

## *The Intuitive Magician: Why Belief in the Supernatural Persists*

*The brains of even young babies not only organize sensory information but supply what is missing, determine cause and effect, and use the information to generate theories about how the world operates. Such natural intuitive reasoning persists when we become adults, says British cognitive neuroscientist Bruce Hood, Ph.D., and may underlie the tendency of even the most rational of us to believe in supernatural phenomena. At its distorted extreme, such reasoning can cause the paranoid delusions of schizophrenia. But sensing connections where others do not can be a hallmark of creativity and even scientific discovery.*



*About the Author:*

Bruce Hood, Ph.D., is chair of Developmental Psychology and professor at the Bristol Cognitive Development Centre, University of Bristol, United Kingdom. His research interests include developmental cognitive neuroscience, face and gaze processing, inhibitory control of thoughts and actions, spatial representation, and magical reasoning. Prof. Hood can be reached at Bruce.Hood@bris.ac.uk.

---

*by Bruce Hood, Ph.D.*

## *The Intuitive Magician: Why Belief in the Supernatural Persists*

---

How often have you thought about someone you haven't heard from in a long time, only to soon receive a telephone call from that person? You may find it difficult not to think that some connection exists between the events; surely they were not simply a coincidence. Would putting on secondhand clothing that had belonged to a murderer make you feel uncomfortable? Even though the clothes have no physical trace of the previous owner, you may feel that they are contaminated. Have you ever felt that you were being watched from behind and then discovered that, indeed, someone was staring at you?

Most of us have had similar unusual experiences and sensations that defy obvious explanation. Even in this modern scientific age, many who consider themselves rational are still sometimes surprised by irrational thoughts. We may all recognize the fantastical nature of ghosts, fairies, and wizards, but other, equally magical beliefs are so common that the majority of adults assume that supernatural occurrences—those that cannot be explained by natural laws—are real. For example, a 1990 Gallup poll found that only 7 percent of Americans did not believe in any form of supernatural experience, such as telepathy, déjà vu, reincarnation, or ghosts.

But not one shred of reliable scientific evidence can be found for such phenomena. In 1979, a panel commissioned by the U.S. National

---

*Humans reason about physical, biological, and psychological aspects of the world before their first birthday. How do scientists form conclusions about a baby's reasoning when language has not yet developed? Quite simply, they show the baby magic tricks.*

---

Research Council to investigate psychic events concluded that “despite a 130-year record of scientific research on such matters, our committee could find no scientific justification for the existence of phenomena such as extrasensory perception, mental telepathy, or ‘mind over matter’ exercises.... Evaluation of a large body of the best available evidence simply does not support the contention that these phenomena exist.” Somehow, the message of the National Research Council has fallen on deaf ears.

How can science make sense of such mass delusion? I propose that a belief in supernatural forces originates with the same mental and physiological processes that also lead us to rational explanations through what is called intuitive reasoning. By “intuitive,” I mean the spontaneous, unlearned reasoning that governs many of our decisions and that often operates in the background of our conscious awareness.

### **THE DEVELOPMENT OF INTUITIVE REASONING**

Intuitive reasoning emerges early in development and operates in several areas of knowledge. For the past 20 years or so, psychologists interested in the developing mind have considered intuitive reasoning to be a group of specific problem-solving mechanisms designed to manage different types of knowledge, rather than a general, all-purpose mental process. Hundreds of experiments observing very young babies indicate that humans reason about physical, biological, and psychological aspects of the world before their first birthday. How do scientists form conclusions about a baby's reasoning when language has not yet developed? Quite simply, they show the baby magic tricks.

Magic tricks fascinate us because they violate our knowledge of the world. If I hide a solid object in my hand and then open my hand to reveal that the object is no longer there, an observer expresses surprise. We all understand that solid objects do not suddenly go out of existence, even if we cannot see them. Our minds represent the object—we remember it—and so its apparent disappearance violates our expectation that it should still be present.

