TEACHING LEADERSHIP WITH THE BRAIN IN MIND

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Al H. Ringleb
University of Iowa/CIMBA

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Leadership and Neuroscience at CIMBA

◆ Al H. Ringleb

Executive Director, Consortium of Universities for International Studies

◆ David Rock

CEO of RCS, Faculty at CIMBA

Bolstered over the past decade by the advent of affordable and effective brain-imaging technology, neuroscience research is beginning to influence how leadership scholars both think about the brain and view the contribution neuroscience can make to furthering our understanding of leadership generally and to teaching leadership more specifically. Based on this research, readily available technology capable of measuring an individual's psychological data in real-time has the potential to make significant contributions to leadership-learning environments, particularly as it relates to students gaining an experiential understanding of the fundamental relationship between cognition and emotion. In this article the authors look at how such technology and the neuroscience research

that supports its use are impacting learning environments at CIMBA, an international MBA program located in Italy and headed by the University of Iowa. At CIMBA, MBA students are wired up and measured using nonintrusive, wireless technology to support a broad range of learning events and activities from traditional classroom discussions and team-based exercises to specifically designed emotion elicitation business simulations. Although leadership is just at the beginning stages of teaching and developing leaders with the brain in mind, the authors are encouraged by the observed results and motivated by the opportunities for further research.

> *Oddly, despite B schools' scientific emphasis, they do little in the areas of contemporary science that probably hold the greatest promise for business education: cognitive science and neuroscience.*
>
> —Bennis and O'Toole (2005, p. 104)

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Imagine an MBA program where students wear a device throughout the day that wirelessly, continuously, and unobtrusively collects, transmits, and stores their neurophysiological data for concurrent and later analyses. Classrooms where students not only observe the professor's presentation, but where both professors and students are able to observe their neuro-physiological (emotional) responses as they learn, engage in discussions, and participate in team activities together. Student consulting projects where the same data are collected and analyzed in assessing progress toward personal development goals, whether the student is within the walls of the school or at the client's site. Workshops where a student learns both the emotional and skill components of a particular leadership competency by confronting a variety of simulations designed to elicit the emotion commensurate with the leadership competency being taught—again, measured wirelessly, continuously, and unobtrusively and transmitted to a team and the student's personal development coach for analysis. Something for the future? In reality, the technology is readily available now and this learning environment currently exists at CIMBA, an international MBA program located in Italy and headed by the University of Iowa.

Readily available neurobiofeedback technology has the potential to significantly impact the way in which we teach and develop leaders (Johnson, Boehm, Healy, Goebel, & Linden, 2010). Within the traditional **Being-Knowing-Doing** framework (Hesselbein & Shinseki, 2004), a successful "leader" learns skills (**Knowing**) and makes them actionable or operationally effective (**Doing**), all under the assumption that both leader and followers manifest at will the appropriate emotional and mental states (**Being**). Through observation and experience, we found traditional, informational or epistemological, skills-building approaches particularly deficient in **Being**, the development component needed to guide, support, and assist learners to reach a deeper psychological understanding of both *their* values, emotions, behaviors, and thinking and *those of others*. In searching for **Being** development alternatives, our experiences moved us outside the confines of the major disciplines whose "theories" were then defining the traditional informational (and other) approaches to leadership development.

In this article, we provide an overview of the leadership and leadership development instructional approach we have developed based on the experiences, observations, insights, and thinking generated by our search for an effective **Being** component of leadership. An important part of that journey was an exploration and assessment of **Being** components within other systems and the research that supported them. While it was evident that **Being's** importance was very much understood and appreciated, its express inclusion and effectiveness in the leadership development experience was clearly constrained by the technology available to the theorists at the time they developed their systems. It was not difficult to envision a traditional leadership theorist asking himself or herself: "How would our leadership development system be different if we could actually measure emotion?" Through our various experiences, we found a viable solution at the intersection of neuroscience and social psychology, overlaid it onto more traditional approaches to leadership and leadership development, and created an approach that makes use of neurobiofeedback technology based on neuroscience research to explicate a leader's emotions. We begin by providing an overview of the core neuroscience and social psychology research and conceptual tools that support the approach, and some of the history that brought us to understand and appreciate the contributions they could make toward an effective leadership learning experience.

I. The Basic Foundation and its History

While we fully appreciated both the importance of technically competent leaders and the ability of the classroom to deliver that competency, in the late 1990s we decided to move beyond traditional classroom-based leadership education with the intent to bring more process (**Doing**) and behavior (**Being**) into the leadership learning equation. To assist and guide us, we actively involved social psychologists, instructional psychologists, cognitive scientists, neuroscientists, leadership scholars, business leaders, coaches, and others. Social psychologists identified both the core psychological components upon which leadership as a social event would function most effectively and the role emotion plays in influencing the success of such events. Neuroscience was identified as a natural science upon which leadership as a struggling social science could seemingly be built or rebuilt, with neuroscientists assisting in connecting emotion and, more importantly, the measurement of emotion and its consequences to the efficacy of leadership events. Instructional psychologists provided us with insight into the most effective learning environments to replicate the emotions being generated by leadership as a social event. With the assistance of this eclectic group of thinkers, leadership at CIMBA came to mean understanding leader and follower minds with attention to neuroscience theories and research in order to better develop leaders for the effective **practice** of leadership and management.

LEADERSHIP AND NEUROSCIENCE

Through the late 1990s and early 2000s, the underlying subtleties and complexities of human interactions due to *individual differences* in the efficiency and sensitivity of brain structures were increasingly becoming understood and appreciated by neuroscientists working in cooperation with social psychologists. Much of this new comprehension was flowing from a rapid expansion in research on the biological underpinnings of social processes driven by the advent of functional neuro-imaging and other technologies. In this light, we observed and experienced several significant learning enhancements to be had from reframing traditional leadership and leadership development theories and concepts through the lens of neuroscience.

