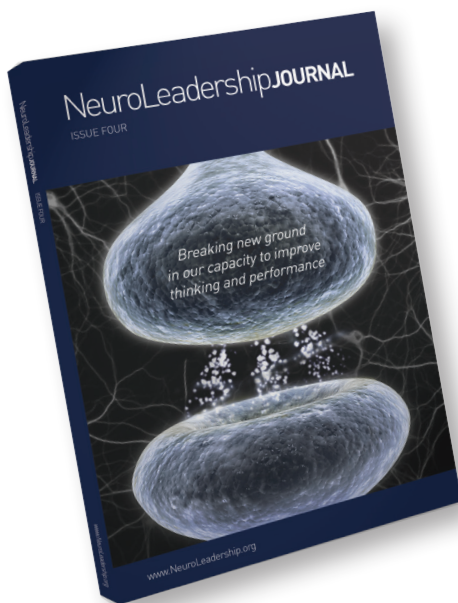# NeuroLeadership in 2011 and 2012

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NeuroLeadership in 2011 and 2012

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Neuroscience is one of the fastest growing areas of interest in contemporary science. As it has from its inception, the NeuroLeadership Institute continues to work both in organizing and disseminating neuroscience findings applicable to the effective practice of leadership, and in supporting practitioners in their personal and leadership development efforts. Within the Institute, enrollment in the NeuroLeadership Institute's education programs, Institute membership, Summit attendance, requests for Institute and Summit materials, and participation in local chapters worldwide are following a similar growth pattern. Outside the Institute, research scientists continue to publish both scholarly works in the interest of expanding the field of knowledge and practitioner works in the interests of expanding its field of use and application.

Due in large measure to rapidly advancing technology both to define and support brain-imaging research and to allow its seemingly instantaneous distribution, practitioners can easily be overwhelmed with the breadth and depth of insights that seem to arrive on a daily basis. As of early 2012 there were over 60 labs in the United States alone focused on social or affective neuroscience, a field from which NeuroLeadership draws heavily.

To assist in that specific regard, as in past Journals, the intention of this article is to look back over the past year and reflect on neuroscience and social psychology research relevant to NeuroLeadership and its practitioners. In reviewing the available research, and guided by suggestions from the scientists, we will again categorize the research based on the four domains set out in the initial Journal (Ringleb & Rock, 2008): *Decision Making and Problem Solving, Emotion Regulation, Collaborating With Others* and *Facilitating Change.*

As in the past, in selecting research for inclusion the following basic criteria were applied to the extent possible: significance to the field of NeuroLeadership; likelihood of significantly expanding or creating research linkages between neuroscience and the practices of leadership and leadership development; impacts on current thinking as driven by social science research; and, perhaps most importantly, relevance to the interests of practitioners in this growing field.

> *Neuroscience is one of the fastest growing areas of interest in contemporary science.*

Part one: Decision Making and Problem Solving

In the 2010 review, the *Decision Making and Problem Solving* domain was broadened to encompass the neural bases of the processes and procedures a leader uses to produce results (Ringleb, Rock, & Conser, 2010).

As noted by practitioners, this delineation closely accords with the *Do* (or *Doing*) component of the generally accepted *Know-Be-Do* leadership model (Hesselbein & Shinseki, 2004). This change also provided a more consistent representation of what this domain means to the fields of both NeuroLeadership and traditional leadership, defined, at a minimum, as *groups* making decisions and solving problems in the *Doing* sense.

...neuroscience teaches us to appreciate the brain efficiency gains provided by express (versus implicit) processes...

Given the highly complex social environments in which leaders must operate, many of a leader's most important decisions are additionally dependent on the concomitant choices of others (Rilling & Sanfey, 2011). In this sense, this broader definition serves to distinguish NeuroLeadership from the fields of neuroeconomics and neuromarketing, both of which are more focused on how an individual makes decisions. In contrast to neuroeconomics and neuromarketing, NeuroLeadership research (and much of social psychology and neuroscience) is more likely to make explicit efforts to measure rather than control for SCARF (Status, Certainty, Autonomy, Relatedness, Fairness) affects inherent in effective leadership's social interactions.

Decision making and SCARF

As we discussed in 2010, neuroscience teaches us to appreciate the brain efficiency gains provided by explicit (versus implicit) processes (Herbig, Muller, & Petrovic, 2007) in overcoming the working limitations of the prefrontal cortex (PFC) (Halford, Cowan, & Andrews, 2007) by tempering negative and promoting positive SCARF affects in social interactions (Rock, 2008). The leader's objective in using express *Doing* processes and procedures is to increase overall organizational engagement and employee performance and well-being (Rock & Tang, 2009). Difficult issues eliciting conflict between emotion and reason (Frith & Singer, 2008) addressed in teams through the use of

implicit, unstructured processes and procedures are highly susceptible to emotional contagion (Johnson, 2008). Those emotional contagions arouse "SCARF emotions", and impose measureable negative consequences on limited team cognitive resources. Increasingly, traditional neuroscience and social psychology research are finding the management of SCARF emotions to be an important determinant of the success of collaborative activities (e.g. Li, Liang, & Michael, 2010; Rilling & Sanfry, 2011). At the NeuroLeadership Labs, we have consistently observed reductions of 50 percent and more in group emotion (as measured by aggregate individual skin conductance) when we compare group performance on statistically similar decision tasks, the first completed without an explicit process (using any approach the group chooses) and the second completed with an explicit process (Kepner-Tregoe's PSDM rational process tools), all of which we attribute to team control over SCARF emotions brought about by the use of explicit versus implicit process.

Neuroscience and social psychology research in 2011 continued to implicitly highlight the functional simplicity of SCARF...

Neuroscience and social psychology research in 2011 continued to implicitly highlight the functional simplicity of SCARF and support its applications in collaborative, *Doing* activities among other applications and uses. Traditional research conducted in the *Decision Making* domain typically makes use of models based on game theory with decision-makers being studied as they interact with one another (Neumann & Morgenstern, 1947).

The most commonly used research models are the Prisoner's Dilemma, the Trust Game, the Ultimatum Game, the Dictator Game, and the Iowa Gambling Task. In addition to these models in their classic designs, a number of recent studies have employed creative adaptations to examine other aspects of social interaction, such as social conformity (Klucharev, Hytonen, Rijpkema, Smidts, & Fernandez, 2009), norm-abiding social behavior (Spitzer *et al.*, 2007), revenge and altruistic punishment (De Quervain, Fischbacher,

Treyer, Schellhammer, Schnyder, Buck, *et al.*, 2004; Singer, Seymour, O'Doherty, Stephan, Dolan, & Frith, 2006), and reputation management (Izuma *et al.*, 2008). Taken together, the characteristics being studied – trust, fairness, altruism, social conformity, norm-abiding social behavior, and others – map comfortably and consistently into NeuroLeadership's SCARF model.

...sleep-deprived people may make risky decisions based on too much optimism.

For example, Nguyen, Koenigs, Yamada, Teo, Cavanaugh, Tranel, *et al.* (2011) used the Ultimatum Game (UG) to ferret out differences between the "rational" and "irrational" response patterns in the game. In considering a wide variety of demographic (age, gender, education), cognitive (intelligence, attention/working memory, speed, language, memory, executive functions), and personality ("Big Five", positive affect, negative affect) variables, they found that only the personality variables of trust (for the "rational" response) and negative affect such as anger and contempt (for the "rational" response) – SCARF's Status, Relatedness and Fairness – were the only variables that differentiated the two response patterns. Demographic and cognitive factors did not differ between rational and irrational players. The study accentuates the importance of affect in our understanding of individual differences in decision-making and other *Doing* processes and procedures – what we at the NeuroLeadership Labs refer to as individual differences in "SCARF profiles". Such a profile provides insights into an individual's hypersensitivities and suggests the situations and circumstances that might lead to unproductive and unhealthy choices.

Researchers are also confirming that a variety of factors can influence SCARF sensitivities, and thus influence an individual's ability to make reasoned decisions. Such factors include exercise, sleep, relationships and mindfulness, among others (see the discussion on the *Healthy Mind Platter* in the *Change* domain review). With regard to the impact of sleep, Venkatraman, Huettel, Chuah, Payne, and Chee (2011) used fMRI data to show that a night of sleep deprivation leads to increased brain activity in those brain regions that assess positive outcomes and decreased activity in brain regions that process negative outcomes. In other words, sleep-deprived people may make risky decisions based

on too much optimism. Participants in the study tended to make decisions that emphasized monetary gain, and were less likely to make choices that reduced loss. One of the study's authors, Professor Jessica Payne, presented these and other findings in a presentation at the NeuroLeadership Summit in San Francisco. We will discuss more about her work in subsequent sections.

The NeuroLeadership Summit provided a forum for after-session discussions about the role of individual values in the SCARF model and ethical decision-making. There was some discussion about the need for a sixth category in the model to account for values explicitly, while others asserted that values were accounted for implicitly in the current categories. The discussion offered a rich opportunity to raise some of the interesting issues discussed in the 2010 Boston Summit by Professor Joshua Greene.

Researchers are also confirming that a variety of factors can influence SCARF sensitivities, and thus influence an individual's ability to make reasoned decisions.

In looking at the role of emotions in ethical decision-making, a team of German researchers considered the affect of stress on moral decision-making (Starck, Polzer, Wolf, & Brand, 2010). The study compared performances between a stress-induced group of 20 participants and a controlled second group of 20 participants on moral decision-making tasks in which *everyday* moral dilemmas were described. Consistent with the notion that values may be implicitly accounted for in the current SCARF categories, the results showed that the two groups did not differ significantly in *everyday* moral decision-making. However, and consistent with the notion that emotion in decision-making is important, the study did show an association between an individual's cortisol stress response and *egotistical* decision-making in high-emotional situations.

In another interesting study on moral decision-making using fMRI data, Decety, Michalska, and Kinzler (2012) showed that an individual's moral responses to similar situations change as they age. According to the authors, the different responses between children and adults correlate with the various stages of neuro-development. As the brain ages, it becomes better equipped to make reasoned judgments and integrate an understanding of the mental states of others with the outcome of their actions. In the *Collaborating* domain discussion, and consistent with this finding, we will take a look at interesting research showing that the development of our social awareness circuitry begins in infancy and that its development seems to occur in advance of our self-awareness circuitry.