Using the same logic, scientists studying infants have contrived sequences of events to test intuitive reasoning. They make objects disappear or suddenly behave as if they are alive. Babies may not gasp and applaud at such tricks, but they do look longer at apparently impossible sequences than they do at similar sequences that do not break any rules

---

*Because intuitive theories are based on unobservable properties... such theories leave wide open the possibility of misconceptions.*

---

about how the world works. By comparing the amount of time that infants spend looking at unexpected outcomes versus expected ones, scientists infer that infants respond differently to the two outcomes. The babies' brains must be processing and representing fundamental properties that govern the way the world operates. Scientists call such properties "intuitive theories" because, like formal theories, they provide an explanatory framework that enables the child to make sense of events as well as to predict future events.

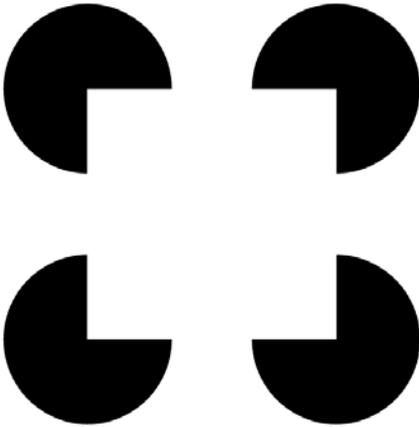
In most cases, intuitive theories capture everyday knowledge, such as the nature and properties of objects, what makes something alive, or the understanding that people's minds motivate their actions. But because intuitive theories are based on unobservable properties (many of the properties of objects, such as the force that makes something alive or possession of a mind that controls behavior, are not visible), such theories leave wide open the possibility of misconceptions. I believe that these misconceptions of naïve intuitive theories provide the basis of many later adult magical beliefs about the paranormal.

To understand how this could happen, we need to look at the function of the brain. My argument that belief in the supernatural derives from normal brain processes includes four important points:

- The brain is designed to process and fill in missing information from a complex world of input.
- Understanding and predicting the world requires generating intuitive theories that infer invisible mechanisms to explain our experiences.
- Normal intuitive theories can bias rational individuals toward irrational reasoning.
- Not only are supernatural beliefs unavoidable (since they are anchored to normal intuitive theories), but these beliefs may confer beneficial effects by giving us a sense of control and purpose, perhaps even enhancing our creativity.

### PERCEPTION: FILLING IN THE BLANKS

Our brains are designed to make sense of a world that bombards them with input. Often this information is messy, incomplete, or ambiguous, and so to organize it into meaningful patterns or perceptions, the brain makes assumptions about what the input should be and tries to fit the



information into existing models. This model building is highly sophisticated in that it can make assumptions about the true nature of input even when that input is incomplete.

For example, the white square floating above four black circles that most of us see in the shapes at the left is not really there, but we assume it is, since it is the best explanation for the arrangement of elements in the diagram. Spookily, neurons in the visual processing areas of the brain that correspond to the location where the edge of the square should be if it existed, known as “end stop cells,” respond to our hallucination of the invisible edges, actually firing as if the white square is really there. Sensing an overall organization

in what it perceives, the brain literally fills in the missing information.

Human perception is full of many such examples. As my colleague Richard Gregory, D.Sc. at the University of Bristol, has championed, the brain generates models or hypotheses that look for the best approximation of what exists in the real world. Even young babies do this. If you show them the pattern above, they see the ghostly square. If, after they look at this pattern for a long time, you show them a real square or some other shape, they look longer at the new shape. Neuropsychologists interpret this response to mean that the babies saw the illusory square, eventually got bored with looking at it, and so found the different shape more interesting.

The argument for a brain that not only organizes but generates input is compelling when we look further at the way the brain fills in missing information to make sense of data. For example, as you read this text you are unaware that large portions of your visual field are missing. The brain supplies these to create the illusion of completeness. None of us can see the whopping big holes in our visual field that correspond to the blind spot on each retina (it’s about the size of an apple held at arm’s length).

Close your left eye and focus on the cross below with your right eye, move the page from side to side—or move your head if you are looking at a computer screen—and the circle will mysteriously disappear.



You have just found the blind spot in your right eye that corresponds to the point on your retina where you have no photoreceptors (the cells that are triggered by light photons to begin the process of vision). The blind spot might be considered a design defect in the wiring of the sensory system, but under normal conditions we are not consciously aware of it. We simply cannot see what we are missing. But what I find even more interesting than this lack of awareness is the way that, as cognitive neuroscientists have shown, the brain appears to generate input to fill in the gaping hole in our visual field rather than simply ignoring it.

