
The Brain On Dance - I

Dr. Hwa A. Lim
D'Trends, Inc., 40467-40471 Encyclopedia Circle, Fremont, California 94538, USA
hal_lim@yahoo.com

Practice as if you are the worst; perform as if you are the best.
- Mahatma Gandhi

Reporter to Hal. "Are you a scientist who dances skillfully or are you a dancer who excels in science?"
Hal's response, "I am happy to say I am neither and both. I am a rounded person."
- At an interview, April 2017.

Drug Or Dance

If you think that I have mistyped and it should have read "The brain on drug", you are half right. You are half right because it is well known that a lot of top-notch performers are on some form of psychedelic drugs, which have dramatic effects on the brain. While a study of this half will be quite interesting and will constitute a topic in a forthcoming article in this multipart series, in this article, I am more interested in the other half – the half on how the brain functions during dancing.

Since we are talking about dancing, let us begin by observing there are a few features that remain the same for each dancer. If we assume that we each are "normal" human beings, that is, we for the most part, are each born with two arms and two legs, with those limbs located in approximately the same place relative to our shoulders, heads, and feet; and the head encases a brain over the shoulder. Depending on the body physique, this would also dictate how a dancer can body dynamically improve his or her dancing for effects.

Body physique aside, generally speaking, natural selection favors large brains in humans. Whereas our australopithecine kin possessed an estimated mean cranial capacity of 450 cubic centimeters (roughly that of a chimpanzee), by 1.6 million years ago *H. erectus* more than doubled that capacity, with an average of 930 cubic centimeters. And by 100,000 years ago, *H. sapiens* had a mean capacity of 1,330 cubic centimeters.

Larger heads over a relatively slim neck have unfortunately made us more injury-prone, but the increase capability to create more than compensate for the liability.

The 3-lb Enigmatic Brain

Inside the spacious brain case, there are an estimated one hundred billion nerve cells called neurons which form the basic structure and functional unit of the nervous system. Each neuron makes something like one thousand to ten thousand contacts with other neurons and these points of contact are called synapses. It is here the exchange of information occurs, along some 165,000 kilometers of myelinated nerve fibers, and across some 0.15 quadrillion synapses.[1]

Structurally, the brain has two mirror-image halves, called the cerebral hemispheres, and it resembles a walnut sitting on top of a stalk, called the brain stem. Each hemisphere is divided into four lobes: the frontal lobe, the parietal lobe, the occipital lobe, and the temporal lobe.

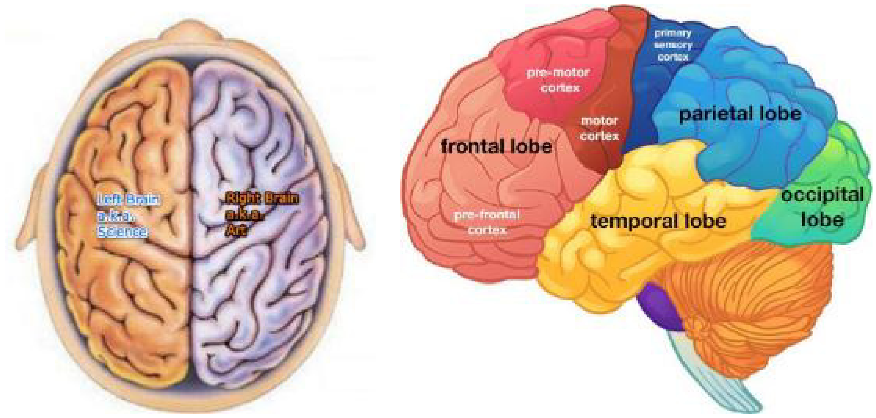

Figure 1. Cross anatomy of the human brain. (l) the two cerebral hemispheres resemble a walnut. (r) The left side of the left hemisphere and the four lobes: frontal, parietal, temporal, and occipital. The frontal is separated from the parietal by the central or rolandic sulcus, (furrow or fissure), and the temporal from the parietal by the lateral or sylvian fissure. The two hemispheres of the brain are bridged by corpus callosum, and the whole brain sits on top of the brain stem.

The occipital lobe in the back is concerned with vision; the temporal lobe is concerned with hearing, emotions, and certain aspects of visual perception. The parietal lobes, at the sides of the brain, are concerned with creating a three-dimensional (3D) representation of the spatial layout of the external world, and also of our own body within that 3D representation. The frontal lobes are concerned with some very enigmatic aspects of human mind and human behavior such as moral sense, wisdom, ambition, and other activities of the mind.

