261**
	<i>p</i> < .01 two-tailed		<i>p</i> < .10 two-tailed		* <i>p</i> < .01 two-tailed ** <i>p</i> < .05 two-tailed		

Changes in a person’s peripheral blood volume and galvanic skin response are indicators of the human ‘fight-or-flight’ response, a coordinated activity of our autonomic nervous system. And changes in brain wave patterns indicate significant, even if subconscious, mental activity. Combined, these measures potentially offer researchers an opportunity to track reactions of the human

organism to particular events, even if such reactions never emerge into conscious portions of the mind.

A larger study utilizing this strategy was conducted by Drs. Marilyn Schlitz (Institute of Noetic Sciences) and William Braude (Institute of Transpersonal Psychology, both in California). These researchers analyzed 19 laboratory experiments conducted in Edinburgh, Scotland and California between 1979 and 1996 in which professional ‘healers’ had directed their thoughts toward individual volunteers located in separate rooms, at time intervals dictated by a randomized scheduling device. In between those ‘sending’ intervals, the healers rested, allowing their thoughts to move onto other matters. The recipients’ skin conductance was measured. A total of 105 senders and 317 recipients were observed, and in most cases, the bodies of the recipients registered a change at the moment when the senders’ thoughts were being focused on them. When the senders rested, the recipients’ physiologies likewise returned to the more normal, quieter state. The statistical significance of these changes was quite high:  $p = .000054$ , and the single-mean T-test reported a success rate of 37%, compared to only 5% had these correlations been occurring by chance [5].

During the same two decades, in parallel with such mind-to-body studies, a large number of mind-to-mind experiments were conducted. Forty studies, comprising 2,549 sessions by 10 different research teams used the “Ganzfeld” procedure, which isolates receivers from auditory and visual stimuli by covering their ears with earphones through which white noise is played, and by covering their eyes with white cups onto which soft red light shines. This is done to decrease the usual stimuli that enter a person’s brain, so that the individual might more readily notice any non-sensory information available. To test whether mind-to-mind information might somehow be conveyed by a form of electromagnetic radiation (like radio waves), the researchers enclosed the recipients within steel walls and Faraday screening. Each sender was shown one of four pictures, either on a card or a video screen, at randomized intervals; and each recipient wrote down what came into her or his mind. Despite the steel and copper shielding, the receivers’ overall accuracy rate was 33.2%, which elementary statistics predicts should occur by chance only once in  $10^{15}$  attempts (Figure 1) [6].<sup>b</sup>

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<sup>b</sup>In response to the objection that such high statistics might have been caused by unsuccessful studies having been withheld from publication, a calculation was made of that thesis, which revealed that 15 studies would have had to have been conducted and hidden for every one of the published studies, in order to be the sole cause of the published studies’ combined success rate [6, p.80].

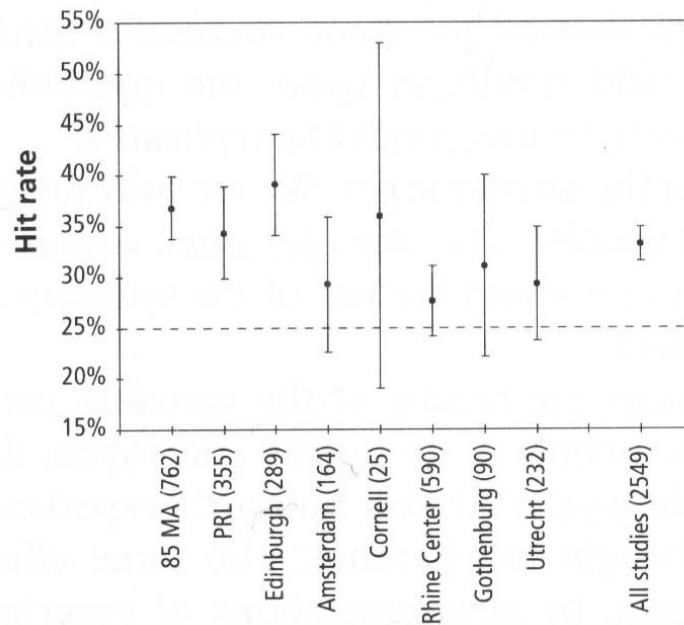


Figure 1. Telepathy experiments using the Ganzfeld technique [6].