We first saw that neuroscience provided evidence-based, "hard" science to assist in the explanation of the **Being** component of leadership, which traditionally had been considered "soft" or a "soft" science. As a "soft" science, the **Being** component's contribution to effective leadership was understood but was typically "held constant" as being beyond the purview of traditional business education and training. But research in neuroscience would change that practice. Second, by taking neuroscience's findings identifying the active, biological "ingredients" of leadership and relating those findings meaningfully to the learner, the efficacy of those teaching efforts was significantly improved. Neuroscience provided a science-based vehicle for setting out for the learner the *What, Why, and How* of leadership—moving leadership and leadership development beyond its traditional classroom-based focus on the *What*. Learners enjoyed, were in fact drawn to, learning about their brain, as well as their ability to expressly direct its attention and its impact on leadership practices. Third, neuroscience provided the necessary scientific rigor to promote the discovery of new and important insights into the leadership mental process going forward, with some of those insights supporting existing theory and others suggesting consideration of alternatives. Finally, and perhaps most importantly, neuroscience greatly assisted us in understanding how to effectively measure emotion and along with it the objective evidence to guide us in working to understand individual differences in performance and well-being—fundamental for improving leadership competencies.

LEADERSHIP AS A SOCIAL EVENT

Our first encounter with neuroscience involved a neurobiologist who brought us to the realization that leadership is a **social** event. She and other neurobiologists argue persuasively that many of the adaptive challenges facing our earliest ancestors were social in nature, with those most able to solve survival problems and adapt to the social environment the most likely to reproduce and pass along their genes. Given that belonging to a social group had considerable value, the human brain was clearly motivated to evolve dedicated neural mechanisms acutely sensitive to social context, especially to any signals that group membership was somehow endangered. The brain understood that social rejection meant death and must be avoided to survive.

With this realization, we focused on understanding the underlying psychological components necessary to support leadership as a social event. We understood that being a good group member involves an awareness of one's thinking, feelings, behavior, and emotions with the ability to alter any of those to satisfy group standards or expectations. Social psychologists showed us that this awareness implies the human need for at least four psychological components, the failure of any of which can lead to undesirable outcomes and being ostracized from the social group: self-awareness, social awareness, threat/reward circuitry, and self-regulation.

Individuals need self-awareness to reflect on their emotions and behaviors to judge and evaluate them against group norms. Social awareness, or *theory of mind*, provides an individual with the ability to infer the mental states of others (particularly those within the individual's social group), to empathize with them to be able to predict their judgments, emotions, behaviors, and actions. The notion of social awareness implies that the individual understands and appreciates that they are the objects of continuous social group evaluation, which in turn necessitates knowing that others are fully capable of making such evaluations and acting upon them. The human brain's evolution further responded to this social awareness need by providing dedicated circuitry for detecting inclusionary status. The brain's threat detection circuitry continuously monitors our social environment for any signals or other evidence of possible group exclusion. Once the circuitry senses that the individual's actions have or may violate group standards and that others group members are evaluating them negatively, the individual needs the self-regulatory ability to rectify the situation and re-establish or maintain group status. The individual needs to inhibit impulses and control thoughts, actions, and emotions to change according to social context.

Against this evolutionary framework, we ultimately placed considerable importance on individual self-regulation and the ability to control impulses. From a leadership and leadership development perspective, those "impulses" are generated by the individual's brain threat/reward circuitry responding to social environment stimuli (real or perceived). We saw those "impulses" as being different individual-to-individual and generated by something we referred as SCARF events—generated by real or perceived stimuli in the social environment affecting the individual's status, certainty, autonomy, relatedness, and/or fairness (Rock, 2008). How an individual's SCARF "stressors" are managed depends upon the individual's self-regulatory circuitry (control-related prefrontal cortex) and the rate at which the individual depletes available brain energy in activating and engaging that circuitry. Within the development context, this further implies the need to assess and measure both an individual's SCARF profile and his or her self-regulatory ability in creating both an effective leadership development plan for the individual and the appropriate intervention strategy to bring about the desired goals and objectives set out in that plan.

By piecing together and testing relevant neuroscience and social psychology research findings the basic foundation of our instructional and developmental system took a definitive form. In essence, the system functions upon the following three core components (On the basis of our current observations, individual growth and development seem to proceed to a significant degree in the same order):

1. **Explicit understanding of emotion** (Barrett, 2006; Gooty, Connelly, Griffith, & Gupta, 2010; Izard, 2009, 2010);
2. **Self-Regulation** (Bauer & Baumeister, 2011; Hooker, Gyurak, Verosky, Miyakawa, & Ayduk, 2010; Lieberman, 2009); and,
3. **The ability to effectively call upon cognitive resources regardless of one's emotion or mental state in order to enhance performance and well-being** (Farb et al., 2007; Gross & John, 2003; Gyurak et al., 2009; Lutz, Slagter, Dunne, & Davidson, 2008; Ochsner & Gross, 2005; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010).

We found that the technology allowed us to both develop and test our understanding of emotional and mental states, and to assist in developing mindfulness, a necessary ingredient in strengthening self-regulation (Farb et al., 2010; Jha, Stanley, Kiyonaga, Wond, & Gelfand, 2010). From a source of information standpoint, and as the opening quote to this article also illustrates, we were surprised at the dearth of interest in applications of neuroscience among leadership and organizational behavior scholars. We were equally surprised at the science of emotion, particularly in the seemingly divergent ways in which various disciplines sought to deal with it. Leadership and organizational behavior, for example, readily acknowledged its existence but basically held it constant (Gooty, Gavin, & Ashkanasy, 2009). Sports psychology, on the other hand, seemed to have a sense of urgency in understanding the emotion-performance relationship (see, e.g., Hanin, 2007). It was when we realized the fundamental role played by emotion in effectively teaching and developing leaders and began to explore emotion's dimensions with the technology that we came to understand why.

LEADERSHIP AND EMOTION

It has been nearly 60 years since Skinner (1953, 1974) declared that emotion—*that what [is] felt or introspectively observed* (Skinner, 1974, p. 18)—was on the list of **fictional** causes to which an individual's behavior is commonly ascribed. The *Managed Heart* (Hochschild, 1983) and *Emotional Intelligence* (Goleman, 1995) among other publications brought the discussion of leadership emotion into the open, and served to assist both practitioners and academics in overcoming a seemingly unwritten reluctance to acknowledge the contribution of emotions to the mix of what constitutes the effective practice of leadership. Over the past two decades, leadership scholars have expressly recognized the importance of emotion and emotion regulation in effective leadership and have begun to define its core elements and components (Gooty et al., 2010). This attention on leader emotion parallels the growing attention placed on emotion in neuroscience, psychology, and organizational behavior over the same time period.[1]

In contrast to traditional social science research, the use of brain imaging has served to fortify our understanding of core concepts and their applications by providing us with a "hard science" understanding of the neural circuitry involved in emotion, emotion regulation, and cognition (e.g., Gyurak et al., 2009). As a consequence, neuroscience allows us to better understand and appreciate the role emotion plays in leadership practice, guiding and assisting in the selection and application of more effective tools and techniques in developing leaders.