Decision making, emotions, and emotion regulation

Decision research in economics, business, psychology, and neuroscience now readily accepts that emotions play a significant role in decision-making. Several neurological theories have been developed to explain the emotion–decision-making relationship, including the Somatic Marker (Lawrence, Jollant, O'Daly, Zelaya, & Phillips, 2009), Risk-as-Feeling (Loewenstein, Weber, Hsee, & Welch, 2001), Anticipatory Affect (Kuhnen & Knutson, 2005), and, from marketing, Net Emotional Response Strength (Hansen & Christensen, 2007) theories. Much of the controversy among the theories centers on the neuro-anatomy of the decision-making process, with Somatic Marker theory's more holistic analysis (Reimann & Bechara, 2010) arguably a better fit with SCARF and current NeuroLeadership thinking on emotion and its management.

Specifically, Somatic Maker theory asserts that decision-making incorporates a multitude of brain areas involved in emotion (amygdala, ventromedial PFC) and memory (hippocampus, dorsolateral PFC). With the amygdala long-recognized for its involvement in emotion, both Gospic, Mohlin, Fransson, Petrovic, Johannesson and Ingvar (2011) and Gupta, Koscik, Bechara, and Tranel (2011) looked to explore more deeply the role of the amygdala in decision-making, and to differentiate its contributions from those of other functionally connected neural regions. In Gospic *et al.* (2011), the research team used a benzodiazepine treatment to dampen down amygdala activity and thus participant response to somatic marker cues as they played the Ultimatum Game.

In Gupta *et al.* (2011), the research team used patients with amygdala damage known to lack autonomic responses to reward and punishment and who, consequently, cannot utilize somatic marker cues to guide future decision-making. Somatic marker cues include emotion-related signals such as changes in heart rate, blood pressure, gut motility, and glandular secretion, which assist cognitive processes in implementing decisions. Using the Iowa Gambling Task model as a laboratory proxy for the real world, they observed deficiencies in decision-making in patients with bilateral amygdala damage consistent with the real-world difficulties they were experiencing.

The research teams theorized that the amygdala is part of an impulsive, habit-type system that triggers emotional responses to immediate outcomes. Implicit in the application of these research findings is the importance of either express process and/or emotional regulation strategies (such as mindfulness, discussed below with regard to decision-making and in the *Change* domain more generally) in those situations where emotion and habitual responses to it may lead to unproductive or unhealthy choices.

> *Decision research in economics, business, psychology, and neuroscience now readily accepts that emotions play a significant role in decision-making.*

In 2010, several studies added to our understanding of "collective intelligence". Social psychologists found convincing evidence of a collective intelligence factor (as opposed to the psychologist's general intelligence applied to individuals) that seemingly explains group performance differences (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010). One of the study's authors, Dr. Alex Pentland, explained at the 2010 Boston NeuroLeadership Summit that while collective intelligence is not strongly correlated with the average or maximum individual intelligence of group members, it is correlated with the average social sensitivity of group members (the ability to read and understand the emotion of others). Groups with higher social sensitivity shared criticism constructively, were more open-minded, were less autocratic, and had leaders who more effectively managed conversational turn taking – in NeuroLeadership terms, they undertook express efforts to control negative SCARF influences.

Taking the importance of social sensitivity to effective group success as a given, the MIT study raises interesting questions for practitioners: Is team success a function of social sensitivity for the purpose of controlling unproductive emotion? Could a well-defined, express process or procedure play a similar, more consistent, role in the control of group emotions? The distinction may be more fundamental than is apparent in that the study's participants were given a well-defined set of tasks to perform. The answers are important in light of the authors' hypothesis that a collective intelligence test – in essence, a test for social sensitivity – might be a strong predictor of a sales or top management team's long-term effectiveness. Consider the Mojzisch and Schulz-Hard (2010) study noted in the 2010 review. Their study demonstrated that, in the case of unstructured decision-making processes that opened with team members sharing initial preferences, team members pay less attention to relevant information during subsequent group discussion and thereby risk reaching suboptimal decisions. Avni-Babad (2011) shows us that if the process involved is "routine", group members are more likely to feel comfortable, confident, and safe – again, in NeuroLeadership terms, a positive SCARF environment.

Groups with higher social sensitivity shared criticism constructively, were more open-minded, were less autocratic...

In an interesting fMRI study, Reverberi, Bonatti, Frackowiak, Paulesu, Cherubini, and Macaluso (2012) show that the parts of the brain used differ depending on the type of reasoning involved in the process. If we take this result as a given, what can we say about the emotional state of the team as it wrestles with the uncertainty as to which rational process thinking tools to use: Is it a decision (choice), problem (cause), strategy (visioning), situation appraisal (information gathering), or potential problem (planning)? Reverberi *et al.* suggest that each such thinking process may have its own reasonably independent circuitry. Is it feasible to hypothesize that such an emotional state brought about by explicit process would eliminate the wrestling (thereby firmly moving the brain from a "mentalizing" to

an "analyzing" state, a concept discussed in detail in the *Collaborating* domain), calm the brain, and lead to greater social sensitivity and, derivatively, greater productivity? The implications for the application of this line of research make the resolution of this question fundamental.

...participants who successfully used cognitive emotional regulation made fewer risky choices...

Consistent with the growing interest in emotion across disciplines generally, a number of studies considered the impact of emotion on decision-making and on varying efforts to manage those emotions. Martin and Delgado (2011) investigated the efficacy of cognitive emotional regulation strategies during decision-making under risk. Prior studies had largely focused on the efficacy of such strategies in reward expectation environments (e.g. Tom, Fox, Trepel, & Poldrack, 2007). The research team found that participants who successfully used cognitive emotional regulation made fewer risky choices in comparison with trials where decisions were made in the absence of such regulation.

On the basis of extensive observations of equity, bond and derivative traders in the city of London, Fenton-O'Creevy, Soane, Nicholson, and Willman (2011) found that high-performing traders made greater and more effective use of both their intuitions (a notion consistent with Somatic Marker theory) and emotional regulation strategies than did their lower-performing colleagues. The study provides important insights into the role of emotion and emotion management in what would seemingly be a highly rational profession. In a somewhat related study, Bollen, Mao, and Zeng (2011) found that "public mood" (in essence, defined as a relatively long-lasting emotional state held in common by the public) was a reasonably accurate predictor of the stock market. The research team made creative use of the content from a large number of Twitter feeds to develop its "public mood" measure. The study is supportive of the notion that SCARF engagement environments are both scalable and similar in their impacts on productivity and well-being across a wide variety of situations.

A number of studies looked at a specific emotion and its impact on decision efficacy. For example, Thiel, Connelly, and Griffith (2011) explored the relationship between anger and ethical decision-making. Kligyte, Connelly, Thiel, Devenport, Brown, and Mumford (2009) had found that incidental anger negatively influenced ethical decision-making.

The study found that angry individuals were less likely to thoroughly evaluate ethical dilemmas, were more likely to make punitive judgments of others, and were increasingly deceptive in making ethical choices.

Thiel *et al.* (2011) observed that the cognitive evaluations made by angry individuals during the decision-making process seemed to resemble anger appraisals identified in the appraisal literature (e.g. Kuppens *et al.*, 2007; according to the Appraisal Theory of emotions, how we feel about a certain situation is determined by our appraisal or evaluation of the event).

The study showed the appraisals of certainty are the primary driving mechanism behind the negative relationship between anger and ethical decision-making.

Certainty appraisals led to less application of ethical decision-making promotional strategies and more unethical social motives. Such appraisals cause an individual to feel certain about who caused the event, about why the event occurred, and about future outcomes directly or indirectly related to the affective event.

> *Certainty appraisals led to less application of ethical decision-making promotional strategies and more unethical social motives.*

The study sheds light on how certain emotional states can disrupt ethical decision-making through the underlying appraisals and social motives, suggesting the need to focus efforts in training initiatives that address these factors and provide strategies for overcoming them.

Decision making and gender

Several interesting studies looked to the neural bases for gender differences in decision-making, either by experimental design or as an observation of research intended for other purposes. In the previously mentioned study by Gupta *et al.* (2011), who looked to explore the role of the amygdala in decision-making, they found evidence for a differing interaction between males and females and laterality of amygdala functioning: Unilateral damage to the right amygdala results in greater deficits in decision-making and social behavior in men, while left amygdala damage seems to be more detrimental for women.

> *...gender differences in behavior are associated with differences in activity in the insula and dorsal striatum, the brain regions involved in computing risk and preparing to take action.*

Lighthall, Sakaki, Vasunilashorn, Nga, Somayajula, Chen, *et al.* (2011) found that under stress men and women respond differently to risky decision-making. Under stress, males take more risk and females take less risk. These gender differences in behavior are associated with differences in activity in the insula and dorsal striatum, the brain regions involved in computing risk and preparing to take action. Interestingly, when stress was absent their behavior and brain activation was more similar. The authors assert that men and women faced with difficult decisions might improve the outcome by waiting until a stressful situation has passed – that is, until the emotion has subsided. Again, we see the same potential result coming from the use of express process and/or emotion regulation strategies. One possible practical implication of this finding is that practitioners may want to recommend mixed teams in situations where the issue being confronted carries with it significant emotion.

Neuroscience and social psychology continue to develop and define the relationship between self-awareness and self-regulation...

Decision making, self-awareness, self-regulation, and mindfulness

Neuroscience and social psychology continue to develop and define the relationship between self-awareness and self-regulation, and the influential impact that mindfulness can have on strengthening that relationship. With regard to self-awareness, Dunn, Galton, Morgan, Evans, Oliver, Meyer, *et al.* (2010) investigated the way interoception (the ability to detect subtle changes in somatic marker signals, including muscles, skin, joints and viscera) shapes emotional experience and intuitive decision-making. Interestingly, the research team demonstrated that the more accurately participants could track their heartbeat, the stronger the observed link between their heart-rate reactions and their subjective arousal ratings of emotional images. In other words, the more self-aware was the participant (as measured by their ability to sense and interpret their somatic marker signals), the greater was their ability to assess their emotions and predict their cognitive consequences. In building upon this finding, the group found that increasing interoception ability either helped or hindered adaptive intuitive decision-making, depending on whether the anticipatory bodily signals generated favored advantageous or disadvantageous choices (a result consistent with prior studies looking into the accuracy of intuitive decision-making; see, e.g., Myers, 2004; Shiv, Loewenstein, Bechara, Damasio, & Damasio, 2005); in other words, to the extent an intuitive decision relies on more than an awareness of physiology.