## 2.2 Research on ‘remote viewing’ (person perceiving a place or object)

As he was with telepathy, Prof. Joseph Rhine was one of the first researchers to rigorously investigate remote viewing (which he called ‘extra-sensory perception’) — that is, the appearance in a person’s mind of accurate information about a location or object out of range of his five senses. In these experiments, there is no human ‘sender’ of information, only a receiver and a ‘target’ object selected at random so its identity is also unknown at the time to the experimenter. Rhine used the same symbol cards he had devised for his telepathy experiments, but concealed them within opaque, sealed envelopes, in later trials also placing those sealed envelopes behind an opaque screen, and in still later experiments putting the sealed envelopes into different rooms and buildings from where the perceivers were situated. All told, Rhine and his colleagues conducted 34 such studies between 1934 and 1939, amounting to 792,000 trials [3].

Because there were five possible images in each trial, pure chance would have led to a success rate of 20%, but Rhine’s subjects were correct 21.52% of the time. Most of his subjects were average university student volunteers, not persons who claimed to be ‘gifted clairvoyants’. So of particular interest to science is a more recent series of experiments that searched for and found individuals who repeatedly manifested higher rates of success. This series was

conducted between 1973 and 1988, funded initially in secret by the US Central Intelligence Agency at the Stanford Research Institute in Palo Alto, California. The experimental procedure was to place into a sealed envelope a photograph or the geographical coordinates (longitude and latitude) of a particular locale, and to ask the percipient to describe what he or she saw at that locale. Percipients were allowed to describe the location not only verbally but also graphically, that is by drawing on paper the scene they perceived in their mind's eye. Independent judges were then shown a set of photographs, some of which showed the actual site (depicting its landscape, buildings, etc.) and others which showed other locales. The judges were not told which photographs were the correct ones, but were asked to match the percipient's description and drawings to one of the photographs. Over 9,700 trials were conducted, and the probability that their high accuracy rate could have occurred by chance is estimated by elementary statistics to be only one in  $10^{11}$  [7,8].

### ***2.3 Research on 'precognition' and 'presentiment' (person perceiving the future)***

Perhaps the form of intuition most familiar in the life of the average person is a hunch about *the future*: we feel, suspect, or have a premonition, that something will 'turn out bad', or that, against all likelihood, some effort will be successful. Can this, too, be studied scientifically, under controlled laboratory conditions?

Scientists have been trying to do so at least since 1935, and by 1989 309 studies had been published in English that could be subjected to a collective assessment. Dr. Charles Honorton (Psychophysical Research Laboratories, Princeton, New Jersey) and his colleague Diane Ferrari analyzed that collection. In all the experiments, the subjects had been asked to predict a target (symbol cards in the 1930s, computer-displayed numbers by the 1980s) that would be selected in the future by a randomized process. The time interval tested in these experiments between the subject's prediction and the future generation of each target varied from less than one second to a full year. In total, nearly two million such trials were performed under strict laboratory conditions by more than 50,000 subjects, in experiments conducted by 62 different researchers. The overall accuracy of the predictions made by the experimental subjects had the probability of occurring by chance, according to elementary statistics, of only one in  $10^{25}$  attempts [9].<sup>c</sup>

Besides making *conscious predictions* about the future, humans have been observed to experience sometimes-difficult-to-articulate *feelings* about the future. Indeed, this is commonly how most of us experience a 'hunch' — as a

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<sup>c</sup> In response to the objection that such high statistics might have been caused by unsuccessful studies being withheld from publication, that thesis was calculated statistically: 14,268 negative studies would have had to have been conducted and hidden in order to be the sole reason for these positive results [9].

feeling, often in the ‘gut’, rather than as a clear image or thought in our conscious mind (‘head’). Scientists use the term *presentiment* for such feelings, from the Latin words “sentir” (to feel) and “pre-” (before) — that is, to feel an event before it occurs. In the 1990s, this form of intuition was subjected to laboratory investigation, in particular by Dutch psychologist Dick Bierman at the University of Amsterdam and by American researcher Dr. Dean Radin at the University of Nevada. Both investigators monitored the usual physiological indicators of their subjects’ emotions — heart rate, skin conductance, and peripheral blood volume — while computers randomly displayed pictures of two types: calm, pleasant scenes of nature and happy people; or disturbing, violent or erotically stimulating scenes. As Figure 2 shows, the subjects’ bodies reacted differently *before* they saw each type of image, not only *after* their eyes took in the image [10].