Cranial Functional Areas

The adult cortex is made up of more than 50 separate functional areas, each responsible for some part of our capacities. The borders between these areas are, like border between nations, often invisible and independent of geographic boundaries (and can thus lead to border conflicts between neighboring nations). Similarly, there are no physical or organizational differences between the neurons in one functional area and those in another. Each is apparently formed simply by the unification of their populations of neurons for a common cause (and can thus lead to cross-talks such as in synesthesia in which patients see numbers in colors).

The cells in the part of our cortex where we recognize human faces (known as the fusiform face area and located in the fusiform gyrus, itself located on the underside of the temporal lobe) look just like those in the motor cortex, involved in the planning and execution of movements. Nevertheless, most of us seem to use that one particular little spot in our fusiform gyri to recognize a human face and use our motor cortex to initiate the movements required to, for example, make a thumb okay.[2]

In fact, our motor cortices are arranged in a similar fashion, with a standardized map of our bodies contained within them. For example, in the motor cortex, the neurons that tell a person's foot to move during dancing are tucked in at the top of the brain, between the two hemispheres, and the neurons governing the tongue are located at the side of the brain (see Figure 2). This somatotopic map – point-for-point correspondence of an area of the body to a specific point on the central nervous system – is represented in what is known as the Wilder Penfield map.[3]

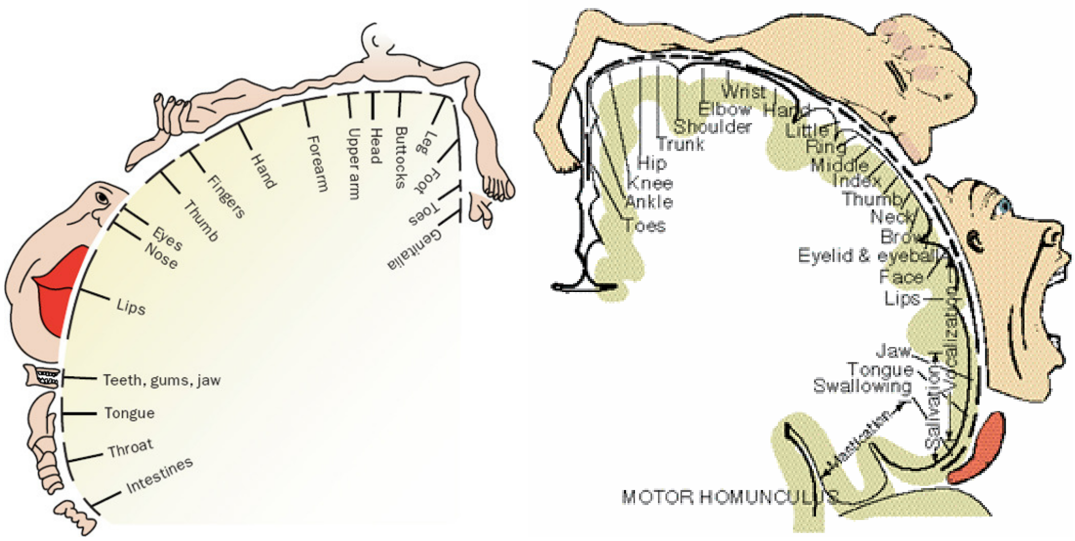

Figure 2. This is a coronal section of a brain, meaning it is the view people would get of your brain if, when you put on your headphones, they slice off the front half of your head while you are looking at them. (Left half of the slice is on the right).

The most striking aspect of this map is that the areas assigned to various body parts on the cortex are not proportional to their size, but rather to the complexity of the tasks that they can perform. The areas for the hand and face are thus especially large compared with those for the rest of the body because the speed and dexterity of human hand and mouth movements are precisely what give us two of our most distinctly human faculties: the ability to use tools and the ability to speak!

