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The Mind/Mind Problem

"I think, therefore I am. I think..."

George Carlin

An often recurring theme in robotics that forever amazes me is just how feeble even our best attempts at emulating the human body stack up when compared to Mother Nature's vastly more elegant designs. I first made this observation when building *Walter's* manipulator back in high school. These days, when I and an able-bodied associate lift all 168 pounds of *ROBART III* up onto the bed of my truck for transport, we're experiencing 42 pounds per arm. Estimating joint rotation to occur 0.5 inches from the back of the elbow as shown in Figure 20-1a, the moment arm defined by the point of force application where the bicep attaches to the forearm is approximately 2 inches. The distance from the elbow rotation joint to where my fingers curl around the load is 16.5 inches, which means the force applied by the bicep is over eight times the load, or 336 pounds. In contrast, I had to attach *Walter's* mechanical biceps much further out along his tubular forearms to lift even a few pounds, much less 42 (see Figure 20-1b). Even more telling, it was but a single degree-of-freedom elbow, as opposed to three.

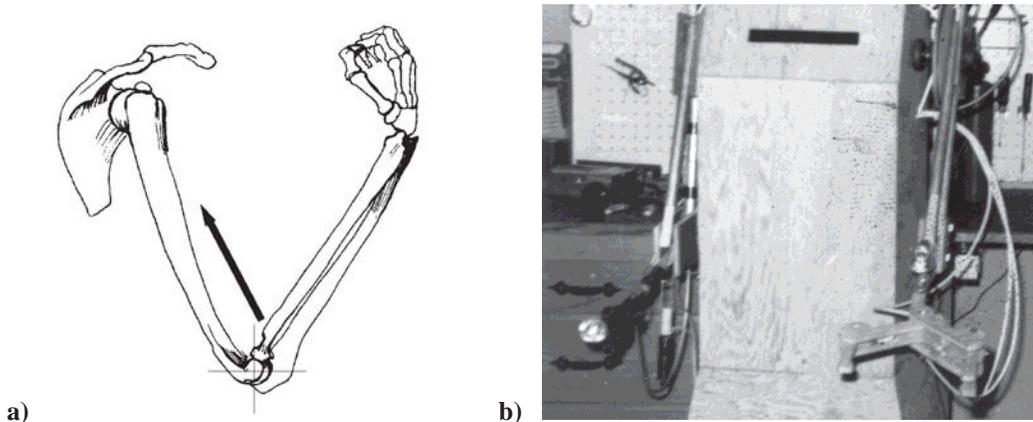


Figure 20-1. a) Point of elbow rotation (cross) and bicep attachment (arrow) on human arm (adapted from Sheppard, 1992); b) This 1965 photo of *Walter's* manipulator configuration shows the increased mechanical-advantage requirement for actuator attachment to the forearm.

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So I was somewhat bothered by the rather stark exception to the general rule of *Nature-knows-best*, where paradoxically the *conscious mind* and the *subconscious mind* do not openly communicate with each other. When I design a robot with more than one computer, I certainly don't isolate them in such fashion, as there is so much synergy to be gained by networking them together. Why then would the human body, which so clearly excels in all other areas relative to our most advanced artificial creations to date, take precisely the opposite approach? Pondering this apparent disconnect reactivated a number of mind-related interest areas I'd long found intriguing, but never had much time to pursue, a few of which I will briefly recount below.

20.1 Hypnosis

By far the most fascinating of such topics to me was that of hypnosis. What exactly is the phenomenon at work here, which enabled one individual to take control of another's mind, seemingly with little or no effort? It seemed to me that such a feat was rather monumental in its significance, and yet it appeared to be just casually accepted, as opposed to seriously entertained. Yet according to Dr. Erhard Freitag (2003), "descriptions of a hypnosis session were recorded in Egypt and Babylon some 6,000 years before we began to measure time."

I had read somewhere that we humans typically use only about 10 percent of our available brain capacity, which if true would be rather at odds with the conventional adage that cautions us to "use it or lose it." Why would this unused portion continue to exist, and not atrophy away from neglect? I was also wrestling with the concept of the *subconscious mind*, and wondering where it fit into this same picture. Was it included in that 10 percent, or occupying some portion of the remaining 90? Hypnosis was supposedly a bridge between the *conscious* and *subconscious*, and I wanted to cross that bridge, to see if there was a way perhaps to tap into that unused potential. I decided to probe further.

The first thing I discovered was there was no shortage of books on the subject if you went looking for them (Kreskin, 1973; Bowrs, 1976; Randi, 1982; Baker, 1990; Peiffer, 1996; James, 2000; Simpkins, 2000; Freitag, 2003), some pro and some con. But I was somewhat disappointed by the content of most of these, from the standpoint that little was said about the enabling mechanism for hypnosis itself, in terms of what was actually going on inside the brain. After perusing a dozen or so (there is some irony here in terms of the brain reading about itself in a book!), and for the most part seeing the same general issues presented by yet a different author, I decided to experience the phenomenon first hand. It wound up being one of the more interesting sidebar excursions of my life.

20.1.1 Getting Hypnotized

For starters, my hypnotherapist turned out to be quite professional and intelligent, dispelling any concerns I may have been harboring (however subconsciously) about opportunistic charlatans, psychic hotlines, or Gypsy palm readers. I was admittedly a bit taken aback when she proposed we'd known each other in a former lifetime, but I let that pass easily enough. I wasn't interested in communicating with the dead; I simply wanted

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to see what it felt like to be hypnotized. But then came the inevitable question, which I had failed to anticipate: “Why are you here?”

It seems most people go to a hypnotherapist with some problem to be solved, like they want to quit smoking, or they want to lose weight. Not knowing what it felt like to be hypnotized apparently did not qualify as a suitable issue, so I had to select an appropriate multiple-choice answer. I picked “unable to sleep” without the slightest feelings of deception, for it was certainly true I suffered mightily from that malady more nights than not. And thus the session began. My hypnotherapist, Shirley, sat me in a comfortable reclining chair, turned on some soft music as she dimmed the lights, then began a classic progressive-relaxation metaphor for hypnotic induction.

Part way into this procedure my eyes for some reason started noticeably twitching, which couldn't have been more disconcerting in terms of the untimely distraction. Then I remembered from my reading that rapid eye movement (REM) is routinely experienced during transition to a hypnotic state. Still more amazing was the realization that I was consciously aware of all this, even as I was being hypnotized. In fact, throughout the session I noted that part of my brain (or more appropriately my mind) remained fully alert and logically calculating, essentially monitoring the entire procedure, making observations and even assessments based upon these observations. I could have arisen from that chair and terminated the whole process at any time, and yet all the while I was technically hypnotized.

One particular example of this real-time assessment I will vividly remember always. As part of the standard progressive-relaxation induction technique, Shirley had me picture a descending stairway, down which I was to slowly proceed, taking one step at a time. With each step I was expected to feel “twice as relaxed as before,” until I reached the bottom, at which point I would be fully hypnotized. As we began this process, I was instructed to first look down at my foot, and from there to the step just below it. Manipulating the suggested imagery in my head, I did just that – then almost jumped up out of my chair! For when I mentally shifted attention to my foot, the picture my mind instantly supplied for this conjured up scene had me dressed in sandals and a robe!

Now I have never worn sandals and only rarely put on a bathrobe, so there was no good explanation as to why my mind would choose to recall such a picture, as I had never provided it any such imagery in my lifetime. Shirley later explained this unexpected visual was from a prior life, when I supposedly *had* dressed in such a manner. I let her know it would take more than a few follow-on sessions before I'd be buying that one! She took no offense at my friendly sarcasm, but instead pointed me to a couple of informative texts by some highly educated authors with unquestionably scientific backgrounds.

The first of these, entitled *Hands of Light*, was written by Dr. Barbara Brennen (1988), a former NASA researcher with an advanced degree from the University of Wisconsin in atmospheric physics. The book provides a scientist's perspective on the increasingly popular subset of alternative medicine known as bio-energetic healing, and within that

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context discusses perceptual tools such as seeing auras associated with the human energy field. But in all honesty, when the discussion turned to third-eye chakras, I pretty much tuned out.

20.1.2 Prior-Life Memories

The other text Shirley recommended was entitled *Many Lives, Many Masters*, by Dr. Brian Weiss (1988), a well-respected graduate of Columbia University and Yale Medical School, and former Chairman of Psychiatry at Mount Sinai Medical Center in Miami, FL. This book is a fascinating case study of an actual patient he was treating for recurring nightmares and anxiety attacks, using hypnotherapy to explore for possibly repressed childhood memories. To make a long story short, the patient regressed even further back in time than intended, and much to the therapist's surprise, began recounting specific and verifiable recollections of events well prior to her own birth. Needless to say, the detailed accounting of these astounding claims by such a distinguished source gave me considerable pause for thought.

I eventually accepted Shirley as a sincere professional who was experienced in a whole new side of human existence about which I knew very little. She talked about how buried memories carried over from previous lives could possibly explain things like child prodigies, xenoglossis, irrational phobias, maybe even homosexuality. All very intriguing ideas to say the least, but I was unconvinced they were any more plausible than a host of alternative hypotheses on some of these same issues. Plus it seemed strange to me that after all these years, the supporting body of evidence for reincarnation remains entirely anecdotal. Where was the irrefutable proof of science?