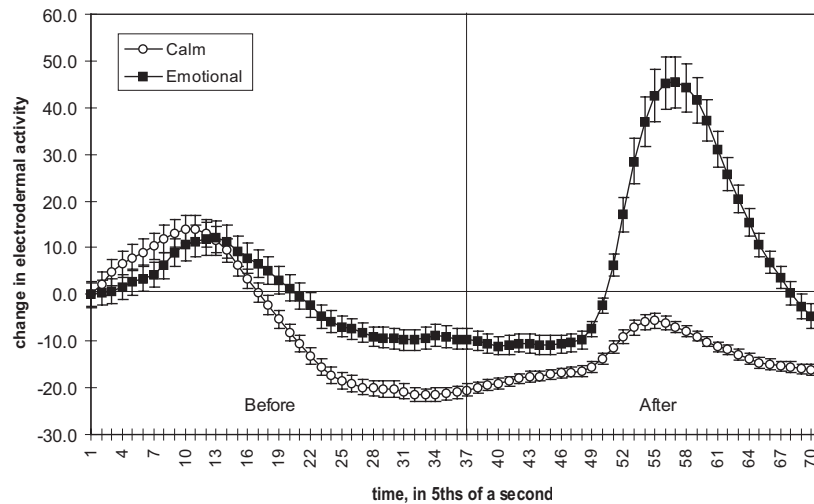


Figure 2. Presentiment experiment, showing differences in subjects’ physiology before, not only after, emotional (violent or erotic) images were displayed, as compared to calm images [10].

In subsequent research, Dr. Bierman observed the internal brain activity of his subjects (using functional magnetic resonance imaging) when they were shown each type of picture, and again he found distinct differences *before* the violent-emotional pictures were shown, in comparison to the calm pictures. In particular, brain regions near the amygdala (where we process certain strong emotions, including fear and sexual drive) exhibited activation before the violent and erotic pictures were shown, but not before the pleasant and calm pictures [11].

### 3 Theories

When one considers together these findings about presentiment, precognition, remote viewing and telepathy, at least four generalities emerge, which, therefore, any theory seeking to explain intuition would have to account for:

- From remote viewing experiments, during which some perceivers were separated by thousands of miles from their targets, one observes that the human ability to acquire information intuitively *does not decrease with distance*.
- From presentiment and precognition experiments, it appears that intuition is *not limited by the normal causal relations of time* (since the cause of the perceivers' knowledge or emotions took place only after their response was measured).
- From the shielding of recipients by Faraday cages and steel walls during telepathy experiments, it seems fairly certain that *electromagnetism cannot be the 'carrier wave'* for intuitive information traveling between persons.
- The skill of intuition appears to be more developed in some persons than in others, and can vary over time, so it therefore may be an inherent skill, like athletic or musical ability.

During the past one hundred years of research, many theories have been proposed to explain how intuitive information transfer might be possible. Very often, those theories — as typically occurs in the development of any science — 'borrow' a mechanism better understood in another area of science to try to explain the phenomenon at hand. For example, in the 1930s a theory was put forward that telepathy was 'mental radio' [12], building upon the recent discovery that radio waves could be modified to carry information over long distances.<sup>d</sup>

In our day, theorists have borrowed models from quantum physics, special relativity, and holography (the science of holograms) in their attempt to explain the characteristics of intuition observed in the laboratory data. For example, because of intuition's apparent independence of distance, theorists have explored the quantum phenomenon of entangled non-locality. And because of intuition's independence of forward-only time, they have delved into elaborations of Einstein & Minkowski's space-time model. In an attempt to account for intuition's access to information about seemingly any location, theory-builders have explored the holographic principle, by which information about the whole can be contained in any of its minute parts.

The remainder of this article examines those theories, organized into the three categories we used when considering the empirical studies:

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<sup>d</sup> Since that time, as we've already mentioned, the use of Faraday caging has shown that electromagnetic signals, including radio waves, can not be the main carrier of intuitive information.



- (i) intuition between one person and another — or, using mathematical symbols, when  $A$  acquires information concerning  $B$ :  
$$\mathbf{A} \leftarrow \mathbf{B}$$
- (ii) intuition that involves  $A$  acquiring information about a place or locale ( $L$ ):  
$$\mathbf{A} \leftarrow \mathbf{L}$$
- (iii) intuition whereby  $A$  acquires information now (at time  $T_1$ ) about the future (time  $T_2$ ):  
$$\mathbf{A}_{T_1} \leftarrow \mathbf{X}_{T_2}$$

None of these theories yet claims to have been proven. Rather, they are based on some empirical work already done, and they point to the kinds of empirical investigations that might fruitfully be undertaken in the near-term future.