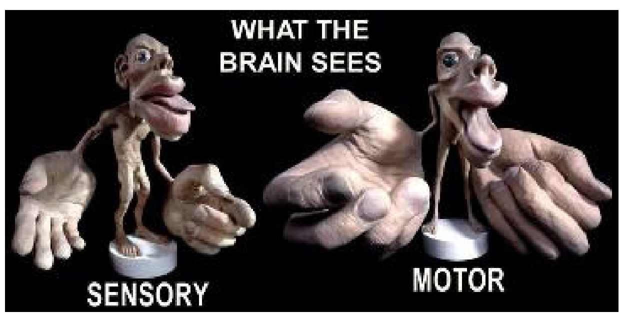

Figure 3. The homunculus or little man, from the sensory and motor parts of the brain. Penfield's experiments in stimulating the cortex enabled him to develop a complete map of the motor cortex, known as the motor homunculus (right). There are also other kinds, such as the sensory homunculus (left).

The front of the brain may be considered as a *homunculus* or little man, and the back of the brain as where sensory input arrives. In general, if someone has brain damage to the back of the brain, he does not hear or see or feel things, whereas if he has damage to the front of the brain, he alters his character. This broad generalization, however, does not give a general impression of what is going on in the brain. For the most part, the front of the brain puts together information brought to the back of the brain by the nerve tracks from the sensory organs. While the back of the brain does some initial processing of information from the eyes, for instance, most evidence shows that it is the front of the brain that creates meaning from that information, much as a spectator puts together images he sees on a performance stage (back of the brain) and makes meaning from them (front of the brain).

Because it is easy to tell whether and when someone is moving, it is well established that the motor cortex is necessary for movement, and that stimulating it results in movement. But there are other less quantifiable capacities, and it remains to be seen how much variation exists in the size, shape, and organization of functional areas of the brain, how such variation develop, and what it means. Just as some of us are born with more prominent chins or longer fingers, some too are born with larger or smaller fusiform gyri. Or just as some people are left handed and some are right handed, some of us recognize faces using the left fusiform gyri instead of the more commonly used right fusiform gyrus (see also below about the left-hemisphere and right-hemisphere attributes). But while we know that overall brain size does not correlate well with intelligence (for example, Einstein's brain weighs only 2.7 pounds, about 13% below average) and generally which part of the brain allows us to move our fingers, we do not yet know where in the brain a gift for physics, a love for piano playing or an aptitude for dancing arises.

In general, the two hemispheres of our brains are associated with two broad (and differing) aspects of thoughts – the right hemisphere is creative (or the art-hemisphere) and the left is logical (or the science-hemisphere). These distinctions are somewhat misleading since all of the characteristics can in some ways be associated with each hemisphere (just like a person can be right-handed or left-handed). There is also evidence to suggest that following a trauma to one of the hemispheres, the other hemisphere can adapt to what has been lost due to the trauma.

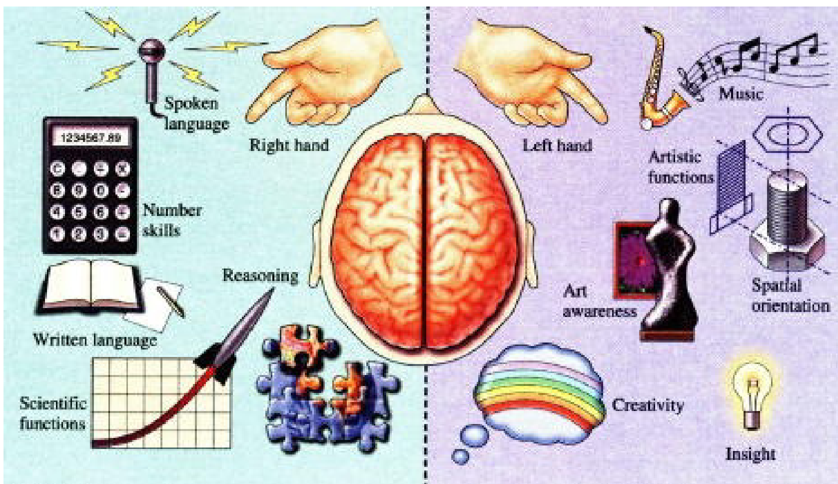

Figure 4. Functions of the two hemispheres of the human brain: In general, the left hemisphere is the "science" hemisphere; the right-hemisphere is the "arts" hemisphere. The left is for statistics, experimentation, details, math, analytics, programming; the right is for psychology, synthesis, language, design, creativity, role-playing. But this does not mean that scientists are not creative!

Though there are recent findings that confront notions of the left- and right-brain hemispheres, the perception persists of the following left-brain right-brain attributes:

The right-hemisphere of the brain controls the left side of the body, and is chiefly associated with nonverbal ideation. The functions connected to the right-hemisphere include: creative thinking, image processing, intuitive cognitive style, sound and facial recognition, figurative thinking, spatial orientation and integration, tactile perception, pattern spotting. In summary, the right-hemisphere appears to control spatial orientation and judgment, and has capacity for recollecting events and for putting together pieces of information to draw conclusions.