One particular issue especially bothered me about this supposed wealth of subconscious experience we apparently cannot readily access. If there was indeed such a thing as reincarnation, and we did have memories hidden away in our subconscious from previous experiences in these former lifetimes, why would we start all over again at birth with no recollection of our past? It seems an incredibly inefficient way to learn, taking three steps forward and then almost as many back. Why can't our *conscious mind* access this treasure trove of information for valuable learning experiences, if indeed such prior-life memory exists? It didn't make sense to me, so I sought Shirley's opinion.

She responded by asking if I had any unpleasant memories from childhood, evoking a contemplative nod to the affirmative on my part. How might I feel, she then inquired, if able to remember all the bad memories from multiple previous lives, keeping in mind that I may have suffered some extremely brutal treatment in less civilized times. I could see where that emotional baggage might be a bit disconcerting. So the theory is that we are normally prevented access to these prior-life memories, but they supposedly do exist somewhere in our protective subconscious, and we reassess our extended history only between lifetimes. I didn't really know what to think about that. I'd certainly had occasions where some random stimulus triggered a long-forgotten memory from my much earlier days, suggesting that stored representation of current-life experiences is certainly to some extent nonvolatile. But I had never even remotely considered the concept of archiving multiple lives.

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If such were indeed true, then perhaps that other 90 percent of our estimated brain capacity no longer seemed so idly disposed. But local storage in our own vulnerable brain seemed a strange and potentially flawed manner for archiving data. Suppose one were to suffer some massive head trauma that resulted in the destruction of those memory cells where prior-life experiences are stored. What happens when they ascend to that proverbial higher level of existence, but having lost their entire service record? Wouldn't it make more sense to preserve such files back at headquarters, as opposed to out in the field where undue risk is pretty much a statistical certainty over the long haul? And then of course there's that minor wrinkle that when we die, so does our brain, at which point our neural capacity to store information ceases to function altogether.

20.1.3 Trance

But seriously, my point here is not to pad this already lengthy text with some totally irrelevant psycho-babble, although I'm sure some readers will come to exactly that conclusion. There is nothing magical about hypnosis per se, despite many popular misconceptions brought on by stage hypnotists, Hollywood distortions, and human ignorance in general. Rather than some peculiarly altered mental status, hypnosis is a very natural phenomenon that most people experience on a fairly routine basis, in most cases characterized by a relaxed trance-like state of heightened concentration. As explained by Freitag (2003):

"In hypnosis, one's attention is captivated in the same way as while listening to good music or reading an exciting book. The state of hypnosis is not one of sleep, but a special form of waking state. In this trance state, one's readiness and ability to absorb suggestions are particularly high."

It may be the word *trance* that spooks some people, yet we routinely go into trance all the time. Probably the most common example of the average person entering a trance is that associated with watching television, when one can become so wrapped up in their focus on the program that they become oblivious to everything else, essentially *mesmerized* by the TV. Better yet, have you ever tried to talk to a kid who was playing a video game? They don't even know you are in the room, much less attempting to communicate.

In Chapter 2 we considered the trance-like state of driving while thinking about something else, paying no conscious attention to where we were going. I once went out for breakfast early one Saturday and wound up in the parking lot at work, 15 miles away, only to sit there and consciously ponder why I did it. In this case, my subconscious was not only directing appropriate motor-control responses to keep the car on the road without hitting anything, it was also route planning, taking me someplace I had no conscious desire to go.

Another common hypnotic experience is encountered when getting a full-body massage, although I suspect very few people ever realize it as such. At the end of the session, when the masseuse leaves you laying on the table in blissful afterglow, you are

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in a totally relaxed trance-like state, essentially hypnotized. (In my younger days growing up along the South Carolina coast, we used to invoke a similar condition in Blue Crabs by turning them upside down and rubbing the underside of their body shells.) Disruption of equilibrium is another method for inducing trance, as practiced by mothers gently rocking their babies to sleep. So going into trance is something we all do as a matter of course, presumably because evolution found it to be beneficial. Precisely why it is beneficial, and how it could possibly be exploited in this regard, are the underlying reasons for my interest.

It should be noted, however, that not all such naturally occurring trance states are without risk. Some people have actually wrecked their cars while driving along in a preoccupied daze, paying no conscious attention to the road. A few years back there was a story in the San Diego paper about a jogger who would invariably “zone out” while running, until one evening he jogged right off the top of a cliff and was killed. I myself lost the tip of my right thumb in the late seventies to a radial arm saw, because I was mentally focusing on my next task instead of paying attention to the current one involving a very sharp rotating blade. Stupidity tax, I’m thinking.

Also detrimental, albeit to a much lesser degree, is the subconscious facilitation of eating, which in some cases involving “nervous eaters” can even lead to life-threatening obesity. While the conscious mind is otherwise preoccupied, the subconscious takes over automatic execution of motor responses, in this case those required for consuming food. Often while working up some fairly complex design, or perhaps trying to collect my thoughts in order to suitably express the result in writing, I will wander around the house in a trance, literally lost in thought. Occasionally I grab something to eat from the cupboard or fridge before settling down on the garden bench outside my study, where my subconscious will then open the soda can, unwrap the sandwich, and proceed to both eat and drink.

I once absent-mindedly consumed an entire package of cookies in this fashion, much to my later chagrin, ingesting thousands of unneeded calories with absolutely no conscious awareness (much less savoring!) of the addictive chocolate flavor. You don’t eat cookies for their nutritional value; you eat them solely for the taste. So eating them without realizing it is rather pointless indeed.

20.1.4 Human Suggestibility

Humans are by their very nature suggestible, and for reasons that are not yet fully understood, some much more so than others. It is not at all clear what makes certain individuals cynically skeptical while others seem to be gullible enough to believe just about anything. But there is significant evidence to suggest that those who are very susceptible to suggestion make the best hypnosis subjects, which certainly seems logical. Differences of opinion arise over how this suggestibility should or shouldn’t be used to influence memory recall, particularly with regard to regression techniques in hypnotherapy, particularly where the results may be introduced in criminal proceedings.

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Were it not for this very suggestibility, however, watching a movie (and life in general) would be a rather bland experience. Instead, because we in fact *are* highly suggestible, it is not uncommon to get caught up in the plot, even though we remain very much aware it's just a movie. Despite this awareness, some will readily cry at a sad scene, or feel real fear during the scary part. I went to see *The Exorcist* with my young wife when it first opened way back in 1974. Suffice it to say the movie was an order of magnitude more frightful than what we were used to at the time. Neither of us slept a wink that night for fear some demonic entity was lurking in every conceivable hiding place, waiting to drench us both from head to toe in projectile vomit before feasting upon our beating hearts.

I remember consciously chiding myself over this, unable to believe that two rationale college graduates were that freaked out so many hours later from simply watching a fictitious horror movie! We both agreed it made no sense, yet neither of us got up during the night to go to the bathroom. The vivid imagery had significantly influenced the suggestibility of our subconscious, and reversing the effect was not going to quickly come about through conscious application of logical thinking. (In truly extreme cases involving post-traumatic-stress disorder, the effects can be prolonged and debilitating.)

It should be noted that our susceptibility to suggestion was greater as a result of the novelty of this experience, in that *The Exorcist* clearly broke new ground with shock and awe, depicting graphic violence and horror as never before. Watching the movie today would be quite different, in that we've since been conditioned to expect such. This is the challenge now driving the entertainment industry: how to repeatedly find a way to always go one better, to make each new release exceed our jaded expectations and produce that ultimate frightening thrill.

The subconscious is the workhorse of our mental existence, performing the all-important collection and preprocessing of sensory information, executing automatic motor behavior, even assimilating related thought strings and working out solutions to specific problems. It does all this and more in the background, while simultaneously preparing executive updates of any relevant issues to be passed along to our consciousness for higher-level scrutiny. This filtering and preprocessing action allows our attention to focus more effectively on the important issues, without the distractions of low-level minutia. If we had to consciously attend to all the overwhelming details inherent in our sensor and actuator subsystems, our bodies would suffer the same ineffectual performance seen in the conventional AI *sense-think-act* approach Brooks abandoned for his subsumption-architecture alternative in 1986 (Brooks, 1999).

A reasonable conscious/subconscious analogy is seen in a typical corporate business structure, which generally exists as a layered hierarchy with some executive oversight function at the top. A number of support departments (i.e., personnel, sales, shipping, receiving, accounting, travel) function at a lower level, each of which has some subset of the overall business flow to locally manage. The individual departments make sure their assigned responsibilities are carried out in a timely and productive manner, and keep the boss informed of any developing problems or unusual situations that warrant high-level

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attention. If the executive level chooses to micromanage the affairs of the various supporting elements, effective performance soon slows to an unacceptable rate, often followed by frustration and perhaps even failure.

Perhaps this is one reason why nature made it rather difficult for our conscious mind to directly access our subconscious? Not that it can't inadvertently interfere, however, and occasionally at the most inopportune time. Ever consciously examined something you normally take for granted, and in so doing confused yourself to the point of doubting its very validity? Every once in a while I'll look at a word I just typed and think it seems a bit amiss. The more I scrutinize, the stranger it begins to appear. Whereas at first I was worried about a possible misspelling, now all of a sudden I'm not sure if it really is even a bona fide word. Hence I am the world's biggest fan of automatic spellcheckers!