Transferring that understanding of emotion in a practical sense to leadership students presented its own unique challenges. We soon learned that emotion scholars regardless of their discipline were confronting the same challenge, with relatively little consensus on the most appropriate approach. Our international learning environment made it evident from the onset that the use of English language labels was not going to produce the results we were looking for, particularly in light of the fact that descriptive labels for emotions can easily generate lists of 200 "emotion" words or more.

Furthermore, unconscious differences in individual SCARF profiles were revealed in attempts to gain agreement on the meaning and application of emotion definitions as they applied to situations a leader would commonly encounter in the workplace. To both simplify emotion identification and make that simplification operational, we moved to labeling emotion by **color**, based on its physiological and brain state properties (see Figure 22.1 for our emotion color-coding scheme). For example, fear became a "red zone" emotion and was characterized by its physiological and brain chemical properties (for example, simply speaking, elevated heart rate and increased levels of cortisol), its corresponding reduction in available cognitive resources, and reliance on hardwired or habitual responses to the stimuli (again, real or perceived).

Rather than experiencing "fear," an individual was said to be experiencing a "red zone" emotion, with a variety of other emotions capable of generating a similar "recipe." By contrast, when attentive and focused on learning, thinking or creating, an individual was said to be experiencing a "green zone" emotion, characterized by a moderate heart rate and lower levels of cortisol. As stress increases, an individual moves from a "green-zone" to a "blue-zone" to a "yellow-zone" to a "red-zone" emotional state with corresponding changes in physiology and brain chemicals making up the "recipe." With primary emphasis on available cognitive resources, both pleasant and unpleasant emotions are seen as generating the same "green" to "red" emotion/cognition pathway (but with differing brain chemicals defining the "recipe").

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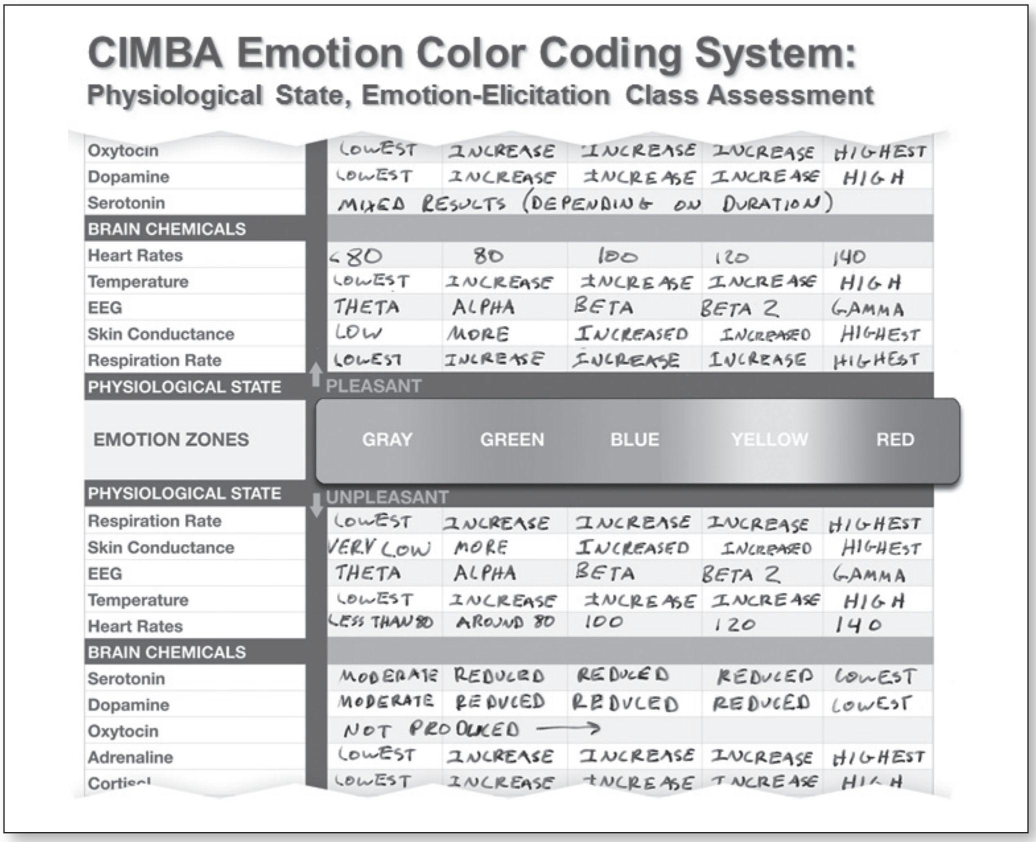
[1]professor Carroll Izard (2010) perhaps best summarizes the growing interest in emotion and emotion regulation:

Only three decades ago . . . it was difficult to find books and empirically based journal articles on emotion. Now we have a cornucopia of emotion books—amazon.com has 347,272 titles, and it is not unusual for a university library to have more than 400 scholarly books on the topic. Today there are at least five scientific journals with "emotion" in their titles and there are many more that publish research on emotion, resulting altogether in 2,732 articles in the past decade. There appears to be more agreement on the significance of emotion and much greater acceptance of its place in science than was evident 25 years ago. (Izard, 2010, p. 363).