The left-hemisphere, on the other hand, controls the right side of the body, and is chiefly associated with logical, linear line of thinking. The functions connected to the left-hemisphere include: receptive language, detailed precision thinking, writing, analytical thinking (logic), linear-based math, organization and calculation, speech, sequential processing. In summary, the left-hemisphere appears to control the understanding and the uses of language and communication as well as make detailed analysis of incoming information.

The Visual Pathways

We – the hairless primates – are highly visual creatures. We have not just one visual area, the visual cortex, but thirty areas in the back of our brains which enable us to see the world. Each of these areas is specialized for a different aspect of visions: For instance, the area V_4 seems to be concerned mainly with processing color information (that is, seeing color), whereas another area in the parietal lobe called MT (the middle temporal area) is concerned mainly with seeing motion.

The anatomy of the thirty visual areas in the brain may seem bewildering, but there is an overall plan of organization. Messages from the eyeball on the retina go through the optic nerve to two major visual centers in the brain. One of these, the old system, is the evolutionary ancient pathway that includes a structure in the brain stem called the superior colliculus. The second pathway, the new pathway, goes to the visual cortex in the back of the brain. This new pathway in the cortex is doing most of what we usually think of as vision, such as recognizing objects, consciously.

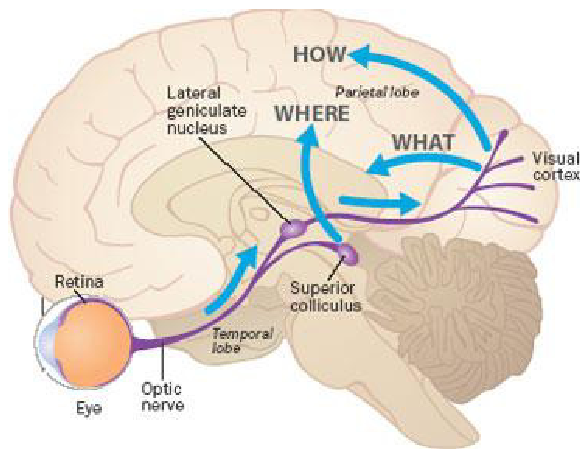

Figure 5. Schematic diagram of the left hemisphere viewed from the left side. The fibers from the eyeball diverge in two parallel "streams": a new pathway that goes to the lateral geniculate nucleus (shown here on the surface for clarity: it is inside the thalamus, not the temporal lobe), and an old pathway that goes to the superior colliculus in the brain stem.

The new pathway, upon reaching the visual cortex, diverges again, after a couple of delays, into two pathways – a "how" pathway in the parietal lobes that is concerned with grasping, navigation, and other spatial functions, and the second, "what" pathway in the temporal lobes concerned with recognizing objects. These two pathways ("what" and "how") were discovered by Leslie Ungerleider and Mortimer Mischkin of the National Institutes of Health.[4]

The old pathway mediates blindsight – the ability to respond to visual stimuli without consciously perceiving them – and projects to the parietal lobe in the sides of the brain. The parietal lobes are concerned with creating a symbolic representation of the spatial layout of the external world. The ability that we call spatial navigation – avoiding obstructions, dodging an elbow (if dancing ever gets so dangerous), catching a falling robot – all of these activities depend crucially on the parietal lobes.

In this way, the old pathway, involved in locating objects spatially in the visual field, enables you to reach out for it or swivel your eyeball toward it. This allows the high-acuity central foveal region of the retina to be directed toward the object so that the new visual pathways can then proceed to identify the object and generate an appropriate behavior toward it: eat it, mate with it, run away from it, name it, or dance with it, etc.

The new pathway is conscious, events in the old pathway, going through the colliculus and guiding the hand movement, can occur without a person being conscious of it. Why should one pathway alone, or its computational style, lead to conscious awareness, whereas neurons in a parallel part of the brain, the old pathway, can carry out even complex computations without being conscious?

This unconscious (or zombie) mode is a good evolutionary strategy: to have some fast, stereotyped reactions and processes in addition to a slower, integrative function like consciousness. With such as schema, consciousness can react to new and evolutionarily unanticipated circumstances while not having to dirty its hands with the mundane work of survival, which it can leave to the zombie modes.