Never had that happen? How about this one – I was in the grocery store one night punching my debit-card PIN into the terminal when the perky cashier asked for my phone number. (My boosted ego quickly deflated as she explained their new system that tracks preferred-customer status was organized by such.) Trying to look unfazed, I smartly rattled off all ten digits without once skipping a beat, and in so doing blocked all mental access for the next 24 hours to my PIN. Which was still two digits shy of the four required, by the way. (I couldn't even remember the two I'd already entered!) Now I've had that PIN for 25 years and use it on an almost daily basis, but the more I tried to consciously remember it, the worse the situation became. I was lucky to find my street address when driving home...

But getting back to our analogy, the various supporting departments in the organization must work together at their own level, sharing information and planning mutually supportive schedules to keep the company running. Typically these details are transparent to the higher-level oversight layer, which may explain why valuable employees sometimes feel so unappreciated for their tireless efforts. Only the necessary information is passed along to the top, in the form of project status reports, situation assessments, sales trends, market demographics, etc. A skillful department manager will try and stay one step ahead of his boss, anticipating her needs and suggesting solutions before the situation becomes a crisis.

A very similar situation exists in the way information is passed from our subconscious to our conscious mind. When an idea pops into our head, we suddenly take notice and perhaps begin to act on it, but we seldom pause to contemplate from where it came. In a brain-storming session at work, we might even exclaim to those around us, "Wait a minute, I just thought of something!" The subconscious does the legwork, then passes the results to the conscious level for consideration.

Returning once again to our business analogy, consider a scenario where it is desired to influence the normal management process, perhaps to implement a needed change. Under certain circumstances, it might well be necessary to distract the executive level in order to make this happen. Assume, for example, the employees wanted to knock off work for the afternoon and throw the boss a surprise appreciation party in recognition of

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the company's 25th anniversary. Perhaps the strategy would call for someone taking him or her out to lunch, during which time the necessary preparations could be made. In short, the normal executive oversight function must be distracted in order to modify the routine in the lower-level support layers.

An analogous distraction of our conscious thoughts is viewed by many as the fundamental enabling mechanism of hypnosis. The conscious mind is seen as the logical and calculating higher-level mental process which oversees and bounds the more creative, carefree, and emotional nature of our subconscious. If the conscious mind is directed to focus intently on the swinging pendulum bob of the hypnotist (i.e., fixed-gaze induction), it has by analogy been temporarily taken out to lunch, and therefore able to exert less control and oversight over the subconscious. If this conscious distraction is sufficiently effective, the subject enters a state of trance. In the case of a professional massage, the end result is as if the conscious mind has been almost fully shut down, resulting in a dreamlike state of deep relaxation. Once this distraction occurs, regardless of the technique employed, the hypnotist has more direct access to the subconscious, without the intervening executive interference of the conscious.

As presented by Harris (2005):

"The conscious mind is the main inhibitive component in your makeup – it is in charge of putting on the brakes – while the subconscious mind is the seat of imagination and impulse. When your subconscious mind is in control, you feel much freer and may be more creative."

Harris suggests this theory helps explain why stage hypnotists can get people to do bizarre things before an amused audience that ordinarily they would be way too reserved to try, like prancing around clucking like a chicken. Our normal inhibitions are supplied by the *conscious mind*, which has temporarily relinquished control.

It might also explain how hypnosis can be used to enhance creativity. It was once hinted to me that I not attend the second day of a two-day offsite business-development retreat, because my controlling influence was stifling the creative potential of my younger employees. I reluctantly obliged by taking a day of vacation in the middle of the week. Like a conservative boss, the conscious mind tends to reapply the same overriding constraints found helpful in the past, and therefore be much less adept than the subconscious at examining things from an altogether different perspective, hence much less creative. With the boss otherwise engaged, however, the free-wheeling subconscious will consider anything and everything even remotely applicable to the issue under consideration.

The subconscious is the storehouse of our memories, and it's easy to imagine how maximum creativity might arise from an unconstrained search of all these previous experiences, looking for synergistic combinations never before considered. I had a burst of creativity after my first hypnosis session that was truly remarkable, which suggests routine hypnosis might be worth looking into where enhanced creativity is desired. Fortunately, our brain achieves this same effect on a regular basis, slipping our conscious

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mind a chemical Mickey each night, thereby causing us to sleep. And during sleep, as previously discussed, the subconscious runs more or less unfettered.

With the conscious mind out of the way, the hypnotist is now free to more directly influence the subconscious mind. But how exactly does that work? In my sessions with Shirley, she would speak as though having a one-on-one conversation with some little subconscious *humunculous* inside my head, which only reinforced my erroneous perception of two separate and distinct minds. In actuality, a hypnotist's verbal suggestions are taken in like any other auditory input would be, and stored as memories. Filtering and evaluation processes within the brain can be reached and thus influenced (Freitag, 2003). Since the subject is in a relaxed trance-like state, minimum competing inputs are being received. Consequently, the hypnotic suggestions are seeding the brain's seek-and-assimilate memory search with a bias that enhances the chances of a specific outcome.

Memories are also triggered by stimuli, and if the stimuli are heavily weighted in the direction of a desired mental outcome, then the triggered memories will likely reflect a similar bias. Not exactly brain washing, but not at all unlike propaganda. Consider the dual-scene optical illusion, which if confronted out of the blue could reasonably go either way. But if instead our perception is biased by image orientation, prior experiences, or some other suggestive influence, the brain may be predisposed in favor of a certain expectation, and thus more apt to find a match of that type.

For example, some such illusions (Figure 20-2a) toggle back and forth as the image is inverted. Look at it one way and you see a beautiful young woman; flip it over and behold an aging crone. An example of experiential bias is illustrated in Figure 20-2b. Research has shown that young children will see the nine cavorting dolphins as opposed to the amorous embrace, because they have had no prior exposure to the latter scenario. (So to speak...) Whereas most adults have trouble finding the dolphins even after being told where to look! The point is, the first match that comes to mind locks in the image in such a fashion that the other option no longer has much influence.



Figure 20-2. a) Orientation bias: this line drawing has an altogether different interpretation when inverted (artist unknown); b) Experiential bias: children see nine cavorting dolphins in the scene at right, versus an embracing couple (courtesy Jan Adamovic, <http://hlavolamy.szm.sk/brinteasers/>).

The brain is a pattern-matching machine that looks to fill in the blanks when dealing with sparse data, hoping for a recognizable solution. This is how we achieve visual

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invariance with respect to lighting and orientation, allowing us to recognize a visiting loved one in the baggage-claim section of a crowded airport, even though they may be some considerable distance away, facing the wrong direction, wearing unfamiliar clothing, and perhaps largely obscured by the crowd. A fleeting glimpse of bits and pieces is usually all it takes for the brain to generate a reliable composite picture. This resulting image is a combination of what we consciously saw as well as what we subconsciously wanted or expected to see. Which is one reason eye witnesses to a crime are often mistaken in what they remember seeing, yet very adamant to the contrary.

Perception, in other words, is the result of both *sensation* and *expectation*, both of which can be significantly influenced by *suggestibility*. And what we ultimately perceive is what we come to believe. So when all the hype and mystique are stripped away, hypnosis may reduce to nothing more than the power of suggestion as significantly enhanced by the intense mental focus of trance. Which in no way should diminish its potential utility, and indeed I would suspect the very converse to prevail, for as Norman Vincent Peale (1952) outlined in *The Power of Positive Thinking*, it's all about attitude. You are what you think you are, and become what you imagine yourself to be.

It should be noted that trance does not always lead to suggestibility, nor does suggestibility always require trance. Consider "The Amazing Kreskin," a well-known magician and mentalist who during his heyday in the seventies appeared almost 90 times on the *Tonight Show* with Johnny Carson. Kreskin claimed he didn't have to hypnotize anyone (i.e., induce a trance) in the course of his act, that the power of suggestion alone was enough, and specifically denies to this day being a hypnotist (Kreskin, 1973).

20.2 Ideomotor Effect

Another enlightening *subconscious-mind* experience befell me in the spring of 1997 while attending the Force Protection Equipment Demonstration, a biennial tradeshow hosted by our *MDARS* sponsor at the Marine Corps Air Station in Quantico, VA. I was at this event with Tracy Heath-Pastore, then my *MDARS-Exterior* project manager (Heath-Pastore & Everett, 1994), as well as several other engineers from our laboratory, for two reasons: 1) to assist in demonstrating the *MDARS* security robot; and, 2) to assess the force-protection technologies being displayed by the other show participants. One such vendor attending that year was DielectroKinetic Laboratories (DKL).

DKL had a fairly sizeable booth set up just inside of one of the cavernous hangars overlooking the taxiway where the *MDARS* robot was conducting its autonomous patrols. Out on the adjacent tarmac the company was actively demonstrating its newly unveiled product, the now infamous DKL *LifeGuard* (Carroll, 1999), which the company described as a long-range (i.e., up to 500 meters!) human-heartbeat detector. The DKL demonstrations were understandably causing considerable excitement among the gathered throng, since the advent of a practical human-presence sensor is basically the Holy Grail of the military and law-enforcement communities that collectively comprised the target audience. Accordingly, I got in line with all the other interested observers, waiting my turn to get a better look.