Figure 23.1 CIMBA Emotion Color-Coding System



CIMBA Emotion Color Coding System:
Physiological State, Emotion-Elicitation Class Assessment

Oxytocin	LOWEST	INCREASE	INCREASE	INCREASE	HIGHEST
Dopamine	LOWEST	INCREASE	INCREASE	INCREASE	HIGH
Serotonin	MIXED RESULTS (DEPENDING ON DURATION)				
BRAIN CHEMICALS					
Heart Rates	<80	80	100	120	140
Temperature	LOWEST	INCREASE	INCREASE	INCREASE	HIGH
EEG	THETA	ALPHA	BETA	BETA 2	GAMMA
Skin Conductance	LOW	MORE	INCREASED	INCREASED	HIGHEST
Respiration Rate	LOWEST	INCREASE	INCREASE	INCREASE	HIGHEST
PHYSIOLOGICAL STATE	PLEASANT				
EMOTION ZONES	GRAY	GREEN	BLUE	YELLOW	RED
PHYSIOLOGICAL STATE	UNPLEASANT				
Respiration Rate	LOWEST	INCREASE	INCREASE	INCREASE	HIGHEST
Skin Conductance	VERY LOW	MORE	INCREASED	INCREASED	HIGHEST
EEG	THETA	ALPHA	BETA	BETA 2	GAMMA
Temperature	LOWEST	INCREASE	INCREASE	INCREASE	HIGH
Heart Rates	LESS THAN 80	AROUND 80	100	120	140
BRAIN CHEMICALS					
Serotonin	MODERATE	REDUCED	REDUCED	REDUCED	LOWEST
Dopamine	MODERATE	REDUCED	REDUCED	REDUCED	LOWEST
Oxytocin	NOT PRODUCED →				
Adrenaline	LOWEST	INCREASE	INCREASE	INCREASE	HIGHEST
Corti[illegible]	LOWEST	INCREASE	INCREASE	INCREASE	HIGH

This approach to emotion recognition greatly simplified the way in which we taught emotion recognition, from both self and social awareness perspectives. In a "wired" classroom environment (defined below), individuals were baselined against emotion elicitation films identified by social psychology research to produce specific emotions (see, e.g., Gross & Levenson, 1995). Based on students' knowledge from prior classes on neuroscience and the brain, they were confronted with a range of pleasant and unpleasant emotions as expressed by facial expressions, voice intonation, and body language drawn from prior social psychology research. In each case, students were asked to identify the emotion being elicited on the basis of its physiological and brain state "recipe." The intent of the experience was to fully develop an "emotion recognition color chart" with the expectation that from that point forward emotions and emotional states would be defined by their color. By mindfully paying attention to their own physiology and that of others, this approach served to activate and make operational students' notions of self-awareness and social awareness, and thereby enhance each individual's understanding of the impact of emotion on performance through the brain's threat/reward circuitry.

THE USE OF TECHNOLOGY

A fundamental difference between the social- and neuro-science approaches to examining leadership issues is in the research tools they bring to bear on topics of interest—both inside and outside the laboratory. Inside the laboratory, neuroscientists use a variety of technologies, most predominately the fMRI (see Figure 23.2 for a list of common tools used in neuroscience), in seeking to identify the brain region or regions involved in a mental task or process of interest. With fMRI, the relevant parts of the subject's brain indentify themselves by essentially "lighting up" when engaging in a designed mental task or process.

Looking over the shoulder of the neuroscientists, we observed defined social interactions that social science research had concluded produce similar observable behavioral responses; neuroscience research, however, showed that the interactions actually rely on different underlying brain mechanisms. fMRI data allowed the neuroscientists to distinguish between those two underlying brain mechanisms, something difficult to do using traditional social science behavioral methods. Similarly, but in the opposite direction, fMRI data allowed the neuroscientists to identify mental processes expected to *not* rely on the same brain mechanisms, when in fact they actually do.

The determination of a subject's mental state is another important area applicable to leadership understanding where social science and neuroscience research tools can deliver significantly different results.

Figure 23.2 Brain-Imaging Technologies

Brain-Imaging Technologies

Magnetic Resonance Imaging (MRI)

MRI shows detailed anatomical images. It is sometimes referred to as an "X-ray for soft tissues."

Diffusion MRI (Diffusion Imaging, Tractography)

Used to reveal the brain's "long-distance" neural connections by tracking water molecules which diffuses along the lengths of the axons more readily than escaping through their fatty coating.

Functional Connectivity MRI (Resting State MRI)

Like the Diffusion MRI, it reveals "long-distance" neural connections by measuring spontaneous fluctuations in different brain regions, revealing the extent to which they are communicating.

Functional MRI (fMRI)

Exhibits changes in blood supply within the brain, which are assumed to correlate with neural activity during designed mental tasks and processes.

Positron Emission Tomography (PET)

Produces anatomical images to test how organs are functioning by detecting gamma rays emitted by a nuclear substance (tracer) introduced into the body.

Electroencephalogram (EEG)

Uses electrodes attached to the scalp to detect electrical activity in the brain.

fMRI data allow the neuroscientist to infer a subject's mental state by looking at the subject's benchmarked brain activity. To gain the same information in the social sciences, the experiment is often interrupted and the subject is asked, "How do you feel?" to determine mental state. This difference in experimental design is significant because the subject may not want to report mental state, may not remember accurately what state he or she was in before the researcher asked. Perhaps more importantly to the validity of the underlying experiment, the act of simply responding to the question (a response unrelated to the experiment itself) may bring about an important change in current mental state thereby impacting subsequent responses to experimental stimuli. (In developing leaders, this distinction takes on new meaning when in a coaching session an individual is asked to either discuss a journal entry describing an [emotional] event or to examine the applicable neurobiofeedback data. Neuroscience has shown that the act of writing down, and thereby "labeling," the event's emotion has the effect of reducing the emotion's significance (Ochsner and Gross, 2005); neurobiofeedback technology provides actual data on its significance (Johnson et al., 2010).)

With regard to technologies **outside** the laboratory, neuroscience connected the dots between an individual's brain and the body's physiological states. As illustrated
23.3 in Figure ~~22.1~~, brain states observable by an fMRI are also measurable via heart rate, heart rate variability, skin conductance, EEG, and ECG[2]—with all but the EEG currently being measurable wirelessly and unobtrusively outside the laboratory.[3] After initial tests established the efficacy of using these neurobiofeedback measures to study leadership and leadership development, we began to look for viable technology to bring to the classroom. Our decision criteria included cost, durability, precision, intrusiveness, and functionality both inside and outside the classroom/laboratory. With limited options ranging in cost from a few hundred to several thousand dollars, we elected to adapt a SUUNTO performance measurement instrument from the field of sport. We found the SUUNTO td6 device along with its group support equipment and software to meet our basic decision criteria. Once we integrated the device into our classroom environment, the results were immediate and obvious. From a mindfulness standpoint, and in combination with our emotion color-coding system, students became much more aware of their emotional physiology and that of others.