Dancing In And Out Of Unconsciousness

Perhaps the best way to understanding the old and new pathways is by giving an example. Imagine you are driving a car and having an animated conversation with a passenger friend sitting next to you. Your attention is entirely on the conversation –you are performing a conscious conversation. But simultaneously you are negotiating traffic, avoiding pavement, pedestrians and obstacles, obeying traffic rules, that is, performing all these very complex elaborate computations without being really conscious of any of it, unless something unexpected happens, such as a deer charges across the road in front of you.

Interestingly, it is hopeless to imagine the converse scenario: paying conscious attention to driving and negotiating traffic while unconsciously having a creative conversation with the passenger friend. This may sound trivial but it is already telling you something valuable: that computations involved in meaningful use of language require consciousness but those involved in driving, however complicated, do not involve consciousness.

Now if we translate this to dancing, we will see that a good dancer should be able to navigate or floor-craft a dance floor or stage unconsciously (unless another rude dancer cuts across), and consciously listening and dancing to the music. It would be not very desirable if a dancer tries hard (consciously) to regurgitate dance moves and unconsciously listening and dancing to the music. This is when the dancer gets awfully off beat executing patterns from memory. This is also what makes the difference between a novice and a professional dancer, just like a student and a seasoned driver.

Let us take a conscious look at the things we are doing unconsciously so that we can fix those behaviors and send them back to the unconscious mind. This is precisely what dancers do during practice – consciously doing moves so that the moves will become unconscious execution during show time.

Consciousness is the act of steeping outside the process and observing it. To the best of our knowledge, as mentioned earlier, there is only one "machine" that can do this, and consciousness is supplied free of charge in the skulls of most humans.

The vast majority of our actions are unconscious. Obviously, we do not make a conscious decision to have the heart beat, the kidney filter, or the stomach digest. Most of the time, we do not consciously breathe, although now that I have mentioned it, you will spend the next few seconds very consciously to remember to breathe.

If you spend conscious time thinking about every single motion you perform with your hand and feet during dancing, you will be effectively indistinguishable from a student dancer. Think of the first time you danced: every motion you performed was fully conscious, arrived at after some thought and consideration. Think of how awkward and clumsy that was, and you could easily be discombobulated by any distractions.[5]

The problem is most of us can only really think about one or two things consciously in a given track session. Conscious thought is a limited, rare, and relatively expensive mental resource – expensive in the sense of requiring time and effort that you cannot use for something else.

Example of the Rumba Walk

In dancing for example, this could mean practicing something – including something absolutely unnatural – and it takes years to learn to do it right. But once you have it, you have it. That means we may have to consciously think about our moves (during practice) and do it enough times until it becomes unconscious. With much practice, the process of doing the basic dance moves will become so automatic, so unconscious, that a dancer is able to treat it the same way you treat your daily commute to work. That will leave the dancer time to work on the bigger picture.

Take for example, the Rumba walk. There are at least two versions of the Rumba walk: the American style and the International style. Like in other dances, in this partner dance, the sensuous action (especially of the female form) has been explored and exploited to the fullest in the walking technique to achieve maximum impact with appropriate character in entertainment. One style is based on the Cuban action, and the other on the tendu action from Ballet.

The Cuban is a coordinated physical recipe for rhythmic expression with its root in Cuba; it incorporates a type of action which is motivated from the emotional center (ribcage) and manifests itself as a distinctive action of the hips instantly recognizable as something of Latin character. A popular approach is to spice up the Rumba walk with a combination of Cuban on the slow, with the contrasting tendu walks on the quicks. The Cuban action is more natural, while the tendu approach, if done well, would look beautiful but if done badly, would have a somewhat grotesque effect. This creates an opportunity for quantifying, standardizing, documenting and essentially coming up with a methodology for marketing a product to the public. Thus the terms "American" or "International" are superficial terms that are misleading and inaccurate.[6]

In other words, whether one is dancing seriously (or dancing for health), it is prudent to dance well to the music so the dancing will be more enjoyable (or the exercise habit will be sustainable). All these take practice and time: they require that we take a conscious look at the things we are doing unconsciously so that we can fix them and send them back to the unconscious mind.

Otherwise, in a performance, the audience may be pushed into the uncomfortable position of having to decide whether to enjoy the great music, or the "great" dance. Or that the dancer may make a fool of herself dancing grotesquely.[7]

Examples of the Zombie Mode

Just like the visual pathways example or the driving example, most of what happens in our brain is unconscious. These activities are sometimes called "cortical reflexes" or "zombie mode", and they are faster than conscious modes.