### 3.1 One theory component: Receiving from another person [ $A \leftarrow B$ ]

In order to account for the effect ‘healers’ were observed to have on their target subjects (as in the experiments of Schlitz & Braude [5] described in Section 2.1) and to account for other forms of mind-to-body and mind-to-mind transmission, Professor William Tiller of Stanford University’s Department of Materials Science and Engineering (Palo Alto, California) has extended the particle-wave duality discovered by modern physics into a larger theory that posits two types of sub-space in our universe:

- (i) a “coarse, *particulate*” subspace, in which electric charge plays a key role, and
- (ii) a “fine, information *wave*” subspace, in which magnetic force plays a key role [13].

The first subspace is our familiar world of physical matter, which science describes mathematically by using distance and time coordinates. Dr. Tiller calls this familiar realm Direct (or ‘D’) subspace. The other, which he calls Reciprocal or R-subspace, is a portion of the realm described by quantum physics as the ‘vacuum’, from which particles continually emerge and into which particles continually disappear (although Tiller cautions that R-subspace is only the “coarsest” level of the vacuum, not its entire domain).

Electromagnetism (*e.g.*, light, heat, cosmic rays, etc.) plays a central role in both subspaces, but with inverse characteristics: whereas *electricity* can exist in our D-subspace as a monopole (that is, a negative electric charge can exist on a particle without that particle also having to contain a corresponding positive electric charge), a *magnetic* monopole (that is, a ‘north’ magnetic pole existing on a particle without a corresponding ‘south’ magnetic pole) can not. This results in the fact that we observe electric *currents* (flows of particles carrying solely negative electric charges) in our daily world, but we don’t observe magnetic currents (which would be flows of solely north-charged, or solely south-charged, units). However, in R-space, magnetic currents and monopoles

do exist, hypothesizes Tiller, building on the physics and mathematics of Harmuth [14] and Barrett [15] who resolved long-standing problems inherent in Maxwell's equations of electromagnetism by introducing into those equations *magnetic current density*, and by building on the work of Seiberg & Witten [16] who found that key singularities in quantum field theory also could be eliminated by the introduction of magnetic monopoles. The relevance to intuition enters at this point: just as information is transmitted over long distances in our familiar D-subspace on carrier waves of electromagnetism (radio, visible light, etc.) at the speed of light (the velocity ' $c$ '), in Reciprocal subspace, information can be transmitted at much higher speeds, up to  $c^2$ , on carrier waves of magneto-electricity [13]. Human intention and emotion, Tiller has observed in the laboratory [17], can modulate such magnetic waves traveling through R-space, which then, one proposes, could be received and decoded by another human to correctly report what had been in the mind of the 'sender'.

But how could human intention, emotion, and other characteristics of mind cross from our familiar domain into the hardly-ever-measured domain where magnetic currents might be traveling? While R-space, like the rest of the vacuum of which it is one part, is normally chaotic (entropic), its chaos/entropy seems to be reduced (*i.e.*, its symmetry apparently increases) in the vicinity of human individuals when those individuals move themselves into more coherent (*e.g.*, meditative) states [18,19]. Once in that more symmetric state (estimated as being greater than the U(1) and significantly towards the SU(2) Gauge symmetry level [20,48]), magnetic waves can be propagated into R-space by the human mind, modulated by (and therefore carrying) the information-content of the sender's mind, as detailed by the precise Fourier transform equations<sup>e</sup> which the human brain has been empirically observed to use to encode its visual — and perhaps other — experiences [21–23]. In this way, the image in the mind of the sender is encoded into magnetic wave-forms that spread out from that person at great speed.

To illustrate the considerable power which humans possess to propagate such electromagnetic (and theoretically, magnetoelectric) waves, Tiller cites the laboratory measurements taken by Dr. Elmer Green and his colleagues at the Menninger Clinic (then in Topeka, now in Houston, USA). That team found healers' output of electrostatic charges to be fully 103 times greater than the average person's galvanic skin response, 105 times greater than the average electrocardiogram (heart) voltage, and 106 times greater than the average electroencephalogram (brain) voltage [24]. To this Tiller adds empirical evidence which implies that parts of the human anatomy may function at the SU(2) level of Gauge symmetry [25], the coherence level he predicates as enabling the generation of magnetic carrier waves.