Over the past five years, self-regulation has garnered more and more attention from both scientists and practitioners. Here, we will limit our discussion to self-regulation as it impacts on decision-making and other *Doing* processes, with a more detailed discussion on this important topic in the *Change* domain. An interesting study in that regard involved the ego-depletion aspect of self-regulation and

its impact on decision-making. Within the Ego Depletion or Limited Resource Model, leading self-regulation scholars argue that self-regulation is a finite resource (e.g. Hagger, Wood, Stiff, & Chatzisarantis, 2010). Within the context of this model, Danziger, Levav, and Avnaim-Pesso (2011) examined over 1100 judicial rulings to see if extraneous factors beyond legal reasoning were influencing the decisions. They found that the percentage of favorable rulings drops gradually from about 65 percent to nearly 0 within each decision session, and then returns abruptly to about 65 percent after a break. Given that a meal was served at each of the breaks, the research team was cautious about asserting this was the cause for the decision pattern (the effect of glucose on mental resource replenishment as the Ego Depletion Model would assert) or whether simply the period of rest resulted in the restoration of the judges' mental resources. Still, on the basis of the data available, the study suggests that decisions can be swayed by extraneous variables, most arguably when they carry emotion, which perhaps should have no bearing on the choices being made. Again, as we have argued previously, with decisions in this case seemingly driven by the idiosyncratic process of each judge and therefore open to varying extraneous influences affecting emotion and emotion regulation, would the result be different if the decision-making process were expressed with criteria open and understood by all for the purpose of holding such influences constant? Or, perhaps the judges could engage an emotion regulation strategy?

...leading self-regulation scholars argue that self-regulation is a finite resource...

In that specific regard, Alfonso, Caracuel, Delgado-Pastor, and Verdejo-Garcíab (2011) examined the effect of mindfulness training on the decision-making competence of poly-substance abusers (defined as an individual diagnosed with an addiction who has used at least three different drug types indiscriminately over a 12-month period). The study enrolled 18 participants in a mindfulness program and compared them to a control group of 16 participants who undertook standard treatment. The results showed that individuals enrolled in the mindfulness program significantly improved their performance on a variety of neuropsychological measures, including decision-making as measured by performance on the Iowa Gambling Task.

Clearly, and as we shall see in the next section, research to date on the use and application of emotion regulation tools and techniques strongly suggests practitioners consider their inclusion – and particularly when coupled with mindfulness meditation – in personal and leadership development interventions.

Part two: emotion regulation

Effective leadership is in large part defined by the leader's ability to perceive, identify, understand and successfully manage both their emotions and the emotions of others. Effective leaders harness and direct the power of emotion to build trust and improve follower satisfaction, morale and motivation, and thus enhance overall organizational effectiveness (Rock & Tang, 2009; Riggio & Reichard, 2008). In prior reviews, we considered the neuroscience-validated techniques of mindfulness (Farb, Segal, Mayberg, Bean, McKeon, Fatima, *et al.*, 2007), meditation (Tang, Yinghua, Wang, *et al.*, 2007), labeling (Lieberman, Eisenberger, Crockett, Tom, Pfeifer, & Way, 2007), and reappraisal (Ray, Ochsner, Cooper, Robertson, Gabrieli, & Gross, 2005) as vehicles for leaders to gain greater personal control over emotionality. Given its significant potential in leadership development and intervention strategies, it is not surprising emotion regulation has garnered considerable interest among both practitioners and researchers. At the center of much of this research is Prof. James Gross, who shared many of his insights at the 2011 NeuroLeadership Summit in San Francisco.

> *Effective leaders harness and direct the power of emotion to build trust and improve follower satisfaction, morale and motivation...*

Research on emotion

As we discussed at length the 2010 review, it has been nearly 60 years since Skinner (1953; 1974) declared that emotion was on the list of fictional causes to which an individual's behavior is commonly ascribed. 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, Connelly, Griffith, & Gupta, 2010; Rajah, Song, & Arvey, 2011), with this interest paralleling that in neuroscience and social psychology (Izard, 2010). Research studies in neuroscience and social psychology continue to provide leadership development practitioners with insights into the necessary tools and techniques to make emotion and emotion regulation integral components of consistent, effectual intervention and development strategies. Interestingly, virtually all disciplines are confronting research obstacles in the form of competing models and differing terminology.

> *...the ability to process facial expressions assists in the regulation of behavior and social perception...*

Consistent with Heatherton (2011) and the NeuroLeadership Lab's Social Brain Theory of Leadership discussed in the *Collaborating* domain, Niedenthal and Brauer (2012) provide important insights into the fundamental importance of emotion processing for successful social living. Importantly, the authors note its importance regardless of the size of the social unit being examined – from dyads to large social groups. In looking to the question "What are human emotions for?", the authors assert that the ability to process facial expressions assists in the regulation of behavior and social perception in "a dense and efficient way" and is thus a social necessity (as we see in the *Collaborating* domain discussion, this ability develops in infancy and more rapidly than self-awareness).

Vicarious emotions, where one individual feels an emotion because he or she observes another individual experiencing an emotion or observes the other individual in an emotionally evocative situation, play a fundamental role in learning. The authors note that both neuroscience and social psychology research are finding that group emotions and group-based emotions seem to serve the more abstract goals of group cohesion and collective action. Because group emotions can be triggered by powerful leaders and generated in increasing intensity over time, they are considered an important focus of future research.

Our growing ability to measure emotion has elevated its importance in a wide variety of disciplines, including the academic disciplines of leadership, management and organizational behavior. As to emotion and the state of leadership science, Gooty, Connelly, Griffith and Gupta (2010); Rajah, Song and Arvey (2011) provide an in-depth overview of the progress that has been made in bringing emotion and emotion regulation to the forefront in our understanding of leadership. Similarly, from the perspective of neuroscience and social psychology, Gross and Barrett (2011) tell us that, in 1990, there were only four publications containing the phrase "emotion regulation", while by the year 2005 some 671 publications contained the phrase – a more than 150-fold increase in citations over a 15-year period, clearly showing the growing popularity of this topic. Still, it came as somewhat of a surprise to us that the definitions and models of emotion, emotion generation and emotion regulation vary from discipline to discipline, or perhaps more precisely, from research purpose to research purpose (Niedenthal & Brauer, 2012). This lack of consensus is needlessly inhibiting the pace of research efforts in this area of growing importance to practitioners (Izard, 2010).

Our growing ability to measure emotion has elevated its importance in a wide variety of disciplines...

With specific regard to the concept of "emotion regulation," Thompson (2011) argues that it should be studied not in terms of uniquely dedicated neurobiological or executive cognitive processes, but rather as multifaceted influences on emotion that assume a regulatory function depending on the context. Gross and Barrett (2011) argue that disagreements about the nature of the processes that regulate emotion and whether such processes are meaningfully distinct from those that are typically considered to constitute emotion reside in the different ways in which emotion is scientifically defined. More specifically, it depends upon the scientific perspectives taken on emotion generation and regulation. Through a thorough review of the literature, the authors show that four reasonably distinct models of emotion have evolved and that emotion regulation has flourished under two of those models (Basic and Appraisal) and has been limited or

nonexistent under the other two (Psychological Construction and Social Construction). While at the NeuroLeadership Labs we find ourselves more aligned with the former, this divergence in opinion is certainly slowing the development and integration of emotion into the leadership, management and organizational behavior literature. As summarized by Gross and Barrett (2011, pp. 14–15):

...emotion now plays a central role in moral psychology research.

We believe that once differences in perspective are made explicit, it is more likely the researchers and theoreticians from diverse perspectives will be able to surmount terminological differences and join together in addressing shared concerns. ... [W]e believe that this effort must be extended to the many other disciplines which have so much to contribute to our understanding of emotion and other mental states, including linguistics, philosophy, history, communications, sociology, anthropology, cognitive science, physiology, economics, neuroeconomics, and computer science. Acknowledging and respecting differences in terminology and perspective is a critical first step, and the sooner we join together in shared purpose the better.

As if to drive this point home, in introducing a special issue of *Emotion Review*, Greene (2011) focuses our attention on the scientific study of morality. You may recall that Professor Joshua Greene was a speaker at the 2010 NeuroLeadership Summit in Boston. He notes that moral psychology has been influenced by two dramatic changes, the first being that it has become broadly interdisciplinary (including many of the disciplines listed in the quote above) and the second being that emotion now plays a central role in moral psychology research. Again, emotion and its measurement are moving to center stage.

Despite these obstacles, the body of research on emotion is growing. In an interesting study highlighting the consequences of deficiencies in emotion regulation, Aldwin, Molitor, Spiro, Levenson, Molitor, and Igarashi (2011) conclude that men who experience persistently moderate or high levels of stressful life events over a number of years have a 50 percent higher mortality rate. The study used longitudinal data surveying almost 1,000 middle-class and working-class men for an 18-year period, from 1985 to 2003.

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...keeping your major stress events to a minimum, being married, and having a glass of wine every night is the secret to a longer life.

All the men in the study were picked because they were in good health when they first signed up to be part of an aging study in the 1960s. Those in the low-stress group experienced an average of two or fewer major life events in a year, compared with an average of three for the moderate group and up to six for the high-stress group. One of the study's most surprising findings was that the mortality risk was similar for the moderate and the high-stress group. The study also showed that married men and moderate drinkers lived longest, leading the authors to conjecture that keeping your major stress events to a minimum, being married, and having a glass of wine every night is the secret to a longer life. The "keeping your major stress events to a minimum" criterion leads to our discussion of emotion regulation strategies. Importantly in this regard, McRae, Jacobs, Ray, John, and Gross (2012) found a positive relationship between reappraisal ability, reappraisal frequency, working memory capacity, and well-being.