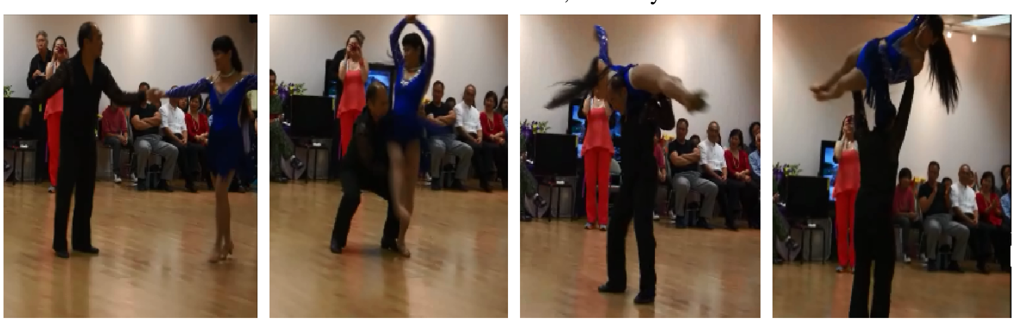

Figure 6. The author (he) demonstrates an overhead press. The sequence of body motions from him and his partner (her) to get her up in the air. All these happen in an unconscious mode: (a) She spins in towards him, with a certain appropriate momentum; (b) He bends his knees to lower himself to receive her with an arm on her straightened leg, and another on her back; (c) She holds her core and continues rotating about herself to aid him in the aerial lifting; (d) He now straightens his legs (which more powerful than hands and thus nifty in lifting) and lifts her overhead while she continues to hold her core.

Take adagio partner dancing (with lifts and tricks) as an example (Figure 6), and if a dancer (he) dances well, most of it is totally at the reflex/zombie level. The partner (she) approaches (runs towards) him with a certain momentum, and his body executes the right sequence of motions to receive her (such as bending knees to lower his body, and lifting her up with both hands, one on her straightened leg and the other on her back to roll her over his shoulders), and this creates a certain rotational torque to induce him to spin with her momentum while straightening his legs to eventually lift her up in the air, with his arms stretched. They each do their respective parts; there is almost no delay between her coming in and reacting to it. It is all smooth seamless motion, ego-less, thoughtless. The dancers may not even hear the cheers from the audience!

Now that she is up in the air, his high-acuity central foveal region of the retina is directed toward the audience (dancer-audience interaction), in a conscious way. The dancer may now hear the applause.

Figure 7. The author (he) demonstrates leverage (pull) and compression (push) with his partner (her). Leveraging and compressing are two key elements in dynamic partner dancing. Partners constantly vary from leverage to compressions, and adjust the intensities of leveraging and compression accordingly to build off each other to achieve the dynamic ends while maintaining their individual forms and lines.

Recall that the motor and sensory homunculus have large hands (implying that the sensorimotor attributes of this part of the body is very well developed), we should tap into these evolutionary assets. Thus as another example we discuss leverage and compression in lead-and-follow in partner dancing (Figure 7). The process is a very sophisticated action. The follower “cups” her fingers in his palms, instead of grabbing his fingers. The dancers have to judge how strong the leverage (or compression) is to let each other know the lead (or the follow). All this requires a lot of information, but most of the information the dancers do not have conscious access to (perhaps after hours of conscious training to send these actions into the unconscious mind)! They just execute this automatically, very quickly, so that they are dancing on top of the music while communicating with each other through the leverage and compression to execute sophisticated and stylist patterns.

The idea that our brains have these systems that mediate this zombie behavior, these sensorimotor behaviors, they work online, in real time – they did not evolve to deal with a delay between sensing and acting, while the systems that seem to involve or require consciousness all have the characteristic that they can store information, at least for a short period of time.

We thus conclude that in a great professional performance, it is a clever mix of unconscious (such as dance executions) and conscious (such as audience interactions) dancing that makes the routine a hit or a flop!

The Waterfall Effect

We iterate that humans are primarily visual (audiovisual, in fact) creatures. We are, relatively, not too aware of the world of taste and smell (even for gastronomists) in which most of the millions of other species thrive. And we are entirely oblivious to the electrical and magnetic fields used by a few animals for orientation and communication. Even in our own world of sight and sound we are relatively close to blind and deaf, able to perceive directly no more than minute segments of the electromagnetic spectrum, nor the full range of compression frequencies that surge past us in our surroundings.