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<sup>e</sup> The Fourier transform is a mathematical representation of images in terms of frequency, magnitude, phase, and orientation, rather than mapping the images as bits or pixels.

When the mind of a second person, the ‘receiver’, is impinged upon by such encoded magnetic waves, it responds instinctively to apply the Fourier transform that it uses for many forms of perception, thereby decoding the waveform and hence becoming aware of the image that resided in the sender’s mind. The telepathic transmission is thereby accomplished.

### ***3.2 A second theory component: Perceiving other locales [A←L]***

The same Fourier transform equation has also made possible the industrial creation of holograms: 3-dimensional projections from 2-dimensionally-stored data. Dr. Edgar Mitchell (Institute of Noetic Sciences, USA) and Dr. Peter Marcer (British Computer Society, UK) combine this efficient information-storage capacity of the hologram with the observed phenomenon of quantum non-locality to propose a theory of how an individual can perceive objects or locations at great distances, even when there is no ‘sending’ human mind at that location to encode the image onto putative magnetic waves [26,27].

Marcer points out that any wave field (be it acoustic, electromagnetic, quantum mechanical, or other) that impinges upon a physical object, has parts of its amplitude and phase altered because of that impact [28]. This occurs not only because a portion of the wave gets reflected back from the surface of the object, but also because portions of the wave get *absorbed* by the object. Thirdly, as a result of that absorption, the object may be energized to emit a wave back outward, at least part of which may travel towards the source of the first wave. All three of these facts result in a communication of information returning to the source of the initial wave which conveys directly, through the spectral Fourier transform of holography, attributes of the object that was impinged, including its shape, color, temperature, substance, etc.

Citing Walter Schempp’s elucidation of the successful focusing of such quantum level information into meaningful images as achieved by devices that perform Magnetic Resonance Imaging (MRI) [29], Mitchell points out that the information conveyed by a returning wave (in particular its particles’ spin numbers and their polarization [26: 300]), inevitably reveal the object’s internal and microscopic, not merely its external and macroscopic, features. In cooperation with Schempp, Marcer developed a model of how the human neuron may process such quantum-level information [30], and also how the assembly of neurons we call the brain might bring that information into useful awareness [31].

In their models, Marcer and Schempp emphasize that the human neural system can retrieve quantum-holographic information from an external object only because it establishes a “phase conjugate adaptive resonance” with that object [27: 158–160]. By this they mean that the neural system combines the incoming wave with its own wavelets optimized to reconstruct the interference pattern that initially established information into the wave field when it interacted with the

external object. Marcer and Mitchell postulate that this human-generated resonant frequency also functions as an *outgoing* wave (which is experienced subjectively by the individual as “paying attention to”, attending to, the external object). As evidence that human attention can be a physically consequential force when directed externally, Mitchell cites laboratory data from thousands of trials, at first pioneered by Helmut Schmidt at Boeing Laboratories and then developed further by Drs. Robert Jahn and Brenda Dunne at Princeton University, in which focused human attention apparently altered the behavior of random-event mechanisms, both material and electronic [32,33].

When brought together, all this may explain remote viewing, as follows:

- (1) An individual calms his normal, thinking mind and directs his mental attention towards a particular location (not visible to his eyes).
- (2) That act allows the individual’s neural system to establish a phase conjugate adaptive resonance with the quantum-mechanical level of objects at the distant location.
- (3) So long as that vibratory resonance is maintained, the individual’s neural structures can apprehend holographic information available through quantum entanglement.
- (4) The holographic information is converted by the brain through a Fourier transform process into visual imagery and other sensations.
- (5) The individual sketches and/or verbalizes the imagery and sensations, thereby giving to other persons a report on the scene at the remote location.

Unlike the model of Tiller and Dibble described in Section 3.1, this model does not invoke magnetic waves as the means of transmission from the source to the receiver’s mind. Instead, it insists on quantum-nonlocality as the basis for the remote viewer’s connection to the distant location. Nevertheless, both models are happy to incorporate the known use by the brain of Fourier transforms, in their explanation of its processing of (the remote) perceptions.