Emotion regulation strategies

In reviewing leadership research over the past decade, scholars have begun to place increased emphasis on emotional reasoning over intelligence (see, e.g., Gilkey, Caceda, & Kilts, 2010) – often reaching contradictory results (Gooty *et al.*, 2010) in large measure due to terminology conflicts similar to those undermining research efforts in neuroscience and psychology (Gross & Barrett, 2011). In looking to the literature, two general themes seem to be forming: a focus on "self-issues" (leader emotional competence and emotion management, particularly as it relates to stress management) and "social-issues" (mirrored emotional contagion and workplace outcomes). In relation to the neuroscience and social psychology literature, and consistent with the way we have mapped those topics into

NeuroLeadership domains, the "social-issues" would be discussed in the *Collaborating* domain, while "self-issues" are covered in this, the *Emotion Regulation* domain. Due in large measure to differences in research design, the principal social science experimental design used in leadership studies has typically focused on observed consequences. With specific regard to emotion regulation, for example, the research is more likely to look into the consequences of leader suppressed and faked emotions on followers, as opposed to neuroscience and social psychology's interest in the effectiveness of the emotion regulation strategies the leader or followers actually employ, with effectiveness measured using brain imaging technology. While often reaching similar conclusions, observing and understanding the neural basis for a particular activity provides valuable insights into the complexity of human behavior – *What else is lighting up when ...?*

...traditional leadership research tells us that emotion regulation and interactions between leaders and followers may affect the relationship as well as job satisfaction...

To illustrate, traditional leadership research tells us that emotion regulation and interactions between leaders and followers may affect the relationship as well as job satisfaction (Glasø & Einarsen, 2008); followers tend to recall more negative emotion displays from leaders and rate them more negatively as a consequence (Dasborough, 2006); followers interpret leaders' intentions as more sincere when the leader is in a positive mood (Dasborough & Ashkanasy, 2002); and leaders are more positively rated when their facial expressions are congruent with the message being delivered (Newcombe & Ashkanasy, 2002).

In NeuroLeadership, the focus is more on looking to neuroscience and social psychology research to assist the leader in understanding the most effective means of bringing about that positive mood, both for the leader and the followers.

...emotional expressiveness, defined as the ability to convey emotional messages to others, is an important skill/ behavior for successful leaders...

For example, Stoeber and Janssen (2011) found that positive reframing, acceptance and humor (see also, Samson & Gross, 2012) are the most effective coping strategies for people dealing with failure. The least effective were using social support, denial, venting, behavioral disengagement and self-blame. The study found that positive reframing (seeing things in a more positive light, looking for something good in what happened) was particularly beneficial for individuals high in perfectionistic concerns, a group more likely to perceive and exaggerate failure. McRae, Misra, Prasad, Pereira, and Gross (2011) undertook to see if the motive of emotion generation influences emotional regulation. The intent was to determine whether certain emotion regulation strategies are more effective when performed upon emotions generated in similar ways. In the workplace, emotions can be elicited in a variety of ways, ranging from an unexpected encounter with an angry customer or superior ("bottom-up" emotion generation, influences from the limbic system to higher cortical regions; elicited from perceptions) to conclusions drawn from an interpretation of a social interaction ("top-down" emotion generation, influences from the PFC to the amygdala; elicited by cognitions). The study found that top-down generated emotions are more successfully down-regulated

by a reappraisal than bottom-up emotions, and that using cognitive reappraisal to decrease bottom-up generated emotions may even be counterproductive. The study provides important insights for those practitioners actively engaged in creating and implementing intervention strategies to assist in leader development.

Traditional leadership research tells us that emotional expressiveness, defined as the ability to convey emotional messages to others, is an important skill/behavior for successful leaders (Riggio & Reichard, 2008). Emotionally expressive leaders are perceived as being both more charismatic and effective (Groves, 2006), and the expression of certain emotions, such as anger, can affect follower processing of social information. Tiedens and Linton (2001) showed that expression of anger increases status, while expression of sadness decreases it. In examining the essence of the latter, Blechert, Sheppes, Di Tella, Williams, and Gross (2012) found that once an individual has *adjusted* their attitude towards someone they are not disturbed by that person's anger the next time it appears. Conversely, when an individual is told to just *feel* the emotion brought on by the person's anger, they continue to be upset. The social environment, and particularly in the workplace, requires people to quickly form contextually appropriate social evaluations. This study suggests that controlled processes, such as reappraisal, can quickly and substantially modulate early evaluative processes in the context of biologically significant social stimuli.

...positive reappraisal and mindfulness appear to serially and mutually enhance one another.

Bridging between this domain and the discussion in the *Change* domain which follows, Garland, Gaylord, and Fredrickson (2011) investigated the relationship between mindfulness and positive reappraisal. In prior reviews we have examined the stress-reductive effects of mindfulness practice (Farb *et al.*, 2007; Tang *et al.*, 2007). In observing more than 300 participants undergoing an eight-week mindfulness-based management course where some of the participants received both pre-and post-interventions

11

involving positive reappraisal, the authors found that positive reappraisal and mindfulness appear to serially and mutually enhance one another. Again, the study findings have interesting implications for developing more effective coaching personal and leadership intervention strategies.

Growing interest in implicit emotion regulation

Research on emotion regulation has historically focused on effortful (explicit) attempts to alter the course and intensity of emotional responses. Specifically, explicit emotion regulation is defined as those processes that require conscious effort for initiation, demand some level of monitoring during implementation, and are associated with some level of insight and awareness. More recently, researchers have started to describe less effortful and more automatic (implicit) forms of emotion regulation. Implicit processes are believed to be evoked automatically by the stimulus itself and run to completion without monitoring and can happen without insight and awareness (Gyurak, Gross, & Etkin, 2011). Both forms of regulation are considered necessary for well-being. This basic distinction is presented here in large measure due to potential implications for coaching and leadership development interventions. Implicit emotion regulation would include explicit emotion regulation strategies that have become habitual (Gross, Richards, & John, 2006); affect labeling (Lieberman *et al.*, 2007); and emotion regulatory goals and values (Schweiger-Gallo, Keil, McCulloch, Rockstroh, & Gollwitzer, 2009) among others. Research in this area is showing the significance of implicit emotion regulation in psychological adaptation, goal-directed behavior, interpersonal behavior, personality functioning, and mental health (Koole & Rothermund, 2011). For example, a study by DeWall, Twenge, Koole, Baumeister, Marquez, and Reid (2011) showed that acute social exclusion sets in motion an automatic emotion regulation process in which positive emotions become highly accessible, which in turn relates to positive mental health. Compared to non-excluded participants, excluded participants recalled more positive memories from childhood, gave greater weight to positive emotion in their judgments of word similarity, and completed more ambiguous word stems with happy words. As we saw in the *Collaborating* domain discussion, the brain will make remarkable adaptations to relieve the anxiety and other social pains associated with social exclusion (real or perceived).

Emotion regulation and gender

Several interesting studies addressed the question: Are there gender differences in emotional regulation strategies? Although asserting that the literature on emotional regulation is likely missing vital information on how men specifically regulate their emotions, Nolen-Hoeksema (2012) provides a review of the literature on this topic showing that women report using emotion regulation strategies more than men do. According to the

study, women ruminate more than man, which accounts for greater depression and anxiety in women compared to men; a greater tendency to use alcohol to cope partially accounts for more alcohol misuse in men compared to women. Nolen-Hoeksema and Aldao (2011) showed the use of emotion regulation strategies decreases with age, with two notable exceptions: (1) the use of suppression increased with age for women, but not for men; and (2) the use of acceptance did not decrease with age for women.

In a study with implications for implicit emotion regulation, Galli, Wolpe, and Otten (2011) showed that men and women differ in the way they anticipate an unpleasant emotional experience, thereby influencing the effectiveness with which that experience is committed to memory. By measuring their electrical brain activity, scientists were able to predict whether the image would be remembered or not, finding that it would be remembered in men, but not in women. The authors speculated that upon anticipation of an unpleasant event, women may spontaneously engage in emotion regulation strategies to counter the impact of negative emotions.

...excluded participants recalled more positive memories from childhood...

Part three: collaborating with others

In reviewing the past year's research in this important domain, we were assisted by an interesting article written by Professor Todd Heatherton (2011). Consistent with the views of the NeuroLeadership Labs, Heatherton provides a detailed discussion of the neural bases of self and self-regulation. Internally, the NeuroLeadership Labs refers to a theory similar to that proffered by Professor Heatherton as the Social Brain Theory of Leadership. According to this theory, the human brain was obligated to adapt to a complex social environment in order to survive, and so evolved dedicated neural mechanisms acutely sensitive to social context – particularly to any signal (real or perceived) that our social inclusion was somehow at risk. The neural drivers for controlling oneself to be a good group member imply a need for dedicated neural circuitries to enhance social awareness (mentalizing, theory of mind, mirror neurons, SCARF); threat and reward detection (social pain); self-awareness; and, self-regulation. To the brain, survival

means acceptance by the social group, with the consistent underperformance of any one of those component circuitries leading to social exclusion and "death". Moderated by self-regulation (with research on this important topic reviewed in the *Facilitating Change* domain discussion), the adaptive challenges of the social environment include adherence to group values and beliefs and the SCARF elements of Status, Certainty, Autonomy, Relatedness and Fairness (Rock, 2008). In that specific regard, in this domain discussion we are largely concerned with research on social awareness and threat and reward detection circuitries. An understanding of these critical circuitries can assist practitioners in focusing coaching interventions more specifically and in creating and maintaining engaged work environments more generally.

Social awareness circuitry

Developing research on social awareness strongly suggests that our need to understand the emotions of others may have evolved a more refined neural circuitry than circuitry dedicated to evaluating our own emotions, our self-awareness circuitry. The authors ((Vazire & Carlson, 2011) make a compelling case for 360° feedback assessments. Additionally, although our first impressions of others seemingly vary in accuracy and misperception, research is showing us that people do very well at sensing when their first impressions are correct (Biesanz, *et al.*, 2011). These and other studies from 2011 suggest that our social awareness circuitry has demanded the brain's greater attention and thus is more developed than our self-awareness circuitry.

To the brain, survival means acceptance by the social group...

Seemingly consistent with this conclusion but coming from another direction, research is beginning to suggest that we are socially aware well before we are self-aware; that is, our social awareness circuitry develops sooner and more rapidly than our self-awareness circuitry. The investigations suggesting this conclusion largely involve creative research with infants. Research by Hamlin, Wynn, Bloom, and Mahajan (2011) showed that infants prefer a person who helps others over someone who hinders from as early as three months. At the age of eight months, infants learn to judge an action not simply on the basis of whether it helps or harms a person, but also on whether the person deserves it. Research by Lou (2011) indicates that at ten months babies start to understand another person's thought processes, a

skill referred to as mentalizing or having "theory of mind" (see Amodio & Frith, 2006). Mentalizing allows people to be aware that other people have emotions and also attempt to understand the context of those emotions. Ultimately, this allows people to empathize with others and predict their judgments or behaviors. The study results indicate that, like adults, even preverbal infants have the ability to consider others' mental states when making inferences about others' actions.