Yet the fact that sight is such an enormous part of human consciousness is reflected in the large amount of brain tissue dedicated to the analysis of images and in the importance of seeing in your daily life. (See for example, Figure 5).

For example, the middle temporal area, MT, is concerned with seeing motion. If the MT area is damaged, the patient cannot tell which direction something is moving, or how fast. The patient may be seeing a moving object not as moving, but as a series of static images as though lit by a stroboscopic light in a discotheque. In this situation, it can become an ordeal for the patient to cross a street, or to dance because she cannot tell how fast something (a car or another dancer) is approaching.

For a non-patient, seeing motion may not be a problem, but in dynamic dancing, a dancer may spin and turn a lot, which can create a very uncomfortable feeling, such as dizziness. This feeling of momentary disorientation is known as the waterfall effect or known less romantically as the motion aftereffect. The effect can be experienced by performing a very simple experiment. First stare continuously at something characterized by movement in a single direction, such as a waterfall. Afterwards if you divert your eyes to stationary objects such as rocks beside the waterfall, for instance, the rocks will appear to be moving upward.

This is easily explained. From animal studies and functional imaging, in humans, it appears the part of the brain where the clusters for movement-to-the-right or movement-to-the-left (and for that matter, movement-to-the-top or movement-to-the-bottom) are located in the area known as V_5 or MT (the middle temporal area). This part of the brain is also activated when people perceive motion that is not there, as they do momentarily after having gazed at a waterfall. The perception of stillness is actually achieved by a kind of tug-of-war between neurons for motion-to-the-left and those for motion-to-the-right, as well as those for motion-up and motion-down. When an object is not moving, the tug-of-war is at a draw. The theory is that as we look at the waterfall, the neurons for motion-down are being so continuously stimulated that they adapt to fire less strongly (sort of getting fatigued), so when you switch your attention to a static object, they cannot fire strongly enough to counteract the motion-up neurons. This gives the feeling that the stationary object is moving up because the motion-up neurons are firing more strongly.

In spinning continuously to the right for example, a dancer motion-to-right neurons will get fatigued, and when she stops spinning, the motion-to-right neuron firings cannot counteract motion-to-left neuron firings, giving her the feeling of the world is swirling left!

This is why good dancers "spot" when executing turns or spins such as in Fouettés. The goal of spotting is to attain a constant orientation of the dancer's head and eyes, to the extent possible, in order to enhance the dancer's control and prevent dizziness. For effects, spotting also dramatizes the turns when the body turns in segments (upper body, lower body, and the head) instead of one unit.

Not that spinning or turning is something natural that we do daily, nor that when we turn or negotiate a corner, we spot. Thus these "unnatural" actions can be a challenge for most people. But to be an established dancer, turns and spins are part of the game. Thus a serious dancer will have to practice these "unnatural moves" by incorporating "spotting" to put these actions (turns and spins) into the unconscious mind so that they can burn the floor when they take the spotlight.

Monkeys See Monkeys Do

Giaccomo Rizzolatti (University of Parma, Italy) carried out experiments on monkeys. It is a known fact that parts of the frontal lobes concerned with motor commands contain cells which fire when a monkey perform specific movements. For example, one cell cluster will fire when the monkey reaches out and grabs a banana, another cell cluster when the monkey pulls something, yet another cell cluster when the monkey pushes something. These are the motor command neurons.

Rizzolatti found that some of these neurons would also fire when the monkey watches another monkey performing the same task. For example, a banana-grabbing neuron cluster that fires when the monkey grabs a banana also fires when the monkey watches another monkey grab a banana. The same thing happens in humans.[8]

This is quite extraordinary because the visual image of somebody else grabbing a can of beer is utterly different from the image of oneself grabbing a can of beer. The brain must perform an internal mental transformation, only then can that neuron clsuter fire in response both to its own movement (grabbing in this case) and to another person making the same movement. Rizzolatti calls these mirror neurons. A better name for them is probably monkey-see-monkey-do neurons.