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On close inspection, however, I was immediately skeptical, and my skepticism turned to ever growing incredulity the more I saw and heard. The *LifeGuard* device, which the company claimed to be a market-ready product, looked more like a senseless marriage between a toy water pistol and a cheap collapsible fishing rod. Yet the unmistakable reaction of those who were observing (and in most cases eventually operating) the device was one of enthusiastic appreciation, so much so that I temporarily withheld my instinctive and rather unflattering two-syllable assessment. Surely this ridiculous configuration of mismatched hardware could not really work! So why did everyone seem so impressed?

I explained to the DKL operator that I was interested in mounting such a sensor on a mobile security robot (the *MDARS* vehicle making a conveniently timed pass down the taxiway even as we spoke), and thus was concerned about the apparent need to keep the device level. Since the handle was not attached at the center of mass, any slight tilt of the wrist caused the body of the unit, with its extended antenna, to swing in response to the gravitational pull. What modifications might be needed to address this problem, and could the *LifeGuard* also detect from a moving platform? I was subsequently told the device only worked when physically held by a human operator. Meanwhile, one of my engineers was asking this same question back at the booth, only to be informed that DKL could build such a robotic-mounted sensor, but would not, as they were “more interested in life-saving applications such as firefighting.”



Figure 20-3. An early version of the *Mobile Detection Assessment Response System (MDARS)-Exterior* robot patrols along the tarmac at the 1997 Force Protection Equipment Demonstration in Quantico, VA.

By now I was fully intrigued. There were literally thousands of attendees at that tradeshow, presumably generating an identical number of heartbeats, which should have produced a classic case of sensor overload, yet the *LifeGuard* always seemed to pick out a single target of interest and ignore the rest. It “locked onto the nearest source,” we were told. Why then didn’t it swing 180 degrees and point directly to the operator’s heart, only 18 inches away, given that electrical fields dissipate in accordance with the inverse square law? Because the operator was in fact “a key part of the detection circuit,” which in turn explained why the device “only responded to human heartbeats!” Give me a break...

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All sarcasm aside, let's just assume it *could* passively detect a heartbeat out to 500 meters, through any material. What then was the mechanism for making it rotate to track moving targets? I was promptly informed this tracking motion was in response to an induced torque, which in turn was based upon the little known principle of dielectrophoresis! Several equally ridiculous answers were provided for the rest of my technical questions, whereupon I eventually wrote the product off and moved on.

Later that night, however, Tracy and I were at a restaurant out in town with Mike Toscano from the Pentagon, waiting to be joined for dinner by General (Ret.) Wayne Downing, former Commander-in-Chief of US Special Forces Command, and author of the famous *Downing Report* on the Khobal Towers bombing in Saudi Arabia the previous year. Also present was a senior representative from the Department of Energy, who curiously enough was literally glowing over his experiences earlier that day involving the DKL *LifeGuard*. Since this individual was an engineer, I couldn't resist probing his rationale, in that Tracy, myself, and many others in our Robotics Group were convinced the device could not possibly work as advertised. But the *LifeGuard* enthusiast held his ground, stating emphatically that he had personally operated the device, and watched it flawlessly track a moving target not once but several times. As he became more and more defensive, I tactfully let the matter drop.

But I could not shake the fundamental question still bouncing around in my head, so much so that it kept me awake later that night until eventually the sun came up and it was time to head back to the air station. Clearly it was easy enough to dupe the average person on the street; con artists do it all the time. But usually the game is over once the advertised claims are not realized, and in sets buyer's remorse. So why would a knowledgeable and well-educated engineer with considerable experience in security-related technology continue to believe in a hoax after testing the hardware himself?

Then I remembered something else that had seriously bothered me that first day. After learning where I worked, one of the DKL staff had informed me he was a US Naval Academy graduate, and I found out from another source he had recently retired at the rank of Captain. For someone with such a background to be knowingly perpetrating a fraud against the military was quite unsettling. Perhaps, I reasoned, he did not know it was a fraud. But how could that be? I began to piece together a possible explanation that at first seemed rather incredulous, but the more I thought about it, the more I suspected it might actually have substance. Were these steadfast believers somehow subconsciously manipulated into *thinking* the device actually worked?

By the time our return flight landed in San Diego, I realized that if such were indeed the case, first-hand users would actually have to be tricked into *making* the device appear to work! The believing would then follow along free of charge. But how could such trickery be reliably called into play, and what form did it assume in the process? I checked out the passing reference to dielectrophoresis in the DKL brochure, which cited a technical article on laboratory experiments addressing the precipitation of fine powders from liquid suspension (Pohl, 1960).

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As is clearly described in Pohl's article, dielectrophoresis involves very small displacements (i.e., a few centimeters) of minute particles (i.e., fine powders) under the influence of extremely high voltages (i.e., thousands of volts) in a laboratory setting. In contrast, the *LifeGuard Model 1* weighed 1.5 pounds, required no batteries, and employed an omni-directional telescoping antenna as its sensing element, yet had an advertised detection range of 500 meters. So to propose on the basis of *dielectrophoresis* the displacement of a 1.5-pound mass in response to the extremely weak electrical field generated by the human heart at a distance of 500 meters was in my opinion quite ludicrous.

Following the *LifeGuard* demonstration at Quantico, a storm of criticism was soon being levied at DKL by incensed skeptics all across the country, who predictably turned to the internet to promote their cause (Randi, 1998; Conover, 1998; Carroll, 1999). The Department of Energy soon tasked Sandia National Laboratories with performing a double-blind study of the *LifeGuard Model 2* (Figure 20-4), slightly upgraded from the *Model 1* unit we'd seen the year before. Sandia, it turns out, had previously debunked an almost identical heartbeat detector called the *Quatro-Tracker* at the request of the FBI, resulting in an injunction taking it off the market (Carroll, 1999). Not surprisingly, the Sandia tests showed the effectiveness of the DKL *LifeGuard* in detecting a human at a distance of only 50 feet was no better than random chance (Sandia, 1998a). The complete report is available on their website (Sandia, 1998b).

In looking back on it, there were a number of audience-conditioning factors at work that contributed to the general acceptance of the *LifeGuard* during the DKL demonstrations at Quantico, not at all unlike the methodical pre-conditioning a stage illusionist works upon his audience. For starters, there's the general expectation that the device is legitimate, or it wouldn't have been brought to a military tradeshow for public inspection in the first place. In contrast, consider the preliminary mindset one might have if this demonstration were being performed by a traveling carnival act at the county fair! The same such supportive expectations exist in those who pay to watch a stage magician or hypnotist perform, in that they arrive for the occasion with the firmly established preconception that they are going to see amazing feats, and thus they in fact want the performer to succeed.



Figure 20-4. Dale Murray of Sandia holds the DKL *LifeGuard (Model 2)* during double-blind testing at Albuquerque in 1998 (photo courtesy Sandia National Laboratories).

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But the professional illusionist doesn't stop there; he or she intentionally works the crowd to reinforce that expectation, exploiting group dynamics to build up social expectations within the subconscious of the observers. They manipulate human suggestibility, in other words, in a very subtle but highly effective fashion. If those waiting in line to try the DKL device see nothing but success on the part of all who precede them, they don't want to be the first to fail, especially in front of an audience. The social expectation is clearly established, and the bias subconsciously implanted. The next user steps up, consciously balances the device with a steady grip, consciously picks out a target, and then consciously observes the antenna start to move as advertised, thus reinforcing the positive feedback to their own subconscious. The subconscious has dutifully taken over motor control of the hands, causing the handle to tilt ever so slightly, just enough to make the antenna point where expectations say it should. The conscious mind, meanwhile, is completely unaware this is happening!

How does the subconscious know how to do this? In other words, if we accept for the moment the subconscious was just so inclined to perform this background assist for the sake of expectation fulfillment, how does it instantly know what motor-control commands to issue to make the antenna track the target? To me, this is perhaps the most intriguing aspect of all with regard to this particular scenario. Recall the first thing the user must do is hold the *LifeGuard* unit perfectly level, presumably to negate the gravitational influence. In the few seconds it takes to consciously do such, through subtle but intentional deflections of the wrist, the passively observing *subconscious mind* is learning all it needs to know about the associated transfer function (i.e., how the device responds in rotation to changes in handle tilt). Once the leveling technique is mastered, the user's conscious attention shifts outward, away from the device itself, in search of a convenient target. The subconscious steps in at this point, tilting the handle in imperceptible fashion, thereby achieving the desired tracking results.

The conscious mind, meanwhile, is unaware this closed-loop motor control is at work, in large part because it is intensely focused on the target! The parallel here to what occurs during hypnotic trance is quite evident: the subconscious is freely attending to business without any conscious oversight, because the conscious mind is otherwise preoccupied with a specific focus. In fact, it was while further researching Kreskin's (1973) accounts of "automatic writing" that I ran across a number of references to the so-called *ideomotor effect*, which is precisely the phenomenon responsible for the mysterious happenings outlined above (Hyman, 1999).

Barret Dorko (2005) describes *ideomotor activity* as:

"actions, or muscular movements, which are automatic expressions of dominant ideas, rather than being the result of distinct volitional efforts."