...research is beginning to suggest that we are socially aware well before we are self-aware...

An important tool supporting this social awareness is our ability to read and interpret faces. According to a study by Germine, Duchaine, and Nakayama (2011), our facial recognition and interpretation abilities do not peak until an individual is in their early 30s. In the study, a large sample of 44,000 people aged between ten and seventy completed an online face-learning test that required them to study several unfamiliar faces. They then had to identify those faces from among further unfamiliar faces. Performance at the task increased steadily through adolescence, peaked among participants aged 31.4 years, and then declined slowly (the average performance by 16-year-olds matched the average performance of those aged 65). Additional studies by the research team controlled for growth and development in general memory and cognitive abilities in order to eliminate them as possible alternative explanations for the phenomenon observed. While group adaptive challenges are arguably different now, the impacts on available cognitive resources remain much the same. A group member with an aroused threat response is likely to find themselves mentalizing about that threat response at the expense of performance and well-being (Hambrick & Meinz, 2011), and particularly so if a person considers themselves to be a "lower-level" employee (Stellar, Manzo, Kraus, & Keltner, 2011).

Miron-Spektor, Efrat-Treister, Rafaeli, and Schwarz-Cohen (2011) examined whether and how observing anger influences thinking processes and problem-solving ability. Interestingly, the authors found that creativity was dampened by observing anger, but enhanced by observing sarcasm.

In three studies involving 375 engineering students, the authors showed that participants who listened to an angry customer were more successful in solving analytic problems, but less successful in solving creative problems compared with participants who listened to an emotionally neutral customer. In subsequent studies, the authors further showed that observing anger communicated through sarcasm actually enhances complex thinking and the solving of creative problems. An engineer's "prevention orientation" was asserted as the characteristic that served to mediate the effect of observing anger on complex thinking. The researchers suspected that the humor of sarcasm makes it less overtly threatening, and thus less likely to trigger prevention orientation.

...observing anger communicated through sarcasm actually enhances complex thinking and the solving of creative problems.

In the 1960s and 70s, anthropologists began to take note that mammals who lived in larger social groups had significantly larger brains, both in absolute size and in terms of brain size scale to body size (see, e.g., Alexander, 1989; Holloway, 1967). They argued persuasively that our ancestors reached a point at which social competition became the primary selective pressure driving human brain evolution, a concept now known as the social brain hypothesis (Dunbar, 2003). Advocates of this hypothesis assert that expanding populations provided evolutionary advantages to social, cognitive and brain adaptations to support individuals in functioning in large cooperative groups which then, in turn, competed against other groups for control of resources and social dynamics (Bailey & Geary, 2009). In building upon this research, neuroscientists in Sallet, *et al.* (2011) found that macaque monkeys housed in larger groups showed increases in the amount of gray matter in several parts of the brain involved in social cognition – the mid-superior temporal sulcus, rostral prefrontal cortex as well as the frontal and temporal cortex used for interpreting facial expressions and gestures and for predicting what other individuals intend to do. Specifically, monkeys who lived in the most socially complex groups had an average increase of 20 percent more neocortical growth than monkeys housed individually. The research team also found correlations between gray matter volume and a monkey's dominance rank within its group, suggesting that increased neural circuitry in certain brain areas promotes or enables social success.

This growing scientific support for the social brain hypothesis leads to an interesting question: Does having more Facebook friends make you smarter? Facebook, Twitter, Google+ and other social networks have clearly become an integral part of life. In an interesting collaboration between neuroscientists and anthropologists, a research team examined social media users, specifically Facebook, to see how such activity affected brain size (Kanai, Bahrami, Roylance, & Rees, 2012). The researchers considered differences between individuals in the number of both their online network of friends and their real-world friends, as well as the size of the neocortical brain regions involved in social behavior. Interestingly, while the research team was able to identify a strong correlation between the volume of three specific neocortical brain regions and the number of that individual's Facebook friends, those three brain regions (the right superior temporal sulcus, left middle temporal gyrus, and entorhinal cortex, areas previously implicated in social perception and associative memory) had no statistical relationship to the real-world social networks of those individuals. One area, the amygdala, did show a correlation between gray matter density and both forms of social networking; however, the other brain regions seem to be specifically wired for the web. Future research will need to ferret out whether online social networking technology is allowing some individuals to express a form of social behavior that has seemingly emerged to adapt to Internet technology but which has been underutilized until now – perhaps providing some sense of relief to those concerned with the interpersonal consequences of the "overuse" of social networking technologies (see, e.g., Carr, 2010).

...people of higher social classes are worse than people of lower social classes at reading the emotional states of others.

Several researchers investigated the extent to which our social awareness circuitry may be limited or constrained. Hurley and Frank (2011) examined whether subjects could control facial behavior while under the scrutiny of a "lie catcher." The researchers found that facial actions – eyebrow movements or smiles – could be reduced, but not eliminated. Kraus, Piff, and Keltner (2011a) found that people of higher social classes are worse than people of lower social classes at reading the emotional states of others. People with a college education or people who reported themselves as belonging to a high socioeconomic group did not perform as well at gauging the emotions of strangers either in person or by looking at pictures when compared to people who had not graduated from college or who classified themselves as belonging to a lower socioeconomic group. The researchers speculated that this difference in empathy could be explained by the fact that people in higher social classes can solve problems without relying on others so they are less dependent on the people around them; less attention on such social awareness circuitry brings about less development.

In a follow-on study, Kraus, Horberg, Goetz, and Keltner (2011b) theorized that lower-class individuals, because of their lower rank in society, are more vigilant regarding social threats relative to their upper-class counterparts and the difference would shape the emotional content of social interactions in systematic ways. The researchers found that lower-class participants (measured in terms of social class rank in society and within the friendship) more accurately tracked the hostile emotions of their friends and, as a result, experienced more hostile emotion contagion. In addition, lower-class participants showed more hostile reactivity to ambiguous social scenarios relative both to upper-class participants and to lower-class participants experiencing elevated socioeconomic rank. The results suggest that class affects expectations, perception and the experience of hostile emotion, particularly in situations where lower-class individuals perceive their subordinate rank. Interestingly, the two studies are consistent with research findings showing that empathy among college students (higher social class) has declined by more than 30 percent over the past 10 years, something that has generally been attributed to social networking and other technologies that reduce opportunities for young people to interact in person and a decline in the amount of time spent reading (Konrath, O'Brien, & Hsing, 2011).

Using EEG recordings, Senholzi and Kubota (2011) showed that the brain works differently when memorizing the face of a person from one's own race than when memorizing a face from another race. The study sheds light on a well-documented psychology finding known as the "other-race effect", which holds that people are less likely to remember a face from a racial group different from their own. The

outstanding question remaining prior to this study was not that the effect existed, but why. The study found that brain activity increases in the very first 200 to 250 milliseconds upon seeing both same-race and other-race faces. Interestingly, they found that the amplitude of that increased brain activity only predicts whether an other-race face (not a same-race face) is later remembered. Why is individuation so fragile for other-race faces? One possibility, the researchers say, is that many people simply have less practice seeing and remembering other-race faces – again, less attention on that social awareness circuitry brings about less development.

Social pain

As Heatherton (2011) points out, one of the four psychological components necessary to be an acceptable group member is an active and responsive threat and reward circuitry. As we have discussed in previous articles in this journal (Rock, 2008; Lieberman & Eisenberger, 2008), NeuroLeadership places considerable significance on social pain as a driver for that circuitry. Building on research on the default brain state (e.g. Ossandon, *et al.*, 2011), researchers are beginning to accumulate evidence on the existence of two additional states – the "mentalizing" and "analyzing" brain states. As we discussed above, mentalizing involves circuitry used to predict other people's emotional or intentional states, and is influenced by social pain (real or perceived). The circuitry for thinking analytically allows us to think about concepts, ideas and the future. As Professor Matt Lieberman pointed out at the NeuroLeadership Summit in San Francisco in 2010, while we may be reasonably efficient at sensing other people's emotions, the first challenge with this circuitry is that we are not good at mentalizing about their thoughts. The second is that the use of analyzing circuitry switches off mentalizing circuitry, and vice versa.

...mentalizing involves circuitry used to predict other people's emotional or intentional states...

As we have seen for other aspects of our social awareness circuitry, people who spend a lot of time being analytical, conceptual or goal-focused may have diminished mentalizing circuitry simply due to lack of use. That is, leaders who spend too much time analyzing and strategizing may find

it difficult to activate their rarely used social awareness circuitry involved in mentalizing. In addition, as we discussed in the *Decision Making* domain review, a leader's lack of an explicit rational process for issue resolution (e.g. defined and understood decision-making, problem-solving, innovation, and other critical thinking processes) causes followers to move back and forth between analyzing and mentalizing brain states, detracting from their ability to deeply focus cognitive resources on the issue being addressed.

In 2011, a number of interesting studies were conducted to more clearly define and characterize social pain and its consequences. Accumulating evidence demonstrates that experiences of social and physical pain actually rely on some of the same neurobiological and neural substrates. To the extent that being ostracized from a social group is detrimental to survival, feeling hurt by this separation may have been our brain's adaptive way to prevent it. Over the course of our evolutionary history, social pain may have assisted us in avoiding social rejection, increasing our connection with others, enhancing our probabilities for inclusion in the social group, and ultimately our chances of survival. In this sense, social pain, though distressing in the moment, is an adaptation that ensures social bonding and ultimately survival (Eisenberger & Lieberman, 2004; Eisenberger, 2011).

...experiences of social and physical pain actually rely on some of the same neurobiological and neural substrates.

Williams and Nida (2011) showed that while ostracism or social exclusion may not leave external bruises, it can cause pain that is often deeper and longer lasting than a physical injury. Confirming the use of the same neurobiological and neural substrates in the brain for both physical injury and social pain, the researchers noted that the process of ostracism includes three stages: the initial acts of being ignored or excluded, coping, and resignation with important individual differences in each stage. Ostracism threatens psychological needs (belonging, self-esteem, control

and meaningful existence), and it unleashes a variety of physiological, affective, cognitive and behavioral responses. More than 5,000 people participated in the study, which made use of a computer game designed by Williams to show how just two or three minutes of ostracism can produce lingering negative feelings.