The SUUNTO system involves a chest strap in which sensors are imbedded and a "watch" which displays a variety of data at the user's discretion in real-time. The watch has the capability to record up to five hours of data, which can then be downloaded and analyzed by the SUUNTO software. Alternatively, data can be captured by a computer loaded with SUUNTO software along with an attached antenna. The SUUNTO software allows heart rate data for up to 72 users to be projected for public observation simultaneously in real-time

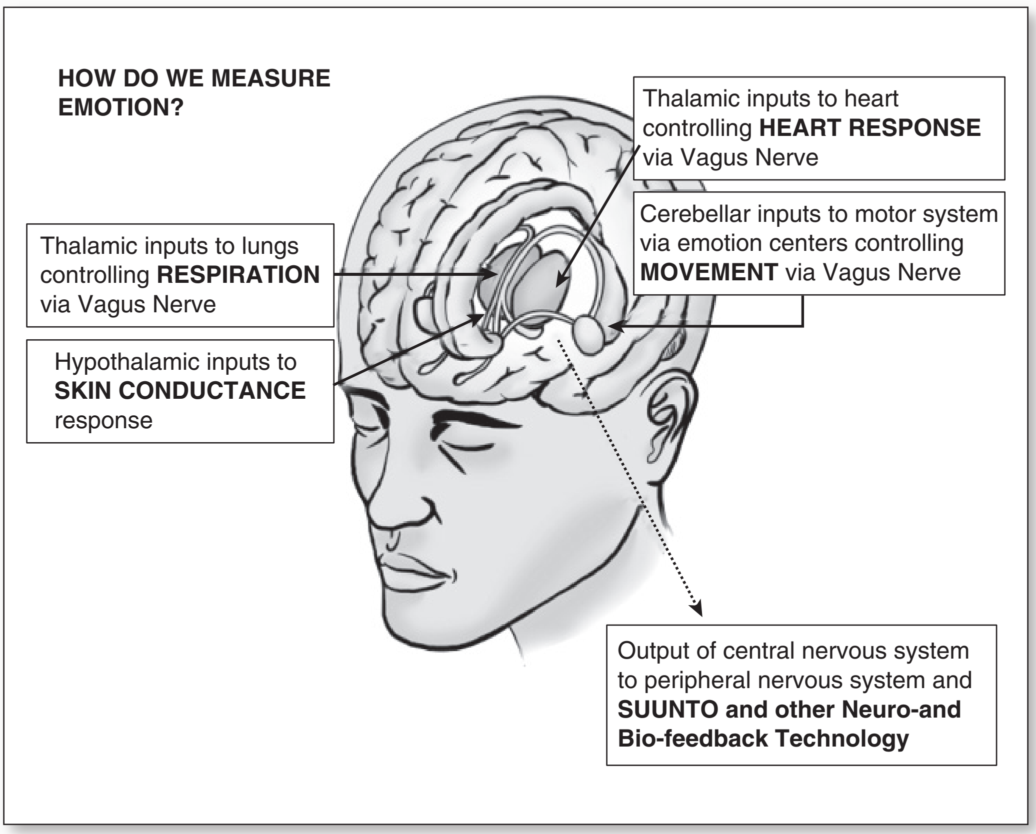
[2]**Electrocardiograph** (*ECG*, or **EKG** [from the German *Elektrokardiogramm*]) is a diagnostic tool that measures and records the electrical activity of the heart over time, captured and externally recorded by skin electrodes. Our current wireless system relies on just two points of measure, and therefore has been of limited usefulness to date.

[3]"Hardwired" measurement devices rely on physical wires running from the sensors to a recording and/or display device, inhibiting user movement and basically confining assessments to the laboratory. Wireless technology operates through a chest strap that houses the sensors and a display device worn on the wrist of the user. Data can be recorded by the display device outside the laboratory or by a computer fitted with an antenna and accompanying software inside the laboratory. Both hardwired and wireless neurobiofeedback systems are "noninvasive" in the sense that no break in the skin is created to secure the requisite data. Wireless systems are "nonintrusive" relative to hardwired technologies in the sense that other than the possibility of some (often initial) discomfort from the chest strap, the device does not interfere with user movement or other activities, making them ideal for the classroom and other leadership development events.

(with other data captured but not presented). The SUUNTO system allows us to calibrate each individual's heart rate according to our emotion recognition color-coding system so that the projected panel of individual data shows "green-zone" for everyone when a professor begins a class and all students are attentive.

Both the success of this experiment and the limitations of the SUUNTO software led us to design and build our own system.[4] SUUNTO, for example, did not have the expectation that the data would be further downloaded and analyzed independent of their software, nor aggregated in a group format. Our new system prototype involves an independent third component in addition to the chest-strap and watch/display. This third component can be a Smartphone, iPad, or other similar device with the ability to collect data from the chest-strap (expanded from heart rate and heart rate variability to include skin conductance, a basic EKG measure, movement, and respiration), analyze it in real-time, and send the appropriate data to both the watch/display and/or to a main server via the Internet. At the server level, the data are analyzed against the greater database and the individual's data. According to prescribed algorithms, the individual and/or the individual's coach can be informed of any action needed in real-time. In initial assessment and measurement stages of an

Figure 23.3



[4]Discussions with SUUNTO about a "SUUNTO Leadership Development Classroom" showed us that their primary focus was justifiably on the known sport performance improvement market.

individual's leadership development journey, the data collected are used to construct the individual's development plan template and to specify to the coach the most appropriate intervention strategy.

NEUROSCIENCE AND LEADERSHIP LEARNING ENVIRONMENTS

Neuroscience also influenced the structure of our leadership learning environments. In our experience, when it came to our **Knowing** component, the traditional classroom proved to be the most effective learning environment. The classroom-based, informational learning/assimilation process provided direct instructional guidance to the learner. For the **Doing** and **Being** components, we found a minimally guided, experiential learning environment supplemented with the support of our process facilitators and leadership development coaches to be far more effective. (For example, with specific regard to leadership the key was to produce an understanding of emotion through a designed experience, event, or activity.) Any effort on our part to alter this basic formula—using, for example, the classroom to instruct students on effective leadership behavior or an experiential learning environment to learn leadership axioms, theorems, principles, and formulas—detracted significantly from the student learning experience. As with many aspects of leadership and leadership development, it was through neuroscience that we came to understand and appreciate why.