But what exactly does that mean?

It is an uncontested fact that our subconscious routinely controls our motor responses. The autonomic nervous system makes us breathe and keeps our heart beating, for

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example. We walk without consciously planning each step, perhaps even run down the stairs, which requires an entirely different gait altogether. If you aren't fully convinced there's no conscious control of this behavior, recall what happens when you inadvertently miscalculate the number of steps remaining, and suddenly encounter an extended planar surface instead of the expected vertical discontinuity. Your conscious mind quickly rejoins the party at that point to generate a recovery, hopefully before you trip and fall flat on your face.

But the ideomotor effect is different from these examples of subconscious motor control, in that we are not consciously aware it's happening, often even in retrospect. You can consciously experience your breathing, even alter or momentarily inhibit it. To a lesser extent you can be consciously aware of your heartbeat, but you can't directly interact to make it stop, although some have learned to significantly reduce its rate. And as previously mentioned, you can consciously influence learned motor-control behaviors such as water skiing, walking, and running. Ideomotor responses, on the other hand, are instinctive subconscious behaviors that directly couple thought to action without any intermediate volition. Note the striking parallel here to Brooks' insight that perhaps action was more directly coupled to perception, without so much intervening cognition (Brooks, 1999).

Our subconscious mind routinely initiates and monitors motor control without our conscious mind knowing such occurred. Ever noticed how some people can't seem to talk without waving their hands? Even more subtle, the very mechanics of just talking are handled by our subconscious, while our conscious level is busy composing the forthcoming verbiage (Dorko, 2005). Consider how an avid sports fan might move their feet in sympathetic concert with the escalating action, all the while sitting on the couch watching the game on TV. My dad had the rather annoying habit of subconsciously shuffling the change in his pocket, which my kids one day informed me I subconsciously inherited. The fact that they had to point it out bears testament to my lack of conscious awareness such was even happening. (Sadly, it seems, we morph into rather faithful clones of our own parents as we age...)

This ideomotor phenomenon, repeatedly described in the medical literature over 150 years ago by William Benjamin Carpenter (1852), and later elaborated upon by the noted psychologist William James (1890), is certainly not a recent discovery. But like hypnosis, it seems to lurk only in the background of mainstream science. Perhaps this is partially due to the fact that ideomotor response is the enabling mechanism behind Ouija boards, dowsing rods, table turning, and other metaphysical activities usually associated with pseudoscience, or in some cases even fraud. A very good overview is presented by Herman Spitz in his book entitled *Nonconscious Movements* (Spitz, 1997).

The following observation by Barret Dorko I find particularly enlightening in the case of the *LifeGuard* demonstrations back in 1997 (Dorko, 2005):

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"And, like a simple reflex, ideomotor movement occurs instinctively, though it is often far more complex and always without volition. This is the primary reason those doing it do not commonly take responsibility for its manifestation or consequence."

That being said, it is still very hard to comprehend the persistence of a scam involving a bogus product that does not actually work, even after the user has had an opportunity to evaluate it over an extended period of time. Some 12 years after the experience at Quantico, an article in the San Diego Union Tribune described an almost identical device purchased in large quantities by Iraqi security forces (UT, 2009):

"The small hand-held wand, with a telescopic antenna on a swivel, is being used at hundreds of checkpoints in Iraq... Nearly every police checkpoint, and many Iraqi military checkpoints, have (sic) one of the devices, which are now normally used in place of physical inspections of vehicles."

Sold primarily to developing countries by ATSC (UK) Ltd., the *ADE 651* explosives detector was also tested by Dale Murray's group at Sandia National Laboratories and found not to "perform better than random chance" (UT, 2009). Nevertheless, the Iraqis "believe passionately in them," and according to their inspector-general for the Ministry of Interior, spent \$85 million in 2008 to procure units costing \$16,500 and \$60,000 apiece (UT, 2009). The persistent power of subconscious perception to overwhelm logic and common sense should thus be quite obvious, and in this particular case absurdly expensive. Worse still, the real price paid for employing such a fraudulent product in a war zone is not so much the wasted acquisition costs, but the subsequent consequences to personnel under life-threatening conditions.

20.3 Synchronicity

Just prior to my first hypnosis experience I had been given a copy of *The Celestine Prophecy* (Redfield, 1993) by my good friend Lisa Thornton, a highly intelligent young woman I met in the summer of 2000. I had wondered aloud during more than a few of our ongoing philosophical discussions just what manner of strange coincidence had caused our paths to cross, which in part may have prompted her to give me the book. I was pretty skeptical as I began reading, in that it came across as the typical new-age yuppie fodder that any self-respecting engineer would quickly dismiss as pointless fantasy.

Yet I had tremendous respect for Lisa, so I persevered, as it was at the very least entertaining. The book's basic premise was that life is a connected series of what on the surface may appear to be random coincidences, which in fact are not random at all, but somehow causally connected beyond the calculations of probability. Such a philosophy was more formally treated in the *theory of synchronicity* developed by the Swiss psychiatrist Carl Jung (1960), who had been a student of Sigmund Freud. In other words, things supposedly happened for a reason, like my meeting Lisa.

In fact, I mused, it *was* sort of coincidental I decided to get hypnotized shortly after reading this unlikely book, given to me out of the blue by someone less than half my age.

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Who had coincidentally picked San Diego as a destination when she packed up and left the Midwest in search of greener pastures. And just happened to look in the classifieds for temporary employment the one and only week I ever ran a want ad for a sculpture model. And further by chance been the one individual I selected from 65 ready applicants. None of whom would have applied in the first place had I not inexplicably taken up life-form sculpture, quite an uncharacteristic pastime I'd previously never even remotely considered. And so it went...

Once the seed had been planted in this fashion, I began to notice all sorts of “amazing coincidences,” which I initially wrote off as self-fulfilling prophecy, in that our brains tend to dismiss things as irrelevant if there has been no prior need for consideration. Hence we usually don't notice them in the first place, even though we may have been exposed to their existence (Dretske, 2005). I never noticed, for example, how many Jeep *Wrangler* 4X4s there were in San Diego until I bought one myself, after which it seemed they were everywhere I looked. So now I assumed I was simply over sensitized to the possibility of strange coincidences.

But even more astounding was my “coincidental” meeting of yet another young woman, only a few hours after my very first hypnosis session had ended, in fact. I had extensively remodeled my upstairs bedroom and bath, and needed some new valances made for the window curtains. One of my sculpture-model applicants had recommended a friend who supposedly did such things, and this friend was coming by that evening to give me an estimate. I, of course, was expecting a rather mousy seamstress-type to show up at my door, and was both surprised and pleased when the young lady turned out to be an electrical engineer. We wound up driving to the mall to pick out some fabric, and somehow got on the subject of my hypnosis experience earlier that same day. Turns out this moonlighting engineer had been hypnotized many times. (What a coincidence, but it gets even better!)

When I mentioned my misgivings about “seeing” someone's energy field, she informed me that she herself had recently learned how to do just that, and began to elaborate on how, when, and where. Now it's a scientific fact that the human body emits energy, the most obvious example being that associated with the infrared spectrum, namely radiated thermal energy. Passive infrared sensors that detect this radiation have been around for quite some time, and were in fact cheap enough even back in 1980 (around \$90) for me to install one on the head of *ROBART I* as was discussed in Chapter 4. Today they cost way less than \$10. I still find it somewhat amazing these simplistic devices can reliably detect the thermal emissions of a fully clothed (and thus somewhat insulated) human at distances of several hundred feet.

Even more amazing is the rather non-intuitive fact that our bodies also emit microwave energy, something I didn't learn until almost 20 years later. I was introduced to this concept by Dr. Bob Rogers of the University of Texas Applied Research Lab, who proposed exploiting it as a means of detecting human presence from a moving security robot. It follows that there could conceivably be other emissive phenomena about which I am similarly ignorant, but it seems highly unlikely such would occur in the visible

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portion of the spectrum. So while I've known for some time there is an energy field associated with the human body, I just never really believed anyone could actually see such a thing!

Understandably then I was rather enthralled to be having a rationale technical discussion about this very subject with a fellow electrical engineer. Thirsting for more information, I continued meeting with this intriguing individual for about 2 months, even accompanying her to see Stephen Spielberg's over-hyped and rather disappointing movie "A.I.," which (you guessed it!) coincidentally opened during that same time frame. Then as suddenly as she had crossed paths with my own she up and disappeared, with no more explanation for why she went than for why she came. After which I went back to being a jaded and cynical engineer...

20.4 Psi Phenomena

The terminology "psi phenomena" (short for psychic phenomena) is generally used to describe "other-wordly" happenings such as mental telepathy, ghosts, poltergeists (ghosts with an attitude), clairvoyance, etc. I think it's safe to say most of us have had at least some rudimentary experience with unexplained perception or even precognition, and I firmly believe there are sensing and/or communication mechanisms (i.e., besides sight, hearing, taste, touch, and smell) at work that we don't yet understand. Perhaps a fairly common example is in the form of a simple hug. If you hug someone you really care about, there is a definite bidirectional sensation of something (energy?) between the two participants, and perhaps this phenomenon is largely responsible for hugs being so emotionally gratifying. Then there's the well known feeling of someone watching you from behind, even though you cannot physically see, hear, or even smell them.