Several important studies looked into the consequences of social exclusion and social pain.

Several important studies looked into the consequences of social exclusion and social pain. Miner and Eischeid (2012) found that workers who witnessed incivility towards colleagues feel negative emotions (specifically, anger, demoralization, fear, and anxiety), especially when incivilities were directed toward others of the same sex. Perhaps not surprisingly, De Ruddere *et al.* (2011) found that the valence of that negative emotional response was significantly influenced by how much that colleague was liked (influenced by how egotistical, hypocritical, or arrogant they were perceived to be). The more the person was disliked, the less sympathetic others were to the colleague's social pain. According to Berger (2011), whether or not the incivility event will be shared with others depends more on how physically or emotionally stimulated people were when they processed the information about the event and not its actual emotional content.

A study by Ferguson (2011) shows that stress created by incivility in the workplace can be so intense that at the end of the day it is taken home by the worker and has an impact on the well-being of the worker's family and partner, who in turn takes that stress to his/her workplace. The author notes the importance of controlling this ripple effect. The study also found that such stress also negatively affected the worker's and partner's marital satisfaction. In an interesting article that reviewed recent psychological research on social acceptance and rejection, DeWall *et al.* (2011) noted research showing that those experiencing social rejection feel isolated and lonely, tend to have poorer physical health, do not sleep well, have lower immune response, and tend to die sooner than people who enjoy social inclusion (whether real or perceived).

Because of a natural proclivity to be drawn to the negative, we often overlook detrimental consequences that can flow from social events that generate positive valence.

In an interesting study conducted by Wood, McInnes, and Norton (2011), the research team looked at the incidence of traffic fatalities after sporting events. The analysis shows that major sporting events in which the game is decided by a close margin results in an increase in traffic deaths compared to games that are decided by large margins ("blowouts"). The authors hypothesize that close games may be more dangerous because they increase the competition-associated testosterone, which then spills over into aggressive driving. The authors further speculate that the results provide benefits for losing in that those fans may enjoy a safer drive home. It is interesting to speculate whether these results could be generalized to such activities as negotiations, sales, or other such competitive events in the business world.

...concepts related to SCARF play an important role in understanding and explaining how brain activity in response to social stimuli is manifested in observable behavior.

The continuing development of SCARF

Within NeuroLeadership, we categorize those social events that can activate mentalizing by causing social pain through the SCARF (Status, Certainty, Autonomy, Relatedness, Fairness) model (Rock, 2008). Several interesting strands of research in 2010 further developed and defined the model. SCARF and concepts related to SCARF play an important role in understanding and explaining how brain activity in response to social stimuli is manifested in observable behavior.

For example, at the NeuroLeadership Labs we expressly consider individual differences in SCARF through what we refer to as an individual's *SCARF profile*. An individual who shows hypersensitivity to status-related issues is likely to require a different intervention strategy, for example, than an individual showing a less sensitive response to such issues. As practitioners, the more we understand about the kind of stimuli that generate a particular SCARF response, the better we are able to assist individuals and organizations in their development efforts.

Status

Liew, Ma, Han, and Aziz-Zadeh (2011) found that in contrast to the Chinese who responded fastest to pictures of their direct supervisor, white Americans responded faster to pictures of their own face than to pictures of their boss. Interestingly, the American tendency toward individualism is less pronounced if the supervisor is considered someone with high social status. That is, status as a social motivator may be influenced in Americans more by one's social status than one's hierarchical position as a boss. The authors point out that while we are quicker to react to faces we think are important, which most of the time is our own face, certain individuals – those with real or perceived social status – may interfere with how we think about ourselves.

Allen and Sherman (2011) showed that when people feel bad about themselves, they are more likely to show bias toward people who are different; it makes us feel better about ourselves. Allen and Sherman used the Implicit Association Test (IAT) – a task designed to assess people's automatic reactions to words and/or images – to investigate their hypothesis. In a follow-on study involving the authors (Gonsalkorale, Sherman, Allen, Klauer, & Amodio, 2011), the research team found that individuals who are primarily internally motivated to respond without prejudice show less bias on implicit measures than individuals who are externally motivated or unmotivated to respond without prejudice, again suggesting a role for individual differences in self-regulation as an explanation for individual differences in hypersensitivities to SCARF's social motivations.

In addition to showing bias toward others in order to feel better about ourselves, Mercier and Sperber (2011) assert that we do the same when we enter into arguments. The authors take on generally accepted philosophical theory, which holds that reasoning exists to allow people to reach beyond mere perception in search of truth, make better decisions, or gain scientific enlightenment. Rather, according to the authors' *argumentative theory of reasoning*, reasoning is a social phenomenon that evolved to assist us in convincing others and in being careful when others attempt to convince us – in social brain theory terms, a social adaptation that enables one group to persuade (and defeat) another, regardless of how far the argument may depart from the truth. In this sense, arguing becomes little more than a hard-wired compulsion to triumph in the debating arena, to gain or avoid losing social status.

One study of great interest to status research (though not in the neuroscience lab directly), showed that "localized" status, or the status you feel in the group you are surrounded by, is more important to your happiness than your socioeconomic status (Anderson, Kraus, Galinsky, & Keltner, 2012).

Prior research on status had shown that monkeys will direct their attention to others of higher or lower status depending on their own position in the group. Ly, Haynes, Barter, Weinberger, and Zink (2011) conducted a study to see if this principle also holds in humans. FMRI was used to measure brain activity in the ventral striatum (prominently implicated in processing value and salience), while research participants of varying social status were shown information about someone of relatively higher status and information about someone of relatively lower status. The study showed that the brain's response to status cues varies depending on an individual's own subjective perception of their status. Individuals of higher subjective socioeconomic status showed greater brain activity in the ventral striatum in response to other high-ranked individuals, while those with a lower status perception had a greater response to other low-status individuals. In other words, if we consider ourselves high status, we both listen to and place greater value on information from higher status individuals; if we consider ourselves lower status we listen to and value information from both higher and lower status individuals. The study raises a variety of interesting questions. Of particular note is the fact that individual differences create varying levels of sensitivity to this social motivator. With hypersensitive individuals likely to see their perceived status shifting over time for better or for worse, how their brain responds to such changes in the context of this research is an intriguing question for future study.

...individual differences create varying levels of sensitivity to this social motivator.

Certainty

In the SCARF model, the concept of certainty deals with the human need for clarity and predictability; ambiguity activates threat circuitry. Roets and Van Hiel (2011) assert that individuals with a hypersensitive need for certainty are more likely to show signs of prejudice. According to the authors, people who are prejudiced have a stronger need to make quick and firm judgments and decisions in order to reduce ambiguity. Being hypersensitive to ambiguity, they are more prone to quickly rely on the most obvious information, often the first information they come across, to reduce their anxiety. They also favor authority and social norms, which make it easier to make such decisions. Once they have made a choice, they adamantly stick to their decisions even in the face of new, contradictory information – all generally done unconsciously. In this sense, sources of prejudice are not ideology, but rather are a basic human need and a way of thinking. The author's proposed solution: provide information – say, by bringing groups together – to find an alternative, more positive source of "first" information upon which to rely.

...people who are prejudiced have a stronger need to make quick and firm judgments and decisions in order to reduce ambiguity.

Autonomy

In the SCARF model, the concept of autonomy deals with the human need for a sense of control over events. Reduced autonomy activates threat circuitry; increasing autonomy activates reward circuitry. Inesi, Botti, Dubois, Rucker, and Galinsky (2011) showed that this control aspect of autonomy forms a critical shared foundation for an individual's power over others and the ability to make choices in their lives. The study showed that power and choice in this sense are substitutable – less of one increases the desire for the other in order to offset the anxiety of the loss (and the social pain associated with it). Further, the authors found that power and choice exhibited a "threshold effect" – once an individual had one source of autonomy/control, additions of the other source yielded diminishing returns. Practitioners will see that the interchangeability of power and choice can provide useful insights into workplace design and team development.

Leotti and Delgado (2011) show that in addition to exercising control by making choices to satisfy a need for autonomy, the *opportunity* to exercise control may also be similarly adaptive

because it activates the areas of the brain associated with rewards (corticostriatal regions, particularly the ventral striatum, involved in affective and motivational processes). Taken in combination with Inesi, Botti, Dubois, Rucker, & Galinsky, (2011) above, these findings may have important applications for understanding the role of perception of control in self-regulatory processes intent on changing habits.

> ## *The study showed that power and choice in this sense are substitutable...*

Relatedness

In the SCARF model, the concept of relatedness involves our sense of safety with others, of being with "friends" rather than "foes." Its impact on our sense of self is important. Cwir, Carr, Walton, and Spencer (2011) showed that even superficial feelings of connectedness with a stranger are enough to lead to a mirroring of their emotions and even their heart rate. Walton, Cohen, Cwir, and Spencer (2012) illustrated that mere belonging, a minimal social connection, to another person or group increased task motivation by creating socially shared goals around the task.

In a demonstration of the interconnectedness of the SCARF elements, Lount and Pettit (2011) showed that high-status people tended to trust people more in initial encounters than did people with lower status – higher status people rated others as more benevolent, which led them to trust more (in other words, the boss is likely to trust a new hire more than the new hire is likely to trust the boss). Kogan, Keltner, Impett, Oveis and Saturn (2011) found that it can take just 20 seconds to detect whether a stranger is inclined to be trustworthy, kind, or compassionate. The authors argue that humans are wired – in fact, may be genetically predisposed – to recognize strangers as more likely to help them out in difficult situations. We will discuss the importance of first impressions in the Change domain discussion.

Fairness

In the SCARF model, the concept of fairness relates to our sense of perception of fair exchanges with people. How to distribute available resources among members of a group is a central aspect of social life. Gospic *et al.* (2011) show that the brain has built-in mechanisms that trigger an automatic reaction to someone who refuses to share. Using brain imaging, the study provides neuroscience data to support the universal human behavior to react with instant aggression

whenever a person behaves unfairly and in a manner that is not in the best interests of the group. The researchers saw that the brain region more active during such decisions was the amygdala, and not the prefrontal cortex and insula as had previously been identified. At what age do we develop the sense that resource distributions are inequitable? A study by Geraci and Surian (2011) suggests that infants aged 12 to 18 months (mean age 16 months) pay attention to the outcomes of distributive actions in order to evaluate the distributor's actions and to reason about the distributor's disposition. And the consequences of such unfair distributions? Robbins, Ford, and Tetrick (2011) conducted a meta-analysis to examine the effects of unfairness perceptions on health. The results suggest that perceptions of unfairness are associated with negative impacts on physical and mental health, particularly in those situations where the unfairness breaches a psychological contract held by group members. In this edition of this journal, there is a deeper discussion by Rock and Cox (2012) of research that has emerged about SCARF in the full five years since it was launched by Rock.