As educational psychology moved into the early 2000s, insights from neuroscience were beginning to impact and reshape thinking. Instructional psychologists began to place increased attention on human cognitive architecture—specifically, examining the relationship between working, long-term memory, and learning. Relying on this line of thinking, a specific work that most confirmed our approach to leadership-learning environments was Prof. David C. Geary's *Educating the Evolved Mind* (Geary, 2007). Geary was the first to draw a distinction between **biologically primary** and **biologically secondary** information and thereby resolve the ongoing dispute regarding instruction design within educational psychology (essentially a dispute over the efficacy of experiential learning[5]). Geary's thesis argues persuasively why learners acquire some information easily and unconsciously (which he labeled as being "biologically primary" information or knowledge) whereas other information can be acquired only through considerable conscious effort, often requiring external motivation ("biologically secondary"). Examples of biologically primary knowledge are listening to and speaking our first language, recognizing faces, using general problem-solving techniques, and engaging in basic social relations, all of which are acquired easily outside of educational contexts; explicit instruction is unnecessary for effective learning. From a neurobiology, evolutionary standpoint, the acquisition of such knowledge was and is essential for survival—as we discussed previously, the brain is clearly motivated to evolve neural connections receptive to such information. Under Geary's thesis, both the **Doing** and **Being** components of leadership constitute biologically primary knowledge best acquired

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[5]According to Professor John Sweller (2008), an educational psychologist best known for formulating cognitive load theory:

David C. Geary's distinction between biologically primary and biologically secondary information constitutes an advance that is rare in our discipline. For researchers in instructional psychology, the distinction adds a major piece of the jigsaw puzzle on which we are all working. In the process, Geary has provided a theoretical framework that has the potential to resolve important issues with profound instructional implications.(p. 214) in a minimally guided, experiential learning environment.

In contrast, biologically secondary knowledge is associated with more advanced learning, learning that one would associate with a particular discipline or subject matter. As such, Prof. Geary's thesis asserts persuasively that we have not evolved to acquire biologically secondary knowledge openly, but that learners acquire such knowledge relatively slowly and with conscious effort through explicit instruction. The vast majority of knowledge acquired by learners through educational institutions consists of biologically secondary knowledge. As in other programs, biologically secondary knowledge is largely acquired by students through classroom instruction at CIMBA. Within this instructional psychology paradigm, there is relatively little difference among leadership training and development approaches with regard to the manner in which students acquire biologically secondary leadership knowledge. Most serious programs rely on traditional student-teacher classroom environments to transmit specific discipline-based knowledge. However, it is in the acquisition of biologically primary knowledge that approaches to leadership differ significantly.

The importance of understanding emotion coupled with Geary's thesis guided us to develop experiential learning opportunities to elicit specific emotions—to best assist participants in acquiring biologically primary leadership knowledge. Our basic premise was to assist individuals in identifying their most influential SCARF elements (their SCARF profile) and the activities within their business day most likely to be affected by their particular SCARF "stressors." Our principal assessment and measurement vehicles are emotion elicitation films and simulations, developed professionally, and baselined against existing emotion elicitation research (e.g., Gross & Levenson, 1995). In addition, we are continuing to experiment with a variety of more active, participative events including "wired" indoor and outdoor leadership experiences and activities, contemporaneous acting workshops, and others.

II. The Neurobiofeedback Leadership Classrooms

From the onset, it was our intent to fully integrate a leadership and leadership development system throughout a traditional MBA program. CIMBA's beautiful location in Italy gave us the ability to attract extraordinarily talented people from a variety of fields, the majority with expertise quite divergent from that typically found in traditional business schools. Our express focus on leadership and leadership development coupled with considerable system flexibility has allowed us to develop and test leadership tools and techniques at a much more determined pace than would be possible at a traditional business school. As an unforeseen consequence of the manner and purpose for which CIMBA was originally created, the organization has focused on student results, and not on the publications it could generate.

In its simplest form, the CIMBA approach to leadership adds neurobiofeedback technology to the traditional approach to leadership and leadership development. The neurobiofeedback technology is fully integrated into all learning environments to capture performance emotion data for the express purpose of improving participant performance and health. The neurobiofeedback technology and accompanying training and development methodology allows CIMBA to expressly generate and measure defined emotion elicitation events and experiences, moving participants beyond traditional skills or content-focused development to an understanding of underlying emotions and their impact on behavior, cognition, and performance—in a word, *Being*.

ASSESSMENT AND MEASUREMENT CLASSROOMS

Assessment and measurement begins prior to MBA content classes with LIFE (Leadership Initiative For Excellence), a two-and-a-half day, highly intensive, experiential self-learning experience. The ultimate goal of LIFE is to deepen and broaden participant understanding of the importance of the relationship between emotion, behavior, and cognition, and how the ability to effectively manage that relationship impacts performance. It begins with a detailed overview of the latest NeuroLeadership concepts, and the neuroscience and social psychology research that supports it. Each subsequent LIFE module raises a designed workplace emotion, reveals how that emotion drives behavior, and shows how it impacts participant and group performance. Through a practical understanding of how the brain works in such situations, each module illustrates experientially how the participant can learn to become cognizant of and then better control emotions to manifest a more effective behavior and improve performance, health, and well-being. During these modules, participants wear the latest SUUNTO performance measurement instruments, which provide real-time feedback on brain performance by measuring body physiology.

Although it is not made known expressly to the participants, the LIFE trainers systematically create a strongly negative SCARF environment (low engagement) and then a strongly positive SCARF environment (high engagement) as an integral part of the LIFE experience. Participant cognition is baselined just prior to beginning of their LIFE experience and then measured during both the low-engagement environment (consistently found to be statistically lower than baseline; and the high-engagement environment (consistently statistically higher). After each LIFE module, the LIFE "Professor" guides participants in understanding experientially the cognitive consequence of allowing their brain to dictate the behavioral reaction to the SCARF element the module portrayed—versus taking cognitive control of their emotions and rationally calling upon a more effective behavior or mental state. The comparison provides the participant with the determination, desire, and hardiness necessary for the demanding CIMBA personal development journey they are about to undertake.