But in all honesty, I've personally never had any truly startling encounters along these lines, although there was one rather odd event that to this day I can't readily explain. I had just flipped off the lights in my office and was heading out the door to go home when the phone rang. Now normally I would respond to such an occurrence at that time of day by walking even faster. Ignore it, in other words, then listen to the voice recording the next morning upon returning to work. Most of my friends and business associates know I much prefer to use e-mail. But for some reason that day a little voice in my head instructed me to answer the phone, and also told me exactly who was calling: a woman from my past who lived some 2,500 miles away, with whom I'd had no contact for over 6 years. I raced back to my office, picked up the phone, and sure enough, it was her!

As this event took place before the introduction of caller ID, there is at present no reasonable explanation for how such could have happened. Despite our many wondrous scientific advances, there remains much we clearly do not yet understand regarding the universe in which we live, and more than a few established principles have been found to be lacking as new information comes to light. Consider for example the concept of quantum entanglement, regarded as *the* characteristic trait of quantum mechanics by the renown Austrian physicist Erwin Schrödinger (1936). Conventional wisdom of the early twentieth century held that space separates and distinguishes one object from another, a

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readily accepted belief now fundamentally challenged by the emergent field of quantum mechanics (Greene, 2005).

Quantum entanglement, still very mysterious and often misunderstood, involves two or more particles which are linked together (i.e., "entangled") such that the measurement of one particle's quantum state determines the quantum states of the other particles (Jones, 2013). Furthermore, the state of one entangled particle can be changed by changing the state of another, even if widely separated (Andromida, 2012), which Albert Einstein (1947) rather derisively described as "spooky action at a distance." In other words, the correlations predicted by quantum mechanics reject the classic physics principle of local realism, wherein information about the state of a system is influenced only by interactions within its immediate surroundings (SD, 2008). What happens at one location can be definitively linked with some action at another place, even if nothing traverses the intervening distance (Greene, 2005).

Just to be clear, I am in no way saying quantum entanglement had anything to do with positively identifying my caller before I picked up the phone. But if two particles can be inexplicably entangled over large distances, as has been repeatedly verified in controlled experiments, there likely exist other natural phenomena we similarly don't fully understand that could explain how I knew it was her.

20.4.1 A Telepathic Horse

It is generally regarded that some purported psi phenomena are simply premeditated fraud, intentionally targeting highly suggestible people that the perpetrators know will bite – hook, line, and sinker. By exploiting social expectations, communal acceptance, and the dynamics of group behavior, for example, television charlatans bilk the masses of their hard-earned money in the name of evangelical religion. But most of what people think they experience in the way of the supernatural turns out to be readily explainable (i.e., serendipity, misperception, apophenia), if in fact the subject truly wants to uncover the facts. Quite prominent in this latter category of natural explanation is the *ideomotor effect* discussed earlier, which despite having been around for over a century and a half, is still not often recognized or understood.

One fairly well-known scientific investigation of a psi phenomenon involved a German horse whose proud owner was a retired math instructor by the name of William von Osten (Heyn, 1904). Believing “Clever Hans” the horse had above-average intelligence, von Osten began systematically teaching his eager student basic math, rewarding the animal with a tasty treat whenever it tapped out the right answer with its hoof. When von Osten first demonstrated the horse’s amazing skills to the public in 1891, it truly appeared Clever Hans not only understood the fundamental concepts of mathematics, but was also responding in intelligent fashion to human language! If von Osten verbally asked for the answer to “four plus three,” his equestrian prodigy obligingly tapped the ground seven times.

Furthermore, basic math was only the beginning. Over time, Clever Hans seemingly mastered long division, fractions, factoring, the calculation of primes, and even learned

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the alphabet! But since the horse never attained an ability to talk like TV's Mr. Ed, perhaps partly because TV had not yet been invented, he was in all cases limited to expressing his answers through simplistic means, like tapping his hoof. Letters of the alphabet could thus be communicated through signaling the numerical value of their ordered position in a known series, enabling Clever Hans to spell out the names of his visitors, even indicate the day of the week. But most astounding of all, the horse performed almost as well in these impressive feats when its mentor, William von Osten, was not even present!

Naturally, as the years went by and the story of Clever Hans spread, the German scientific community was embarrassingly stumped for want of a logical explanation. In 1904, over a decade after the first public demonstrations, a 13-member panel of experts closely observed Clever Hans in the display of his talents, but could find no indication at all of trickery. A paragraph in the prestigious British journal *Nature* (September 22, 1904), reporting on an earlier article in the *Daily Press*, went as far as to say the committee concluded the observed phenomena "were due to the mental powers of the animal" (Spitz, 1997). Members of the commission later protested that this latter claim was but an improper assumption on the part of the press, insisting they had only concluded no evidence of trickery, and nothing more. This scenario is a classic example of the *false-dilemma fallacy*, which illogically assumes "if not B, then it must be A," ignoring the possibility of an alternative rational explanation.

In November of 1904, an informal committee of three began a more detailed investigation, conducted primarily by Oskar Pfungst of the Psychological Institute of the University of Berlin (Spitz, 1997). It was Pfungst who incorporated the proper experimental controls that eventually determined Clever Hans could not provide a correct response to even the simplest math problem, unless someone present knew the right answer! Yet there still appeared to be no indication of trickery, as no evidence could be found that anyone in the audience was signaling to the horse (NYT, 1904). Accordingly, in what might be regarded as a *false trilemma fallacy*, speculation quickly turned to Clever Hans being telepathic (versus mathematically inclined), which to the press was even more appealing.

Pfungst, however, was not finished. Through additional controls it was determined that Clever Hans was picking up visual signals, but the precise nature of these cues was still a mystery. Clearly they had to be involuntary, in that Hans could get the information he needed from just about any examiner, as long as that individual knew the correct answer. Pfungst (1911) eventually zeroed in on what turned out to be almost imperceptible head movements that "Clever Indeed Hans" had learned to detect, movements made without any awareness on the part of those individuals responsible. After posing a question, the examiner would instinctively shift his attention to the horse's feet as the counting began, which resulted in a slight downward tilt of the head.

What no one realized was the counting only began when Clever Hans noticed his interrogator's head tilt downward. Even more subtle, when the count reached the correct value, there was an equally imperceptible upward shift of focus, which the horse had also

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learned to detect, stopping on cue for its justly earned reward. In attempting to teach the horse mathematics, von Orsten had unknowingly displayed these subconscious ideomotor responses in such consistent fashion that Clever Hans learned to read them with amazing accuracy (Pfungst, 1911). In fact, von Orsten responded to Pfungst's findings with much grief and indignation, feeling his character had been called into question, despite repeated assurances to the contrary.

Human beings, in all their vanity, do not readily accept the proposition they might not always be in conscious control of their actions, and surprisingly would rather attribute such occurrences to some supernatural entity we can't influence. Thus most will flatly deny they are either giving or receiving subconscious signals, and they will do so with sincere conviction. Yet it is precisely such naturally occurring subliminal cues that facilitate the illusions of clairvoyance, ESP, and mental telepathy, for example, which some believe not to be illusions at all, but unexplained reality in the paranormal sense.

20.4.2 Psychics and Mentalists

As presented earlier, "The Amazing Kreskin" was in fact an accomplished magician and hypnotist, his technical denial of the latter notwithstanding (Kreskin, 1973). Routinely performing as his own warm-up act, Kreskin used magic tricks to initially prepare an audience for suggestion, building a rapport and earning their trust, changing any initial skepticism to belief as the crowd got caught up in the moment. Such use of on-stage warm-up acts, which is common practice throughout the entertainment industry in general, is analogous to the *long-term potentiation* of neurons that arises from repetitive stimulus, as suggested by Greenfield (2000):

"Think of a warm-up comedy act. Once an audience had been primed to laugh, it will respond much more readily to a joke that might normally have left it cold. Similarly, following the kind of repeated stimulation that might occur during learning or exercise, neurons can be primed to respond more sensitively in the future."

But Kreskin was perhaps most impressive to his loyal followers as a "mentalist," meaning one who possesses the ability to mentally communicate, not only receiving the thoughts of others, but also projecting their own to selected recipients. The warm-up period gave him a chance to evaluate potential participants, identifying those most likely to respond favorably, passing on others that might be problematic. In other words, Kreskin would canvas his audience for those most suggestible, significantly enhancing the likelihood of success in what was still to come. Upon conclusion of his performance, he would routinely invite the host to hide his paycheck, stating that if he couldn't find it through mental telepathy, then he did not get paid. In this scenario Kreskin was unable to selectively choose an optimally suggestible target, for the host was the host. Such a bold claim, backed up by routine success in sniffing out the check location, was all it took to convince most people in the audience. The Amazing Kreskin could read minds!

Now it is generally accepted that magicians are in fact illusionists, that they train long and hard to pull off their slight-of-hand acts in the interest of paid entertainment, and they don't truly possess mystical powers of the supernatural. And Kreskin himself is very

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candid about how hypnosis is similarly a quite natural process that works upon human suggestibility, again nothing other-worldly involved. But although Kreskin categorically denies being a psychic, he stops short of debunking his powers as a mentalist, indeed billing himself as “The World’s Foremost Mentalist.”