> ## *The results suggest that perceptions of unfairness are associated with negative impacts on physical and mental health...*

Social interaction and gender

There is a considerable body of research demonstrating that social interactions are affected by gender. In adding to that body of research, Van Honk, Schutter, Bos, Kruijt, Lentjes, and Baron-Cohen (2011) found that an administration of testosterone under the tongue of volunteers negatively affected an individual's ability to mentalize, an indication of empathic ability. The researchers conjectured that this may help explain why on average women perform better than man on tests requiring the subject to infer what a person is feeling from photographs of facial expressions emphasizing the eyes.

While stereotypes suggest that women are more cooperative than men, Balliet, Li, Macfarlan, and Van Vugt (2011) in a meta-analysis of 50 years of research showed that men are

equally cooperative in situations involving a social dilemma that pits the interests of an individual against the interests of the group. Interestingly, the study also showed that men cooperate better with other men than women cooperate with each other; women tend to cooperate more than men when interacting with the opposite sex. Reuben, Rey-Biel, Sapienza, and Zingales (2011) conducted an experiment in which groups were required to select a leader. The research team found that women are selected less often as leaders than is suggested by their individual past performances. While looking for explanations for this underrepresentation of women, the authors found that men's overconfidence was the driving force behind the observed prevalence of male representation.

Workplace engagement

Workplace engagement involves the degree to which people put discretionary effort and care into their job. Workplaces driven by positive emotions would elicit more of such discretionary effort than would negative environments. While traditional business research has focused on the impact of engagement on organizational performance, only in the last few years have we seen inquiries into the neurological drivers of engagement. Organizational theorists have only recently begun to incorporate neuroscience into investigations of workplace behavior (Becker, Cropanzano, & Sanfey, 2011). In looking for the implications of brain science on workplace behavior, the NeuroLeadership Labs has been guided by a mapping of Gallup's "Q12" assessments into SCARF (Rock & Tang, 2009; Ringleb, 2009). This mapping provides a convenient means by which to tie neuroscience research to the business concept of engagement.

...only in the last few years have we seen inquiries into the neurological drivers of engagement.

In neuroscience terms, a leader increases workplace engagement by increasing SCARF – by increasing employee status, certainly, autonomy, relatedness and fairness. In addition to the seemingly obvious performance benefits from an engaged workforce, such a workforce also enjoys significant health benefits. In a 20-year follow-up study looking into the predictors of mortality, Shirom, Toker, Alkaly,

Jacobson, and Balicer (2011) found that employees who believe that they have the personal support of their peers at work are more likely to live a longer life (even after controlling for such psychological, behavioral, or physiological risk factors, such as smoking, obesity and depression).

...employees who believe that they have the personal support of their peers at work are more likely to live a longer life...

Several studies with engagement implications warrant consideration by practitioners. Bault, Joffily, Rustichini, and Coricelli (2011) investigated why an individual would take a risk when all other colleagues are watching but would never take if alone. According to the study findings, the brain places more value on winning in a social setting than it does on winning when alone. The researchers found that the striatum, a part of the brain associated with rewards, showed higher activity when an individual beat a peer in the lottery, as opposed to when that individual won while alone. The medial prefrontal cortex, a part of the brain associated with social reasoning, was also more active.

Waytz and Young (2012) asked the question "When something goes wrong, who gets the blame: the person or the group?" The researchers found that the more cohesive the group, the more likely it is that people in the group will hold its members less responsible for their individual actions. Interestingly, the researchers speculated that the more people judge a group to have a mind – a "group mind" (that is, the ability to think or plan), the less they seem to judge a member of that group as having his or her own capacity to think or plan. The research raises interesting questions about decision-making, blame and moral judgment.

Researchers in a variety of other fields also provided interesting insights into the engagement equation. Wood and De Menezes (2011) used a large database to show that when employees are given greater independence (autonomy) in their jobs, and when management readily shares information and consults with them, employees feel both less stress and more satisfied. The study also shows that performance-related pay, a highly used management tenet of high-performance work

systems, makes no difference to satisfaction or stress. In an interesting study with broad applications, Xie *et al.* (2011) found that when just 10 percent of a community holds an unshakable belief, the majority of the society will always adopt their belief. This percentage of committed opinion holders remains at approximately 10 percent, regardless of how or where that opinion starts and is spread in the community/society. The fundamental characteristic of these opinion holders is that they are completely set in their views and unflappable in modifying them. At the NeuroLeadership Labs we found this study to be particularly interesting in that it is consistent with our anecdotal observations of when leadership development interventions in MBA and undergraduate groups are more or less successful.

Part four: facilitating change

While we recognize the importance of organizational change research, little research has been done up to now involving neuroscience tools or theories to inform our understanding of how complex systems change. This is largely due to the complexity of change efforts, the difficulties of isolating success factors in change and the challenges of current brain imaging technologies. We hope in the future to see greater research by neuroscientists into organizational change. In this review we are focusing on new research about individual change.

Leadership, psychology and neuroscience scholars all recognize the challenges in changing long-entrenched personal habits.

Leadership, psychology and neuroscience scholars all recognize the challenges in changing long-entrenched personal habits. As we have seen in our discussions in the other domains, recent research in neuroscience and social psychology continues to reveal the importance of emotion and emotion management as fundamental ingredients in effective social interactions. While practitioners will be

the first to express their appreciation for the importance of technically trained leaders, they will also be the first to express their frustration with the effectiveness of skills or content-based approaches to personal and leadership development, which typically leave out, or at best hold constant, emotion variables in the change equation.

The ability to inhibit prepotent impulses is a core feature of self-regulation...

In virtually all disciplines relevant to neuroleadership, individual change has become associated with an individual's level of self-awareness – a personal sense of strengths and weaknesses, and vision of continuous advancement and personal growth. As we discussed in the *Collaborating* domain above, controlling oneself to be socially accepted involves an awareness of how one is thinking, feeling *or* behaving and the ability to alter any of those to satisfy the expectations of the social group. The ability to inhibit prepotent impulses is a core feature of self-regulation and refers to a process by which individuals initiate, adjust, interrupt, stop, or otherwise change thoughts, feelings or actions to effect the realization of personal goals or plans or to maintain current standards (Bauer & Baumeister, 2011). In the broadest sense, self-regulation refers to intentional or purposeful acts that are directed from within the individual. From this perspective, learning, physiology and culture predispose certain behaviors, thoughts or emotions in specific circumstances, but self-regulation allows the individual to change or overcome them.

Learning, habits, and individual change

Neuroscience and social psychology research is now outlining the important consequences of individual differences in working memory capacity for learning (Alloway, Banner, & Smith, 2010), and responses to emotional events and cognitive performance (Beal & Ghandour, 2011). If we take the discussions from the *Collaborating* and *Emotion Regulation* domains and bring them together here, emotions clearly have an impact on working memory capacity. To that end, McRae, Jacobs, Ray, John, and Gross (2012) show us that individual differences in reappraisal ability are positively correlated with differences in working memory capacity; the greater an individual's reappraisal ability, the greater is their working memory capacity.

From the practitioner's standpoint, this line of research strongly supports the notion that change efforts focused on increasing emotion regulation will increase working memory capacity and thereby improve cognitive functioning.

Given our need to be good group members, it seems reasonable to assume that certain life experiences that brought into question our social inclusion (real or perceived) would stay with us and influence our emotional "set points" as adults (Kendall *et al.*, 2011). To the extent those life experiences involved top-down emotion generation, the brain would likely adapt and form habitual responses to similar experiences with the intent to maintain social group survival (the goal). At NeuroLeadership Labs, when such a habitual response is unhealthy or unproductive we refer to the top-down emotion generated as being a "deceptive brain message" (Schwartz & Gladding, 2011). According to Neal, Wood, Labrecque, and Lally (2011a), and as many coaches and leadership development practitioners have experienced, if the habit formed is strong, the individual's perception of recurring context cues will activate the response in memory, deactivate alternative responses, and be relatively uninfluenced by changes in motivational states. With regard to personal development interventions, Duhigg (2012) in his book, *The Power of Habit*, argues that the issue becomes how to bring about change in such circumstances. In a thorough review of the relevant literature, he shows that social psychologists and neuroscientists are developing more effective and person-specific intervention strategies to assist people in overcoming unproductive and unhealthy habits. Our intent is to review some of the more important contributions from this past year.

Research over the past year has offered several insights into what triggers habits and how they respond to motivational influences.

Research over the past year has offered several insights into what triggers habits and how they respond to motivational influences. Neal, Wood, Wu, and Kurlander (2011b) investigated the factors that can alter habit performance.

They conducted experiments by varying the conditions under which people consume popcorn at a movie theatre. Some participants in their research had strong habits to eat popcorn at the theatre (i.e. a history of frequent popcorn consumption in that setting), whereas others had weaker habits. For some participants, the popcorn was fresh, whereas for others it was seven days old and stale. To test the effects of changes in motivations introduced by the stale popcorn, they first controlled for hunger, the degree to which participants liked the popcorn, and habit strength. Striking differences emerged in eating patterns. Strong-habit participants, when they could eat automatically with their dominant hand, repeated past responses regardless of the palatability of the popcorn. However, when strong-habit participants were forced to eat in an atypical way, their behavior was brought under intentional control, and – like the weak-habit participants in all conditions – they ate little of the stale popcorn. Specifically, the use of the non-dominant hand raised self-awareness sufficiently to allow the individual time to make a conscious choice as to whether to eat or not eat the stale popcorn (Baumeister, Gailliot, DeWall, & Oaten, 2006). In subsequent sections below, we will be looking at this relationship among and between mindfulness, self-awareness and self-regulation and the growing body of research to support those relationships.