The brain also tackles more complex tasks, doing much more than processing and organizing sensory input. The human brain can combine that input with memory and learning to generate explanations and predictions about the world. In other words, perception, learning, and memory together form the basis of cognition, the ability to reason.

### **BUILDING MODELS OF THE WORLD**

The second point in my argument states that the brain builds theories of the world to explain many of the world's unobservable properties. For example, the world is full of objects that are controlled by invisible, external forces. When we watch two billiard balls collide, we see one forcing the other to move, but, as the Scottish philosopher David Hume pointed out in the eighteenth century, all we really see is a sequence of events, because the transfer of energy is invisible. Nevertheless, we perceive this causal force directly, and, in fact, it is extraordinarily difficult not to think of such events as involving forces. As the philosophers would say, humans are causal determinists; we cannot help but experience the world as a continuous sequence of events and outcomes. Like other aspects of perception and cognition, this way of experiencing the world may be innate. Many infant studies have shown that babies interpret events in terms of the activity of invisible forces.

Babies, like adults, use the movement of objects to determine whether the objects are alive, or even if they have minds and intentions. Consider the following scenario from a geometric soap opera created by developmental psychologists Valerie Kuhlmeier, Ph.D., Karen Wynn, Ph.D., and Paul Bloom, Ph.D., of Yale University. A green ball rolls toward the foot of a hill and then rolls hesitantly up the slope toward the summit, apparently with some difficulty. At the halfway point, along comes a red triangle from behind and pushes the ball easily up the remainder of the hill. Adults interpret this animation sequence in terms of “thinking” shapes that have mental goals and attributes. The ball has the goal of reaching the summit. The red triangle is helpful by assisting the ball as it struggles toward the top.

Notice how rich our interpretation is. After all, it is only an animation sequence, but our minds are designed to interpret even simple action sequences as being causal and, in some instances, driven by minds. Human babies, by their first birthday, are surprised when the “nice” triangle that has been helping shapes to get up the hill suddenly changes character and becomes “nasty” by pushing other shapes down the slope. It is as if the babies have assigned the triangle a personality, demonstrat-

---

*This tendency to attribute mental lives to nonhumans, or “anthropomorphism,” explains why we get angry with our temperamental computers and talk nicely to our unreliable cars.*

---

ing that the human mind is predisposed from an early age to apply humanistic qualities to all sorts of nonhuman entities.

This tendency to attribute mental lives to nonhumans, or “anthropomorphism,” explains why we get angry with our temperamental computers and talk nicely to our unreliable cars. Psychologists and philosophers ever since Hume have suggested that

this tendency leads us to believe that many aspects of natural phenomena are purposeful, caused by agents with sentient minds. It takes only a short step further to think that things that “go bump in the night” are the result of some spirit or agent at work.

Another kind of intuitive reasoning that is relevant to understanding adult supernatural beliefs is “biological essentialism.” Preschool children believe that living things have something inside them, some kind of essence, that defines what they are, irrespective of outward appearances. Children can therefore understand that although members of the same category may look different on the outside they share some deeper essential property. For example, children understand that something inside a dog makes it a member of the category of “dog,” which is different

from that of “cat.” Children can even reject the idea of outward transformation in favor of an essential identity.

Twenty years ago, the developmental psychologist Frank Keil, Ph.D., of Yale University, told young children a story about a scientist who took a raccoon, painted white stripes on its back, changed the tail, and added a bag of smelly stuff. He then showed the children a picture supposedly of the transformed animal—really a picture of a skunk—and asked whether the animal was still a raccoon or a skunk. Despite the outward appearance, children reasoned that it was a raccoon, indicating that they believed in an essential element or property in the animal that could not be changed by physical appearance. Young children know nothing about DNA and genetics, but they intuitively reason that such an element defines the true identity of living things.