With the intent to develop key participant emotion-behavior-performance baselines, participants continue the assessment process by completing selected traditional psychometric instruments and then move to assessments unique to the CIMBA system. Participants are asked to engage in a variety of emotion-eliciting events common to the stressful environment that interacting and working with others often creates. The interest is in understanding the emotion the stimuli elicit, the behavior manifested, and how that behavior impacts the participant's performance. SUUNTO and additional, more sophisticated technologies provide neurobiofeedback data on the participant's mental state. Statistical comparisons are made between distinct stimulant environments on participant self-regulatory ability and on each of the five SCARF "stressors" identified by neuroscience and social psychology. The assessments assist in determining emotion-behavior-performance baselines with the results compared against psychometric instrument results for consistency. Ultimately, the data collected is analyzed and used to construct the participant's development plan template and to specify to the coach the most appropriate intervention strategy to be used in bringing about the plan's goals and objectives.

NEUROBIOFEEDBACK IN THE TRADITIONAL MBA CLASSROOM

At CIMBA, leadership content (**Knowing**) is biologically secondary knowledge and as such is delivered in a traditional classroom setting. A primary distinction between CIMBA and other programs is that the classroom learning environment for leadership content as well as all other MBA content courses (e.g., classes on accounting, economics, finance, marketing, production, etc.) are "wired" classrooms. That is, all students wear SUUNTO measurement technology with their basic physiological data displayed on a large projected panel. After a period of individual student calibration, appropriate adjustments are made so that comparisons can be made on emotional color rather than on far less relevant, absolute heart rate comparisons. For example, one student may have an attentive brain heart rate of 50 beats per minute and another student 85 beats per minute. As the professor enters the classroom, he or she expects to find those numbers but in each case the emotion color code displayed will be green—designating a "green-zone" emotion state for both students. In fact (unless a student is day-dreaming about a favorite beach or restaurant experience), the professor would expect to find the entire panel green for the class once the calibration process is complete (a period of one to two months, with intermittent adjustments normally required). After each major class, the data are reviewed by the coaches to see if there is a need for extraordinary action or inquiry based on a particular student's physiological response to a classroom activity or event.

While the majority of MBA professors are trained in the system, the intent is to involve them largely indirectly in leadership development. Still, professors actively see how students differ in responses to various classroom discussions, group activities, and project presentations—making them an important source of confirming information regarding student progress toward development plan goals and objectives. In fact, with their interest peaked by the technology, it is not uncommon for professors to both request their own measurement device and to begin to look for classroom activities more likely to take advantage of the new measurement technology. With regard to students, the use of the technology in the traditional classroom is a mandatory ingredient in their implicit mindfulness training, assisting them in becoming more and more aware of their physiology and that of others in a variety of circumstances, both emotional and cognitive.

LEADERSHIP COMPETENCY CLASSROOMS

After assessment and measurement, the participant and his or her coach establish a development plan from the template provided by analysis of the data collected. Depending upon the "Data-Driven" coaching intervention strategy suggested by the assessments, that plan schedules data collection, on-line neuro-based training provided by *My Brain Solutions*, "challenge" tests, and coaching sessions. The CIMBA approach to coaching differs somewhat from traditional coaching systems in its greater reliance on physiological data. In many cases, the elusiveness of the root cause behind the participant's leadership "issue" is the participant's lack of conscious awareness of the emotion or mental state a debilitating workplace stimulus (stress, fear of social ostracism, anger) is creating. The situation is often further compounded by the participant's self-regulatory brain circuitry (observed through participant behavior and responses within traditional coaching systems, as well as through neurobiofeedback assessment and measurement data by our coaches), which if insufficiently developed to control emotion and thus draw up the appropriate behavior. By coaching to the participant's neurobiofeedback data, Data-Driven coaching not only works to make the participant's underlying brain state visible and understandable, it also provides an objective, quantifiable basis for measuring participant improvement. In addition—and as dictated by the participant's needs and assessments—the development plan provides a list of suggested Leadership Competency Workshops, which are separate and distinct from the MBA content courses.

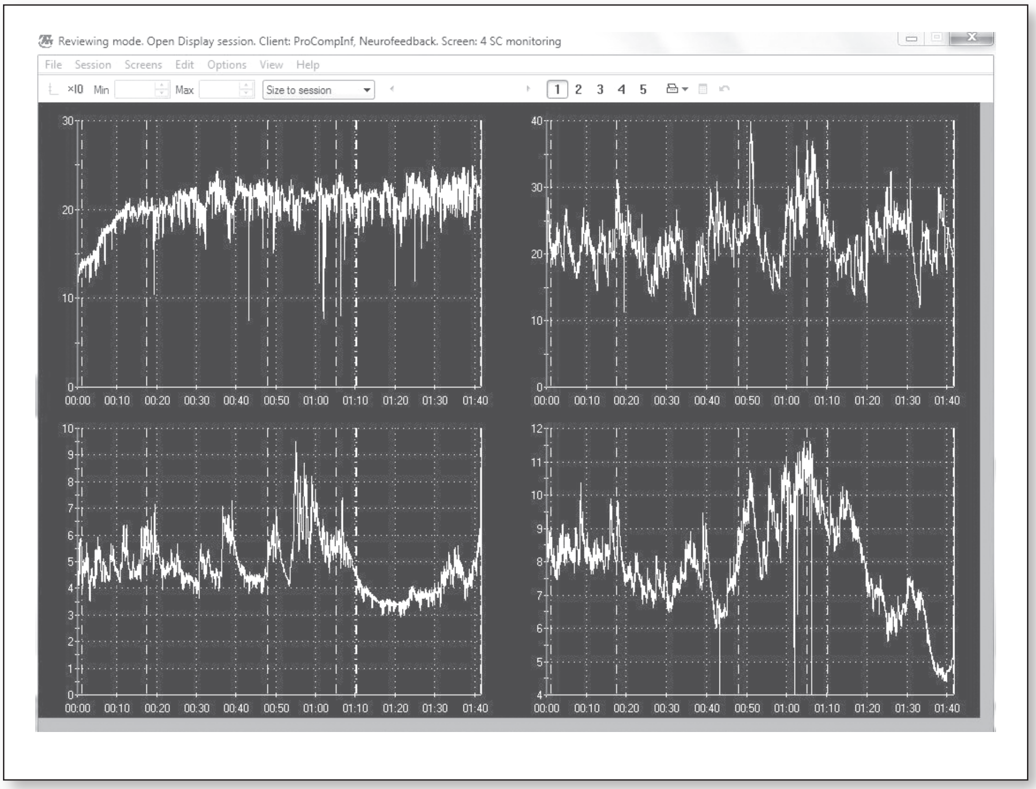
CIMBA defines "leadership competency" quite specifically. A person has a "Leadership Competency" only after having gained mastery over both the appropriate mental state and the appropriate skill making up the competency. In addition to being a wired classroom, a leadership competency classroom may also make use of more sophisticated, neurobiofeedback technologies and data assessments and display. In teaching a specific skill for the purpose of addressing a leadership competency, the workshop design involves an overview of the SCARF emotion anticipated, designed emotion elicitation events involving the competency, an overview of the neuroscience involved, and then the skill component. Under the neuroscience principle "neurons that fire together, wire together," the skill and its corresponding emotion are taught together. In the event an individual registers a SCARF response of concern during an emotion elicitation event, the coach is informed so that it can be assessed against the individual's development plan. For example, consider teaching the leadership competency conflict management. A person who has difficulty managing the emotions associated with conflict will not likely be able to implement skills a traditional conflict management course would teach until the emotional side of conflict has been addressed. In our system, students first visit the emotion of conflict through a series of emotion elicitation simulations. The skills instruction that follows encompasses both the technical aspects of conflict management and the lessons learned about the emotion of conflict from those simulations. Coaches are informed of those students identified as having a sensitivity of concern so that specific issue can be further addressed in a coaching forum.