Not so “The Amazing Randi,” aka James Randi, himself a master magician who prefers instead the term “conjurer.” In fact, Randi goes out of his way to disavow any specific notion of mind reading, as well as psi phenomena in general (Randi, 1982). The James Randi Educational Foundation (JREF), which seeks to create “a new generation of critical thinkers,” offers a standing “one-million-dollar prize to anyone who can show, under proper observing conditions, evidence of any paranormal, supernatural, or occult power or event” (Randi, 2005). Randi even sent a personal letter to DKL, offering to pay them “US\$1.1 million” if they could show where the *LifeGuard* sensor worked “under adequately double-blind testing,” but got no takers (Randi, 1998). The letter, by the way, clearly suggested the *LifeGuard* responded only to the ideomotor effect.

This ideomotor effect, where mental thoughts of a motor activity in fact lead to a motor activity, is conceptually simple but unfortunately very counterintuitive. Consider carefully the following observation made over 130 years ago by William James (1890):

“... every mental representation of a movement awakens to some degree the actual movement which is its object; and it awakens it in a maximum degree whenever it is not kept from so doing by an antagonistic representation present simultaneously to the mind.”

The subtle implications of James’ statement become more apparent if we think about our instinctive subconscious reaction to danger, as for example when a snake crosses our path during a trek in the woods (Greenfield, 2000). Evolution provided this reactive fight-or-flight defense mechanism long before brains had evolved to a stage where deliberative conscious thought was supported. Upon seeing the snake, our subconscious instantly reacts (i.e., run like hell!). But almost as instantly, our deliberative conscious mind overrules this order to flee, having taken just a wee bit more time to determine: *yes it is a snake, but of the non-poisonous variety*. This conscious override is the inhibitive “antagonistic representation” of which James spoke, and a classic case of Brooks’ subsumption architecture being invoked by Nature (Brooks, 1999).

The time lag between these two responses (i.e., reactive and deliberative) means we may jump slightly or startle upon seeing the snake, but we don’t run away, for almost as fast as the subconscious initiates the behavior, the conscious mind terminates it. Almost. The key point to note is that some motion, however slight, did in fact occur in the interim, and this motion was initiated before our conscious mind took control, and thus without our awareness. This miniscule time lag may help explain why people intentionally trying to block giving off physical cues will unknowingly still display them, in that the subconscious essentially jumps the gun. Equally intriguing, one can pick up on such signals without being consciously aware of that happening either (Spitz, 1997; Hyman, 1999). So we now have the mechanism for two (or more) humans to be naturally and

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effectively communicating, yet without any conscious awareness on the part of either party!

One such example is found in competitive sports, where the advantage often falls to whichever player can best anticipate the next move of the other, as opposed to reacting after the fact. In some cases, such as boxing or karate, after-the-fact is simply way too late. Jeremy Campbell (1986) describes how Daniel Stern (1977), a psychiatrist at Cornell University Medical Center, performed a frame-by-frame film analysis of the 1966 World Heavyweight Fight between Muhammad Ali and Karl Mildenerger. Stern found over half of Ali's infamous left jabs "were faster than 9/50 of a second" (180 milliseconds), which according to Campbell was "the most rapid visual reaction time observed in human beings." (Today the observed range is 120-160 milliseconds (Duffy, 2004).) In other words, most of Ali's punches were theoretically too rapid for Mildenerger to dodge, yet dodge them he mostly did. Mildenerger "was decoding Ali's programmed sequences of behavior, anticipating them in time and space, even though they were intended to be difficult to decode" (Campbell, 1986).

Animals, as we clearly saw in the case of Clever Hans the horse, are much more adept than humans at interpreting such body language, since they lack any way to verbally communicate. As a key means of survival, evolution provided an instinctive natural ability for discerning intent (i.e., hostile or friendly) through careful interpretation of subtle cues (such as eye and facial movements, poise, sounds, and even smells). In contrast, most people don't even effectively listen during conversation, much less pick up on body language, but that doesn't mean they cannot learn to do so. Those who have mastered the art of cold reading, who understand the natural human tendencies toward confirmation bias and selective thinking, and who are intimately familiar with the ideomotor effect, are consequently well equipped to amaze the public with their presumably psychic skills.

But how does all this explain Kreskin finding a hidden check? For starters, Kreskin was a master at reading body language, having progressively cultivated the skill since early childhood (Marks & Kammann, 1980). When he ventured out into the audience in mental pursuit of his money, he had the entire assemblage subconsciously giving up helpful information, both auditory (i.e., footsteps, involuntary whisperings, murmuring, changes in breathing) as well as visual (Spitz, 1997). But in that type of dynamic environment, relying upon body language alone would probably not provide sufficient safety margin to warrant gambling with one's entire performance fee.

To minimize such risk, Kreskin counted on the venerable *ideomotor effect* as his principle source of feedback, subtly playing a subconscious version of the popular children's game "hot-or-cold." He picked up his cues from the involuntary muscle movements of his unsuspecting host, as transmitted via a taut handkerchief held by both (Marks & Kammann, 1980). To further level the playing field, if Kreskin failed (as he did on at least three occasions), the money was not retained by the host, but had to be donated to charity. Not quite so "Amazing" when you understand what's happening.

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Bottom line is that Kreskin was an entertainer – a very good one at that – and as he himself readily admitted, not a psychic.

20.4.3 Remote Viewing

The terminology “remote viewing” refers to a form of extra sensory perception enabling accurate description of some distant scene that could not have been discerned through normal visual means (Marks, 2000). I first stumbled upon this concept several years back in a book entitled *The Ultimate Time Machine*, written by Joseph McMoneagle, who served as one of several remote viewers for the government-funded STARGATE project. Originally dubbed GRILLFLAME, this effort was initiated in 1978 by the US Army to assess the concept of psychic intelligence gathering, based on earlier work done at SRI for other government agencies (McMoneagle, 1998). McMoneagle, in fact, was an active-duty Army intelligence officer during his initial involvement, until retiring from the military in 1984, at which point he went to work as a consultant for SRI.

The key players at SRI were a couple of senior research physicists, Russell Targ and Harold Puthoff, who openly published their results in the scientific literature, including an article in *Nature* headlined “Information Transmission Under Conditions of Sensory Shielding” (Targ & Puthoff, 1974). They eventually wrote a book entitled *Mind-Reach*, which chronicles their pioneering experiments involving a stationary “viewer” accurately receiving telepathic images from another individual many miles away (Targ & Puthoff, 1977). Needless to say, I was understandably rather surprised to find such an authoritative work, with a five-star Amazon.com customer-review rating, no less. I was further intrigued, after purchasing a copy, to discover the “Introduction” had been written by the distinguished and highly respected anthropologist Margaret Mead.

In probing a bit further, I noticed the book had just been re-released (Targ & Puthoff, 2005), again receiving a five-star rating, albeit from only three reviews, one written by Targ himself. Considering the facts so far, this situation clearly warranted further investigation: 1) a 24-year period of government funding for remote viewing; 2) an Army intelligence officer as one of the viewers; 3) a world-famous research organization doing the work; 4) senior physicists at this organization as principle investigators; 5) a well-received book on the results; 5) endorsement by the world’s most famous anthropologist; and, 6) presumably enough credibility to warrant republication after 33 years of public scrutiny. One thing didn’t seem right, however. If the research of Targ and Puthoff had in fact been as spectacularly successful as their book implied, why then, over three decades later, were we not seeing the impact of such?

Without going into exhaustive detail, the SRI experiments involved a remote viewer inside an electronically shielded room, tasked with receiving telepathic images of some specific target site within a short drive from the SRI lab, as projected from that site by another experimenter. Also inside the shielded room was an observer, typically Targ, whose job was to transcribe the viewer’s descriptions, both viewer and observer having no knowledge of the target identity or location. In fact, to ensure no prior awareness on any player’s part, the target for each trial was randomly chosen from a pre-prepared list by the Director of SRI’s Division of Information Science and Engineering (Marks, 2000).

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The roving experimenter was then accompanied to the selected target by Puthoff and some additional observers, where they closely inspected the area and attempted to mentally convey their on-site perceptions back to the securely cloistered viewer.

During such channeling, a detailed transcript of the remote viewer's reaction (i.e., target description) was prepared, and combined with any target drawings the viewer might have sketched. The above process was then repeated at another randomly selected target site, usually on a different day. When a sufficient number of experiments had been conducted in this manner, the entire collection of transcripts was provided in unedited format to an independent judge, along with the associated list of targets. The judge was then tasked with personally visiting all target locations and matching each to the most appropriate description as documented in the transcripts.

The results, later obtained from this independent judge by Marks (2000), were in his own words "staggering." In one run of nine target sites, for example, the SRI judge correctly matched seven, for a statistical probability of less than one in 30,000! With regard to random expectations, Marks further states:

"As a backup procedure, five other judges were tasked to match the nine transcripts against the nine targets. A total of twenty-four correct matches occurred instead of the expected total of five, giving odds of less than one in one billion!"

The most irrefutable validation of any scientific study is reliable recreation of the results by other scientists. (Recall the ground-breaking cold-fusion claims of Stanley Pons and Martin Fleischman in 1989, which were initially replicated by others, but soon after succumbed to closer analysis.) In quick response to the extraordinary SRI experiments, New Zealand researchers David Marks and Dick Kamann set about trying to recreate the work in their own remote viewing experiments at the University of Otago, but much to their mounting frustration, they had absolutely no success. Their repeated attempts to contact the SRI team met with little or no cooperation (one notable exception being the SRI judge mentioned above), which only made the pair more determined in their attempts to resolve the disconnect.