### **3.3 A third theory component: Perceiving other times $[A_{T1} \leftarrow X_{T2}]$**

Probably the toughest job in theory-proposing with regard to the laboratory data reported in Section 2, is the challenge of explaining the cause-and-effect dynamics that could lead to precognition and presentiment. Frankly, what could account for a person’s body or mind correctly knowing what a randomized computer process will be generating in the future?

Not shrinking from this challenge, Dr. Elizabeth Rauscher and physicist Russell Targ (Bay Research Institute, California) have offered an extension of relativity theory’s Einstein-Minkowski 4-dimensional space-time into eight dimensions, in order to explain such events [34]. They conceive of the four additional dimensions as counterparts to the four traditional ones, so they have mapped out three additional space dimensions and one additional time dimension.

Mathematically, these four new dimensions they designate by multiplying the original dimensions ( $x$ ,  $y$ ,  $z$  and  $t$ ) by the square root of  $-1$  (conventionally symbolized as the coefficient  $i$ ). This has the consequence that between any two points in the 8-dimensional space-time universe<sup>f</sup> there is always a path that has zero units of separation.<sup>g</sup> In near-layman's language, *non-locality* is thereby demonstrated to be true of *time*, not just of space. So any two points in time can become adjacent: for instance, something that will happen in the future we can be aware of now. And that is what the laboratory experiments on presentiment and precognition seem to confront us with.

Rauscher and Targ's eight-dimensional space-time metric does not violate any of the equations of Maxwell, Einstein, or Schrodinger. Indeed, one might appreciate the Transactional Interpretation of quantum mechanics [35,36] as *requiring* the kind of attention to connections between the 'future' and the present which Rauscher and Targ have explicated. As the Polish theoretical physicist Bialynicki-Birula insists:

The very structure of all quantum theories suggests...that *two copies of space-time*, rather than one, are the proper arena for all quantum processes. ... Every set of equations and formulae in quantum theory, from which all the transition amplitudes are determined, may always be written in two equivalent forms, differing by *complex conjugation*. We obtain one set from the other by *reversing the sign of the imaginary unit  $i$* . [37]

So for physics' own needs, not just for accommodating the data on human intuition, it would seem necessary to adopt 8-dimensional complex space-time into fundamental theory.

### **3.4 A fourth theory component: Registering the perceptions into waking consciousness [the 'biology of intuition']**

Already, some of the theories we examined in Sections 3.1–3.3 included hypotheses about how the human neural system might decode and make available to the conscious mind the information that was acquired during intuitive experiences like telepathy and remote viewing. For example, more than one theory included the Fourier transform process, by which the human neural system has been empirically observed to encode 3-dimensional experience into easily stored and retrieved holographic markers [21–23]. As a completion to this article, we mention five physiological components that have been identified as possibly participating in the pathway of intuitively-acquired

<sup>f</sup> The authors point out that eight is the *minimal* number of dimensions required, if nonlocality — demonstrated empirically by Aspect and Gisin — is to be consistent with the Poincaré and Lorentz invariances.

<sup>g</sup> Using the multi-dimensional Minkowski triangle, a hypotenuse can always be found to connect the two points of interest, such that the sum of the squares of the sides of the designated apex angle will be zero. This is so because one of the distances will always be negative — since  $i$ , the square root of its negative coefficient, becomes squared:  $x^2 + (iy)^2 = 0$ .

information, from the boundary of the receiver's body into that person's conscious awareness.

#### 3.4.1 *Meridian points and channels*

Recalling the Tiller-Dibble model of information traveling from one mind to another on superluminal magnetic waves (Section 3.1), such waves could only be detected, according to that theory, by portions of the receiving human body that could develop an  $SU(2)$  level of Gauge symmetry or coherence. Tiller has identified the acupuncture meridian system as one such portion of the human body [25]; and empirical measurements of the skin locations traditionally identified by Chinese medicine as acupuncture points do indeed reveal an electrical conductance 20 to 40 times greater than all other regions of the human skin [38]. These locations, then, could logically be where magnetoelectric waves might most easily enter the body, to be decoded subsequently, perhaps, by other biological structures.