### **GENERATING SUPERNATURAL BELIEFS**

Let us consider how such intuitive theories underlie adult supernatural beliefs. Take the concept of essence, for example. Psychologist Paul Rozin, Ph.D., of the University of Pennsylvania, showed that this concept might explain the belief in psychological contagion; the idea that a non-physical, usually negative state that we associate with the mind can transfer to objects. Initially Rozin was studying the development of disgust. He learned that if a sense of revulsion toward certain typical categories (such as feces, dirt, illness, disease, or putrefaction) had been established in early childhood, adult participants in his study would still be unwilling to touch objects that they believed to be contaminated by a disgusting item, even though the object had been thoroughly disinfected and cleaned. They perceived

---

*As a general rule, such intuitive reasoning not only increases in strength with experience but becomes generalized. It is also difficult to control consciously.*

---

that the essence of the contaminant was still present. They even avoided objects that had never been in actual contact with a contaminant, such as a brand-new bedpan, thus demonstrating that the association was too strong to be overcome by rational processes.

As a general rule, such intuitive reasoning not only increases in strength with experience but becomes generalized. It is also difficult to control consciously. Recent brain imaging work by Princeton psychologists Lasana Harris, Ph.D., and Susan Fisk, Ph.D., has revealed a neural response to disgust. For example, when they showed undergraduate

students pictures of disgusting people and objects while the students lay in a functional magnetic resonance imaging scanner, they found that the images activated the amygdala and insula systems of the brain, which are associated with nausea.

Rozin's work with psychological contamination is particularly relevant to understanding supernatural thinking. Not only would participants in his research studies avoid contact with items that were associated

with tangible contaminants, but they did not want to wear or even touch items that they believed had once been worn by murderers. It was as if evil, a moral stance defined by culture, had become physically manifest and infected the clothing. I recently replicated this effect at a public lecture at the Dana Centre in London. Everyone in the audience was willing to put on a secondhand cardigan

I held up, if I promised to pay them \$30 for doing so. But all but one member of the audience declined the invitation when told that a notorious murderer had once worn the sweater.

A belief that a psychological state such as evil can manifest as a physical entity explains many peculiar supernatural beliefs. For example, the idea of spirits and souls appearing in this world becomes more plausible if we believe in general that the nonphysical can transfer over to the physical world. It explains why some believe that sentimental objects or voodoo dolls can be invested with supernatural powers.

Another good example of an intuitive theory underpinning adult supernatural beliefs can be found in examining the common assumption that we can detect someone staring at us from behind even though we cannot see them. In 1898 the Cornell University psychologist Edward Titchener, Ph.D, reported that 90 percent of his students believed they could detect the unseen gaze of others. The belief is still so common that most people are unaware that it is controversial. In a recent sample of my undergraduate class, I found that the same proportion (90 percent) of the students believed they could detect an unseen gaze. I think this belief can be explained by a combination of the natural human supersensitivity to gaze, children's intuitive theory of how vision works, our subjective experience of shifting our gaze, cultural endorsement of the belief, and, finally, poor evaluation of the evidence.

---

*The idea of spirits and souls appearing in this world becomes more plausible if we believe in general that the nonphysical can transfer over to the physical world.*

---

In primates, including humans, gaze is the primary channel of non-verbal communication, with neural structures dedicated to faces in the brain's visual processing areas. In addition, gaze is extremely arousing for adults and activates the amygdala in the brain's emotional center. That is why strangers do not look each other in the eye in confined spaces such as an elevator. We talk about "exchanging glances" and a "piercing gaze" as if a physical force leaves the eyes, and many cultures

---

*We talk about "exchanging glances" and a "piercing gaze" as if a physical force leaves the eyes, and many cultures draw attention to the supernatural power of the eyes, as in the "evil eye" beliefs of some Mediterranean cultures.*

---

draw attention to the supernatural power of the eyes, as in the "evil eye" beliefs of some Mediterranean cultures. The most common intuitive theory of vision among children is that an energy beam leaves the eyes, a belief that is perpetuated in our culture by comic heroes and cartoons. Even the subjective experience of gaze gives the impression that, as we move our eyes to scrutinize the world, we are the origin of the changing visual scene

and so gaze must exit from the eyes. This "extramission" theory of vision is actually as old as Plato and was the dominant scientific theory of vision until the great Arabic scientist Al-Hazin (965-1029 CE) demonstrated that vision worked by light entering the eye. With education, most adults come to understand that vision actually works by energy entering the eyes, yet the belief that we can sense someone's hidden stare increases from childhood onward.