And resolve it they did. As meticulously reported in four dedicated chapters of his recent book, *The Psychology of the Psychic*, Marks systematically demonstrates how the SRI findings were nothing more than the result of some very sloppy controls on the part of the celebrated physicists, Targ and Puthoff (Marks, 2000). To make a long story short, the principle problem was the intentionally unedited nature of the transcripts, which were shown to provide multiple embedded cues facilitating a correct match. As an example, the list of target sites provided to the judges was arranged in the order of execution, instead of randomized, while the transcripts themselves showed the date each experiment was performed. In fact, Marks and Kamman went as far in their sleuthing as to show how the embedded cues could yield the correct results, even if the judges never actually visited any of the target scenes they were to match!

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A very similar pull-no-punches critique, of not only this series of experiments but several others performed by Targ and Puthoff, was provided by James Randi in a chapter entitled "The Laurel and Hardy of Psi," contained within his book *Flim-Flam* (Randi, 1982). Randi rather pointedly suggested that Targ and Puthoff, who never acknowledged their errors and continued on unabashed for years afterwards, should formally apologize. The fact that Targ recently had the book republished without the appropriate admissions, and then wrote a glowing five-star review of its questionable contents, strongly suggests no such apology will be forthcoming.

My first point in all this is that you can't always believe everything you read, even if the source appears on the surface to be very credible. There is usually at least one alternative perspective on most issues, sometimes several. Secondly, this sad example effectively illustrates why I find it rather amusing indeed when certain proponents of the *Strong AI Claim* predict that futuristic computers, once they achieve human-equivalent capability, will access all knowledge available over the internet and instantly know everything. I don't think so. The more I read about a controversial subject, the more confused I sometimes get. Indeed, a fundamental problem in the development of expert systems is that often the experts can't agree on the rules.

Nevertheless, we must be careful not to succumb to the inverse *false-dilemma fallacy* by assuming that if several psi case studies have been reduced to logical causes, then there is no such thing as psi phenomenon. The philosopher and psychologist John Beloff sums it up nicely in the context of the *Strong AI* debate as follows (Beloff, 2002):

"There is a further consideration that leads one to doubt the strong claim. There exists a body of evidence that suggests that the mind has certain transcendental powers that cannot be explained in physicalistic terms and are independent of the constraints of time and space. I allude here to what parapsychologists have called "psi phenomena", those transactions between the individual and the external world that do not appear to be mediated by any of the known sensorimotor channels. Of course there is at present no obligation to accept such evidence at face value. The phenomena in question are so unstable and so marginal that, even after a hundred years of psychical research, no conclusive demonstration or unequivocal experiment can be cited to prove that they exist. Nevertheless, my impression, as one who has made a special study of the field, is that it would be unwise and short-sighted to ignore such evidence as of no account."

20.5 Mirror Neurons

In actuality, reading the minds of those around us is something most of us do on a daily basis, though not in a paranormal sense. *Empathy* allows us to see things from the perspective of others, not just to be aware, but to actually feel the very emotions associated with their particular situation. Somehow we create an internal representation of their mental state within our own minds, which facilitates an experience of their circumstances as though happening to us. This ability to empathize represents a key evolutionary milestone in human development, enabling some small window of projected consciousness to arise within our own self-awareness. To put it another way, we not only are consciously aware of our own mental existence, but to some extent that also of others.

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So if the attainment of *artificial consciousness* on the part of a machine seems a daunting challenge, consider now the added difficulty of *artificial empathy*! For human-robot teams to achieve optimal effectiveness, however, it would seem some reasonable capacity in this regard must be realized. The degree to which animals can empathize with other animals or humans is not fully understood, but clearly police dogs can sense when their handlers are injured, or otherwise in certain types of danger. Such insightfulness also plays an important role in establishing intent, and in this case animals very likely outperform their more intelligent human counterparts. Any robot incapable of such inference will be at a decided disadvantage in terms of social interaction and perhaps even survival.

To me, it seems amazing enough that a living organic mass of electro-chemical gray matter can effectively encode enormous amounts of information as memories, bind together related bits and pieces to form concepts, and then produce insightful deductions from it all. What's more astonishing is that this same biological system somehow represents accumulated knowledge in such a manner as to yield conscious awareness of a temporal existence on the part of a unified self. But when you further consider the role of empathy, which enables some small degree of internal awareness regarding the conscious existence of others, the wonderment becomes truly hard to comprehend. A recent discovery by a team of neurophysiologists at the University of Parma in Italy sheds some interesting light on this last issue.

While monitoring neural activity in the premotor cortex of macaque monkeys, these researchers discovered a cluster of cells that fired not only when the monkeys executed a goal-directed hand motion, but also when they observed this same motion performed by some other monkey or even human (Rizzolatti, 1996). In other words, the same cells that fired when a monkey grasped a piece of fruit were also observed to fire when the monkey saw the fruit grasped by another. Furthermore, the cells did not react to the mere presence of the fruit, unlike other neurons in the ventral premotor cortex that encode spatial location of surrounding objects (Graziano, et al., 1997). The Italian team (Giacomo Rizzolatti, Vittorio Gallese, and colleagues) referred to these cells as *mirror neurons*, since their triggering seemed to reflect the observed activities of others (Motluck, 2001).

Recall the previously mentioned observation of William James (1890):

"... every mental representation of a movement awakens to some degree the actual movement which is its object;"

The discovery of this *execution-observation matching system* supports the hypothesis that we recognize certain actions in others by mapping their observed motions into our own motor representation of the same activity (Buccino, et al., 2003). Since we already understand (i.e., from personal experience) what happens in response to our own activation of these neural substrates, we will inherently recognize the same motor actions in others since their observed actions are mapped into these same substrates. Interestingly, *mirror neurons* only respond when observing a *biological* effector (i.e., a

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grasping hand), and do not fire if the same behavior is performed with an inanimate tool. And some portion of these cells (appropriately dubbed *audio-visual mirror neurons*) also reacts to just the *sound* of a known motor action being executed (Buccino, et al., 2003).

Following a presentation on his research results in 1998, Gallese linked up with philosopher Alvin Goldman from the University of Arizona, and together they explored the role of *mirror neurons* in reading the *intentions* of others, as opposed to just the recognition of actions (Gallese & Goldman, 1998). A joint study involving the University of Parma and University of California at Los Angeles employed *functional magnetic resonance imaging* to further show that another specific subset of *mirror neurons* responded only when the *intent* of a mirrored action could be inferred from *context* (Iacoboni, et al., 2005). As Iacoboni succinctly puts it, “The same area of the brain responsible for understanding behavior can predict behavior as well.” For an excellent historical overview of the relevant research involving mirror neurons, see Oberman, et al. (2005).

In addition to facilitating the interpretation of intent, there is a growing consensus that *mirror neurons*, being resident in the premotor cortex, play a significant role in the imitation of behaviors. Seeing someone else yawn often triggers a sympathetic yawn reflex. Stick out your tongue at a newborn baby and it reflexively reciprocates, even though the infant has not yet visually observed the anatomical arrangement of its own face and mouth. Watching another person struggle with some tedious task (such as untying a stubborn knot) often triggers an antsy feeling that causes our hands to twitch with impatience, as though wanting to take over (Motluck, 2001). V.S. Ramachandran of the University of California at San Diego believes this mirror-neuron response was an evolutionary facilitator of imitative learning, and predicts that “mirror neurons will do for psychology what DNA did for biology” (Ramachandran, 2005[?]).

Ramachandran also suggests that mirror-neuron impairment is linked to autism, which may help explain the characteristic social-interaction difficulties (i.e., inability to empathize) autistic individuals display in terms of comprehending and responding to the behavior of others (Baron-Cohen, 1995). According to Gallese (2005), *mirror neurons* facilitate a particular instantiation of *embodied simulation*, providing us experiential insight into other minds:

“Side by side with the sensory description of the observed social stimuli, internal representations of the body states associated with these actions, emotions, and sensations are evoked in the observer, ‘as if’ he/she would be doing a similar action or experiencing a similar emotion or sensation.”

This “intentional attunement,” in his terminology, is what allows us to empathize with the actions, emotions, and sensations of others. In a study involving ten males with autism spectrum disorders, University of California at San Diego researchers found the autistic subjects to have a dysfunctional mirror neuron system, which responded normally to their own motor actions but did not react when observing these same actions in others (Oberman, et al., 2005).

20.6 Summary

Most of the focus in the ongoing debate of the *Strong AI Claim* has been upon the attainment of *artificial consciousness*, which to me is just the tip of the proverbial iceberg. And as you may recall from high-school science, the exposed tip makes up but 10 percent of the total mass; the other 90 percent lurks somewhere beneath the surface, out of sight, but not to be lightly dismissed by the prudent. In this chapter we moved beyond the classical *mind/body problem* to take a closer look at the interaction between our *conscious* and *subconscious*. In the next and final chapter, we consider the possible implications of this interaction in terms of replication on an intelligent robot.

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