These neurons may have played an important role in human evolution. One of the hallmarks of our species *H. sapiens* is what we call culture. Sometime around 50,000 years ago, maybe the mirror neurons system became sufficiently sophisticated that there was an explosive evolution of this ability to mime complex actions, in turn leading to cultural transmission of information, which is what characterizes us as humans. Culture depends crucially on imitation of parents and teachers, and the imitation of complex skills may require the participation of mirror neurons.[9]

This may be how we learn to dance in different cultures, in that particular cultural way. It is often times challenging for someone immersed in one culture to dance well in another cultural dance, and for that matter, for different age groups in different subcultures! Think of the Africo-Cuban dancers who dance very naturally; the Europeans who standardize dances and dance more formally; and Asians whose social behaviors are more subdued and dance mortifily. In the example of the Rumba walk, the Africo-Cuban dancers will do it in the more natural Cuban way; the Europeans will do it in a “reverse” Cuban way; and the Asians normally struggle to do so.[10]

Culture Ratcheting in Crowdsourcing

Chimpanzees are highly adept at using a wide range of tools – cracking open nuts with rocks, mopping up water from tree hollows with leaves, and unearthing nutritious plant roots with digging sticks. But they seem unable to build on this knowledge or to craft ever better tools or more advanced technology. They just “chimpansee” and “chimpando”.

In contrast, we humans suffer from no such limitations. Indeed, we daily take the ideas of others and put our own twists on them, adding one modification after another, until we end up with something new and very complex. Anthropologists call this knack cultural ratcheting. It requires, first and foremost, the ability to pass on knowledge from one individual to another or from one generation to the next, until someone comes along with an idea for an improvement.

This is how different forms of dances become developed, and if we can overcome the monkey-see-monkey-do (or chimpan-see-chimpan-do) restrictions, we can synthesize (fusion) different dance forms to create yet a new dance form. The most recent authentic American dance, the Hustle, was derived from the Mambo and the Cha cha in the late 1960s.

But for this to happen, a key prerequisite, besides cognitive abilities, is social skills. To propel the ratcheting process needs the push of demography. The premise is very simple: the larger a group, the greater the chances are that one member will dream up an idea that could make advances. This is the basic tenet of crowd-sourcing. This is precisely why we have UNESCO’s *Conseil International de la Danse* (CID) as a body, and CID organizing world congresses like this one – to culturally and creatively ratchet the arts and knowledge of dances.[11]

“It is not how smart you are; it is how well connected you are.” Through the networks of CID, we are better connected with like-minded friends. This also brings us to the jostling, teeming, and intimately linked world we live in today. Never before have humans crowded together in such massive cities such as Athens, accessing vast realms of knowledge with a click on the computer keyboard (or a cellphone) and sharing new concepts, new blueprints, design, and new dance moves across the sprawling social networks (such as Youtube) of the World Wide Web. And never before has the pace of innovation accelerated so dramatically, filling our lives with new fashions, new electronics, new cars, new music, new architecture, and new dance forms, and dancing robots.[12,13]

Viva UNESCO CID! *Viva* dance!

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About the Author

Dr. Hwa A. Lim's friends love to joke that "Dr. Lim is a scientist who dances skillfully", or "Dr. Lim is a dancer who excels in science". He is more of the former, who dances more than he can afford, time-wise. Indeed, Dr. Lim is an internationally respected authority on bioinformatics and biotechnology. Currently he is active in both the academic and the private sectors.

Besides his many appointments as scholar, technologist and entrepreneur, Dr. Lim is an articulate and well sought-after speaker at international meetings, including Fortune 500 Summit. He is well-published, with over 150 peer-reviewed scientific papers and 15 books on biotechnology in English.

Dr. Lim is credited with coining the neologism "Bioinformatics", establishing and shaping the field, and initiating the world's very first bioinformatics conference series. He chaired the first ten conferences of this "Bioinformatics and Genome Research" international conference series, charting and mapping out the directions of research and development, leading to the current state of affordable genome sequencing. These pivotal roles and credits earn him the title "The Father of Bioinformatics."

As a bioinformaticist, he has served as bioinformatics expert for the United Nations (Food and Agricultural Organization), and as a review panelist for United States federal agencies (including National Cancer Institute, National Science Foundation), and as a consultant for prominent consulting firms, biotech, pharmaceutical and healthcare companies, organizations, and governments of numerous countries.

Dr. Lim gained his Ph.D. (science), M.A. (science), and MBA (strategy and business laws) from the United States, his B.Sc. (Honours) and ARCS from Imperial College of Sc. Tech. & Medicine, the University of London, United Kingdom.

He currently resides in San Jose, California, USA.

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