Intuitive theories are difficult to eradicate, because we are often not conscious that they are working away in the background. If you combine the intuitive sense of being stared at with the multiple times you recall your hunch was proven to be true, then this belief is naturally going to gain credibility in your mind. We do not take note of all the times when we have a sense of being looked at but, as it turns out, are wrong. Titchener, in his original paper on unseen gaze, provided another clever explanation: If we feel we are being stared at and we turn around to see who is looking at us, anyone behind us is likely to return our stare—which leads us to the false conclusion that we actually did detect their unseen gaze.

### **SENSING CONNECTIONS AND PATTERNS IN THE WORLD**

When we consider the way the brain fills in missing information, generates causal explanations for events, and builds intuitive models of the

invisible properties of the world, the origins of supernatural thinking start to become apparent. Any example of supernatural belief can be viewed as a misinterpretation of the available evidence or as the assumption of patterns, forces, or essences when in fact none exist. In other words, those who infer supernatural activity are detecting order and structure in the incoming information when there may be, in fact, only simple noise.

Moreover, the brain cannot handle random patterns. If I were to take a handful of coffee beans and scatter them across the tabletop, the

---

*Those who infer supernatural activity are detecting order and structure in the incoming information when there may be, in fact, only simple noise.*

---

brain of anyone observing the scene would spontaneously and effortlessly organize the spilled beans into patterns. Likewise, because of our stubborn tendency to see outcomes as being connected to the events that precede them, we have a hard time accepting that sequential events are not causally related.

For some people the sense that events are both structured and connected is quite distorted. In 1958, the German psychiatrist Klaus Conrad coined the term “apophenia” for an “unmotivated seeing of connections” accompanied by a “specific experience of an abnormal meaningfulness.” Apophenia is a well-recognized symptom of schizophrenia. When people with schizophrenia experience florid hallucinations, they have a tendency to interpret random events as not only meaningfully connected but often related to themselves, a tendency that forms the basis for paranoid delusions.

This propensity to detect co-occurrences and patterns lies at the heart of many supernatural assumptions. The neuropsychologist Peter Brugger, Ph.D., from the University of Zurich, recently proposed that it stems from the relative activity of the neurotransmitter dopamine in the left and right cortical hemispheres of the brain. Brugger and his colleagues have consistently found that excessive dopamine activity in the right hemisphere is associated with apophenia and the assumption of supernatural forces.

To test his hypothesis, Brugger identified two groups of individuals—those who tended to believe in supernatural phenomena and those who were skeptics. To measure the study participants’ sensitivity to patterns, Brugger administered a perception test using images of real faces, scrambled faces, real words, and non-words. Real faces and words have an identifiable pattern, but scrambled faces and non-words do not.

Study participants had to pick out the real words and faces as a series of images was flashed on a screen, too quickly for them to look at them carefully. As Brugger expected, the skeptics scored lower than the “believers”; they were more likely, for example, to call a real face a non-face. But after he administered L-dopa, a precursor to dopamine, to both groups, he found that the skeptics were significantly more likely to identify faces and words that they would have previously rejected as non-patterns.

Brugger believes that the activity of dopamine is related to the brain’s ability to discriminate between meaningful signals and noise and that those individuals in whom this neurotransmitter system is overactive are more inclined to see causal connections and patterns. Though all

---

*By advocating the need to abandon irrationality in favor of rationality, Dennett and Dawkins also may have undervalued the advantage of a mind that infers the existence of patterns, forces, and essences that do not really exist.*

---

people experience this inclination to some extent, it is elevated in psychiatric disorders such as schizophrenia and in temporarily distorted brain states resulting from the abuse of psychoactive drugs that affect the dopaminergic system, such as Ecstasy.

#### **WHY SUPERNATURAL REASONING MAY BE BENEFICIAL**

Rationalists such as the philosopher Daniel Dennett, Ph.D., of Tufts University, and the biologist Richard Dawkins, Ph.D., of Oxford

University, have recently lamented what they see as an increase in supernatural thinking in modern society and have accused various religions of propagating myths and fairy tales in the minds of gullible young people. They are particularly concerned about the rise of religious fundamentalism and the creationist movement. I would argue, however, that most supernatural beliefs are an end product of normal intuitive reasoning in children, and so it is not clear how to eradicate such a natural mode of thought.