#### 3.4.2 *DNA as transducer*

As chief nominee to be one of those other structures, some investigators have proposed the DNA molecule that is present in the nucleus of every cell. Those authors point out that DNA's characteristic double-helix structure makes it intriguingly apt to participate in information transfers:

- (i) The molecule's longitudinal configuration might allow it to function as a *blade antenna* in response to incoming electrical waves;
- (ii) simultaneously, the molecule's circular shape (when viewed on-end) might allow it to function as a *ring antenna* in response to incoming magnetic waves. {So far, (i) and (ii) are speculations [39]}.
- (iii) Some empirical evidence indicates that the DNA molecule can, in effect, 'store' information impinging on it from electromagnetic waves by vibrating as a solitonic wave, and then can release that same information, carried on its own generated, coherent light [40].
- (iv) The 90% of the DNA molecule which does *not* contain genes for protein synthesis exhibits the mathematical characteristics of language (syntax, grammar, etc.), suggesting to some investigators that information might also be stored and transferred at that level [41].

#### 3.4.3 *Neuronal microtubules*

Alternatively, if intuitive information does not arrive on superluminal magnetic waves as Tiller and Dibble have proposed, but is instead apprehended through quantum-hologram phase resonance as Mitchell, Marcer, and Schempp have proposed (Section 3.2), then the transduction may occur as British mathematical

physicist Roger Penrose and American anesthesiologist Stuart Hameroff have suggested: nerve cells contain microscopic structures, called ‘microtubules’, which can respond consistently to changes at the quantum level [42]. The particular neuron experiencing those changes can then communicate its response through 4-nanometer-sized gap junctions to adjacent neurons, thereby amplifying the original quantum event to a many-neuron synchronized discharge and sending that on to areas of the brain involved in conscious awareness.<sup>h</sup>

#### 3.4.4 Cranial processing

Once the neuronal microtubules, DNA, or other transducing structures have converted the magnetically or quantum carried information into conventional neural impulses, those signals can travel to the brain for processing. Empirical measurements gathered by Dr. Rollin McCraty and his colleagues at the HeartMath Institute in California reveal the brain’s frontal lobes to play an active part in this neural journey of intuitive information [43]<sup>i</sup> — as did previous research conducted by neuroscientists Norman Don and Charles Warren [44,45].

Experientially, people sometimes report that intuitive information first emerges into their awareness as a vague *sensation*, then becomes a partially-focused *image*, and finally (if ever) becomes specific enough to be put into *words* [46,47]. This movement from sensation or image into words has been correlated with brain processes proceeding from the right hemisphere into the left (via the corpus callosum). Significantly, once the information has traveled into the left hemisphere, we also frequently experience our critical, judgmental faculty (which also seems to be coordinated primarily by the left hemisphere) raising doubts about the validity of the image or sensation. An assessing dialogue then ensues, at the end of which we either decide to accept the image/sensation (or at least to report it to others while maintaining our own skepticism), or to reject the information — especially if we feel uncomfortable being unable to fit it into our pre-existing expectations, or our worldview.

#### 3.4.5 Also the heart

Between the neurons of the body and the lobes of the brain, significant activity takes place in the heart’s neural system during at least some forms of intuitive perception-processing. Dr. McCraty and his colleagues observed consistent changes in heart rhythms *prior* to changes in the brain’s frontal lobes, in persons

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<sup>h</sup> Hameroff and Penrose have responded to colleagues’ objections that the brain is too “wet, warm, and noisy” to permit coherent utilization of quantum events as information carriers, by directing critics’ attention to the finely-tuned cycle by which actin gels emerge and effectively shield the critical microtubule regions from thermal decoherence.

<sup>i</sup> Men differ from women in this respect, involving not only their frontal lobes but also portions of their occipital, temporal, and to a lesser extent parietal lobes in the processing of intuitively-acquired information [43: 330].

exhibiting receipt of presentiment intuition [43]. Subsequently, EEGs indicated that the heart's changes were being signaled to the brain, which suggests that the heart could function either as a perceiver or a transducer of intuitively-acquired information for the brain. Research continues in order to clarify the apparently complex relationship between the heart, brain, and intuitive processing.

#### 4. Conclusion

Although the scientific study of intuition has not yet migrated into the mainstream of academic psychology, many decades of empirical work would seem to have earned its investigators the right to assert that several forms of intuition have been confirmed as real phenomena, and are widespread among the populace. As for developing a theory to explain the findings, mechanisms from fields quite outside the conventional models of academic psychology would seem to be necessary, if one wishes to establish a precise chain of cause-and-effect steps in the occurrence of intuitive perception and intuitive communication. The field of physics presently appears to offer the most fertile explanatory hypotheses, partly because of its experience of grappling with the phenomena of information transfer and time, and also because of its familiarity with using mathematics to map realities that our more culturally-limited verbal apparatus recoils from.

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