III. Preliminary Results and Challenges

An advantage of the CIMBA approach to leadership and leadership development is its reliance on data derived from its neurobiofeedback assessment system, a system established on a foundation of neuroscience and social psychology research. To get a sense of the impact and sustainability of neurobiofeedback-based leadership and personal development intervention strategies, consider the biofeedback for four participants presented in the Figure ~~22.2~~ 23.4. The four participants were being "challenge" tested through a specially designed, emotion elicitation business simulation. (CIMBA trained one of the participants: can you determine which one?).After the simulation, each of the participants was asked about a specific event that took place during the simulation: "What was your emotion, what behavior did it manifest, and how did it impact your performance?" Importantly, all four participants reported being "calm," a response at odds with the data. This lack of self-awareness is a common result and emphasizes the importance of neurobiofeedback and Data-Driven coaching if the intent is long-term, sustainable change.(Answer: Upper left-hand corner.)

CIMBA has several ongoing studies looking at both the short- and longer-term consequences of its intervention strategies. At the very core of the CIMBA development theory is the importance of self-regulation. The CIMBA neurobiofeedback assessment system determines with remarkable precision whether a person is an "A" (low ability to self regulate), "B" (moderate ability to self regulate), or "C" (significant self regulatory ability). Against a very large database, and in most cases highly statistically significant, the results show that a person identified as being in the "A" category has challenges they do not need to face. The challenges facing "A"s, along with the emotions they will experience and the behaviors that will manifest, impact their workplace and life environments, adversely affecting both productivity and health. Demanding situations significantly increase stress; dramatically reduce memory, attention, and planning abilities; increase negativity; reduce communication; and significantly lower

Figure 23.4 Four-Person "Challenge" Test Biofeedback



resilience. As stress levels rise, both creativity and the ability to sustain high-level thinking decline, adversely impacting creative problem-solving in difficult situations and the ability to multitask in less demanding ones. Cognitive companies such as consulting and accounting companies will find a temporary solution by over-training these "A" individuals, so as stress levels increase their brains move to "hardwired," robotic responses to tasks at hand—boredom and/or lifestyle conflicts cause them to quit (or, their negativity brings about their dismissal). Strong anecdotal evidence indicates that this quit pattern follows a two-year cycle unless either the individual develops or is seen as having developed an indispensable skill, or a serious, provocative event or experience causes them to examine his or herself more closely. Many follow up the event of experience by electing to seek assistance through a coach, mentor, friend, or family member (or, in appropriate cases, a therapist).

The CIMBA approach to leadership and leadership development emphasizes the importance of assessing the functional relationship between an individual's performance (and health) as defined by his or her ability to self-regulate emotions that can adversely affect behavior, negatively impact cognition, and undermine skill effectiveness. Thriving organizations are driven by their mental capital—healthy employees whose brains are functioning at their best: employees who can think clearly, are positive, resilient, and can collaborate optimally with colleagues and customers. CIMBA internal studies on a database of more than 1,000 people show statistically significant increases of more than 10 percent in both emotional resilience and positivity bias, considered key indicators in traditional psychometric instrument measurements for self-regulation.

More than 10 years of conversations with HR directors in leading companies worldwide clearly shows that the vast majority of companies, in particular those companies where employee cognition is its primary product, hire employees on the basis of IQ, or some similar proxy for human intelligence. On its face, this is fully understandable: every company wants technically competent employees, managers, and leaders. Those same conversations, however, provide an even more interesting insight: those same companies almost universally fire employees on the basis of EQ (Emotional Intelligence Quotient) and RQ (Rational Intelligence Quotient)—employees who have made poor personal or professional decisions that cast serious doubt on the ability of the employee to meet company expectations. With RQ being statistically correlated with EQ, with both being direct functions of self-regulation, and with both RQ and EQ showing no discernible statistical relationship with IQ within ranges relevant to leaders and managers, the importance of focusing developmental resources on identifying and assisting "A"s seems obvious.

IV. Conclusion

In 1997 there were some 10 neuroscience studies based on fMRI data arguably relevant to explaining personal behavior; in 2010 there were nearly 10 per day. Virtually every major discipline from the arts to the sciences is being impacted by neuroscience and its findings. The teaching and development of leadership is no exception. Although neurobiofeedback technology is still in a laboratory state, the situation is evolving at a rapid rate. We are beginning to more precisely assess and measure individual performance and identify the brain functions holding individuals back from achieving their full potential. Importantly, that same hard data are allowing us to better tailor intervention strategies to assist, challenge, and support individuals in overcoming their personal barriers to effective leadership. With the ability to assess, measure, and understand emotion and its consequences on cognition and creativity, neuroscience is assisting us in creating better leaders than we could before it appeared on the horizon. While we are just at the beginning of teaching leadership with the brain in mind, we are inspired by the real results we see in the classroom, and excited by the opportunities for further research in this area.

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