By advocating the need to abandon irrationality in favor of rationality, Dennett and Dawkins also may have undervalued the advantage of a mind that infers the existence of patterns, forces, and essences that do not really exist. As we have seen, such natural intuitive reasoning supports both rational and irrational models of the world. Brugger has pointed out that apophenia and creativity may be two sides of the same coin; the tendency to sense connections where other people do not is a potentially creative aspect of magical thinking.

Supernatural beliefs also give us a perception of control in situations where in fact we may have none. In his seminal paper of 1948 entitled “Superstition in the pigeon,” the Harvard University experimental

---

*Humans also repeat behaviors that they believe may affect positive and negative outcomes, even when there is no actual relationship between the behavior and its result.*

---

behaviorist Burrhus Skinner, Ph.D., reported that pigeons rewarded with food pellets on a random basis soon settled into repeating movements that they associated with the outcome. Humans also repeat behaviors that they believe may affect positive and negative outcomes, even when there is no actual relationship between the behavior and its result. Every superstitious

sportsman knows how important it is to his performance to indulge in a special ritual and or wear a lucky talisman before a crucial match. This behavior is self-reinforcing, because people who are thwarted in performing the superstitious activities become more stressed, thereby affecting their ability to perform optimally. In early psychophysiological studies of the effects of stress in the 1970s, researchers learned that both animals and humans needed the perception of control, even if illusory, to make stressful events less stressful. This may explain the reported increase in superstitious rituals among residents of the most at-risk neighborhoods of Tel Aviv, compared to those in low risk areas, during the Iraqi SCUD missile attacks of the 1991 Gulf War.

Most important, a belief in the supernatural can give people a deep sense of connection with the past and with each other. Such beliefs impart a consideration of the possibility that the mind will outlive the body. They are common to a variety of religions, but even atheists can benefit from a sense of the supernatural if belief in a deeper reality to existence shields them from facing the existentialist crisis of thinking that life has no purpose or meaning. Certainly being a scientist does not exclude one from supernatural beliefs. In her 2006 survey of 1,600 scientists from 21 elite U.S. universities, sociologist Elaine Howard Ecklund, Ph.D., of Rice University found that only 38 percent of natural scientists and 31 percent of social scientists did not believe in God. Religious scientists, such as the geneticist Francis S. Collins in his recent book *The Language of God*, have attempted to make logical arguments for the existence of God, but such arguments are unlikely to satisfy those who demand objective evidence as proof.

Before science, the dominant explanatory model of the world was what is called “natural magic,” the idea that everything was controlled by hidden mechanisms that God had put into the universe. The wise men or magi who sought to understand these occult forces later became the alchemists, dabbling in potions, who would eventually become today’s experimental scientists. Indeed, the ability to imagine the unobservable has produced biological and computer science advances taking us right to the brink of “mind over matter.” This month, newspapers worldwide are reporting on a paralyzed research volunteer who has learned to control a computer cursor by thinking about it. But the “how” of it is hardly a case of staring and wishing hard enough to make the cursor move. The researchers guiding the project implanted signal-detecting wires in his brain near neurons known to fire to initiate body movement, computer programmers translated the signals into instructions for the cursor, and the patient learned how to calibrate his thoughts of moving well enough to guide the cursor. But the process of science is by and large opaque to the lay public, so many adults still rely on intuitive theories to explain the uncanny events that occur in their lives and to discover a deeper sense of reality. As social animals with evolved inferential reasoning, we cannot avoid the magical beliefs that we fail to recognize because of our rational blind spots.

Finally, we must recognize that science, too, can benefit from a leap into the unknown by looking for structures and mechanisms in the universe that underlie the fabric of reality. We must remember that the scientific method is not a recipe for unraveling the structures of the universe but rather a process that requires systematic evaluation of theories combined with creativity and a bit of luck. Even scientists should try to imagine the impossible sometimes. ■



Editor, *Cerebrum*: Cynthia A. Read

Design: Dawn Rogala

Opening image: © Getty Images / Photodisc Green

For comments or questions about this article or anything else in *Cerebrum*, use our [Feedback](#) Form or e-mail [cerebrum@dana.org](mailto:cerebrum@dana.org)

©2006 Dana Press

The Dana Foundation

[www.dana.org](http://www.dana.org)