Personal characteristics and individual change

The last year saw a variety of studies describing the kind of personal characteristics that seem to generate the most success, perhaps providing some guidance as to the direction a change effort might want to travel. Johnson, Rowatt, and Petrini (2011) showed us that those individuals who possess the combination of honesty and humility have better job performance. In fact, the combination predicted job performance better than any of the traditional five personality traits. Similarly, LaBouff, Rowatt, Johnson, Tsang, and Willerton (2012) found that those same people are more likely to offer time to someone in need than an arrogant person.

Johnson and Fowler (2011) showed that self-deception in the form of a mistakenly inflated belief that we can easily meet a challenge or win a conflict may actually be good for us. Chance, Norton, Gino, and Ariely (2011) took on the notion that although people seem to have an endless capacity for rationalizing what they have done, *they do not know they are deceiving themselves*. The research team found that not only do they deceive themselves, but they are largely oblivious to their self-deception.

Gawronski, Rydell, Vervliet, and De Houwer (2010) found there is more than a literal truth to the saying "you never get a second chance to make a first impression." To bring about a change in that first impression, they found that it is

necessary for the first impression to be challenged in multiple different contexts; as long as a first impression is challenged only within the context in which it was developed, it will continue to dominate. How does making an effort to make a positive impression on others affect the accuracy of those impressions? Human, Biesanz, Parisotto, and Dunn (2012) show that making a positive self-presentation facilitates more accurate impressions, indicating that putting one's best self forward helps reveal one's true self. The research team showed that, done in this way, impressions were more in line with participants' self-reported personality traits and IQ test scores.

> *...self-deception in the form of a mistakenly inflated belief that we can easily meet a challenge or win a conflict may actually be good for us.*

This growing body of research begs an important question: As we direct interventions toward the most productive and healthy characteristics, do we need to be concerned about whether nice guys finish last? According to Judge, Livingston, and Hurst (2012), nice guys really do finish last, or at least make less money. Overall, they are less likely to get fired and just as likely to supervise others; however, they are less inclined to negotiate pay increases and other personal rewards to which they may be entitled.

The Healthy Mind Platter

In looking to improve human performance and well-being from a neurobiological as opposed to a psychological perspective, Dr. Dan Siegel and Dr. David Rock created *The Healthy Mind Platter*. The Platter, conceived in the wake of the US government's revised food pyramid, has "7 essential mental activities necessary for optimal mental health in daily life." Those seven essential daily mental activities are:

Focus Time. *When we focus closely on tasks in a goal-oriented way, taking on challenges that make deep connections in the brain*.

Play Time. *When we allow ourselves to be spontaneous or creative, playfully enjoying novel experiences, which helps make new connections in the brain*.

Connecting Time. *When we connect with other people, ideally in person, or take time to appreciate our connection to the natural world around us, or a world bigger than we are, richly activating the brain's relational circuitry*.

Physical Time. *When we move our bodies, aerobically if medically possible, which strengthens the brain in many ways*.

Time In. *When we quietly reflect internally, focusing on sensations, images, feelings and thoughts, helping to better integrate the brain*.

Down Time. *When we are non-focused, without any specific goal, and let our mind wander or simply relax, which helps our brain recharge*.

Sleep Time. *When we give the brain the rest it needs to consolidate learning and recover from the experiences of the day*.

The Healthy Mind Platter

The Healthy Mind Platter, for Optimal Brain Matter
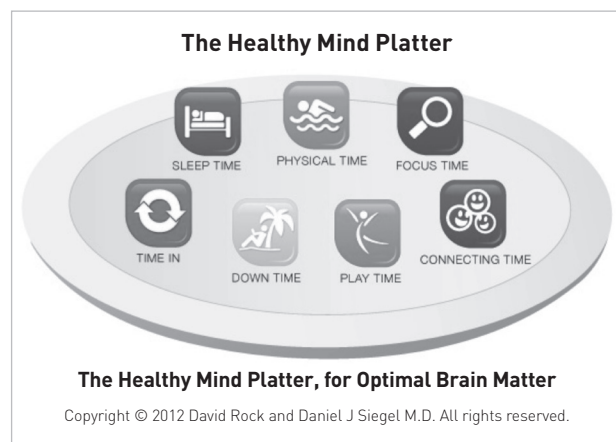
Figure 1: Ingredients of The Healthy Mind Platter.

In the past year, considerable research has been done on several of these ingredients, substantiating their importance to human performance and well-being. Beginning with research at the most general level, social influences are among the influences on brain structure and function that are most powerful in inducing plastic change.

Although the precise mechanisms of plasticity are still not fully understood, moderate to severe stress appears to increase the growth of several sectors of the amygdala, whereas the effects in the hippocampus and prefrontal cortex tend to be opposite (McEwen, 2007). With the amygdala and PFC and their interconnections strongly implicated in emotion regulation (Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008) and well-being (Davidson, 2004), adaptations to those social influences can drive unproductive and unhealthy habits. Using data from the

23

Framingham Heart Study, an investigation of residences of the Massachusetts town ongoing since 1948, Debette *et al.* (2011) showed that smoking, hypertension, obesity and diabetes all caused brains to shrink in size, leading to a decline in the brain's executive function, among other things. Several interventions suggested implicitly by the Health Mind Platter have been shown to promote pro-social behavior and well-being and are likely to induce plasticity-related changes in the brain. That is, those interventions would lead to an increase in brain size and an increase in the brain's executive function (such as self-regulation), as well as promote changes driven by healthy habits (Hölzel, *et al.*, 2010).

...smoking, hypertension, obesity and diabetes all caused brains to shrink in size, leading to a decline in the brain's executive function...

Support for the importance of "connected time" can be seen in the works of Coan, Schaefer, and Davidson (2006) and Eisenberger, Taylor, Gable, Hilmert, and Lieberman (2007), previously reviewed in this and other contexts. With regard to "physical time" studies demonstrated the importance of exercise for both brain health and cognition (Voss, Nagamatsu, Liu-Ambrose, & Kramer, 2011) and with changes in the brain consistent with improved stress management and memory (Erickson, *et al.*, 2011). "Time in," or mindfulness mediation has found considerable scientific support for its beneficial attributes to physical well-being and brain heath (see discussion below).

With regard to the latter, Hölzel *et al.* (2011), in a controlled longitudinal study to investigate pre–post changes in brain gray matter concentration attributable to participation in a Mindfulness-Based Stress Reduction (MBSR) program, found that participation is associated with changes in gray matter concentration in brain regions involved in learning and memory processes, emotion regulation, self-referential processing, and perspective taking.

At the 2011 NeuroLeadership Summit in San Francisco, Professor Jessica Payne showed us the relationship between stress, mood and sleep. When a person has high levels of stress and negative mood, resulting in poor sleep, the consequence will be significant cognitive impairment, affecting basic perception as well as judgment and decision-making. Consistent with other ingredients in the Healthy Mind Platter, Payne and Kensinger (2011) found that lack of sleep led to a shift from the employment of a diffuse memory retrieval network (including widespread activity in the lateral prefrontal and parietal cortices) to a more refined network of regions (including the amygdala and ventromedial PFC). Additional research on sleep demonstrated the positive relationship between sleep and self-control (Barnes, Schaubroeck, Huth, & Ghumman, 2011), and the benefits of a short nap on both performance (Wamsley, Tucker, Payne, & Stickgold, 2010) and sensitivity to emotion (Gujar, McDonald, Nishida, & Walker, 2010). There is a deeper summary of the Healthy Mind Platter in the journal edition in which this paper is published (Rock, Siegel, Poelmans & Payne, 2012).

Self-regulation

While emotion regulation (see part two above) is an aspect of self-regulation, self-regulation relates to the broader issue of personal change, including regulating a wider set of behaviors and processes than just emotion. Self-regulation, and its relationship to self-awareness and mindfulness, is a rapidly growing body of research. As Heatherton (2011) points out, and with which the NeuroLeadership Lab's Social Brain Theory of Leadership concurs, self-regulation is an indispensable psychological ingredient in successful social interactions. The past year has seen serious research on the consequences of individual differences in self-regulatory ability, its neural constructs, and a number of its most important characteristics, particularly the rate and the conditions under which it is depleted.

The relationship between self-regulation and delayed gratification is generally attributed to a landmark study by Dr. Walter Mischel in the late 1960s, in which Mischel used marshmallows and cookies to assess the ability of preschool children to delay gratification (Mischel, Shoda, & Rodriguez, 1989). In that study, the children were told that if they held off on the temptation to eat a treat, they would be rewarded with more treats later. Some of the children were able to resist, while others were not. (At the NeuroLeadership Labs, we assert that the group is normally-distributed.) In Casey *et al.* (2011), the research team (that included Mischel) recruited 59 adults who had participated as young children in the original study and who represented both extremes of the delayed-ratification spectrum. Because marshmallows are less rewarding to adults, the researchers used robust psychometric tests to reveal that the aptitude for delayed gratification was consistent among the participants from

childhood into adulthood. When the test was repeated while participant's brain was being scanned using fMRI, the results showed that the brain's prefrontal cortex was more active in "high delayers" and the ventral striatum (an area linked to addictions) was more active in "low delayers".

> ...the study showed that participants with poor childhood self-regulatory ability were more likely in adulthood to be a single parent, to have credit and health problems, and to have been convicted of a criminal offense...

In a study following the original Mitchell's hypothesis, Moffitt *et al.* (2011) systematically assessed the self-regulatory ability of 1000 New Zealand children at the ages of three, five, seven, nine, and 11 and then interviewed them when they had reached the age of 32. In a result consistent with Mitchell, the study showed that participants with poor childhood self-regulatory ability were more likely in adulthood to be a single parent, to have credit and health problems, and to have been convicted of a criminal offense – even after controlling for intelligence and social class.

Given that the relationship between childhood self-regulatory ability and adult outcomes held across a full range of self-control scores, the researchers recommend introducing universal intervention strategies intended to assist students in raising self-regulatory ability into the core school curriculum. On the basis of the evidence, why not consider it an integral part of all personal development interventions?

In looking to more fully understand the neural basis of self-regulation, Figner *et al.* (2010) were, for the first time,

causally able to show that self-regulatory ability is rooted in the prefrontal cortex, and specifically the left lateral prefrontal cortex (LPFC). The research team used a non-invasive brain-stimulation technique called low-frequency repetitive transcranial magnetic stimulation, or rTMS, to temporarily disrupt the function of the lateral prefrontal cortex in a group of 52 healthy volunteers. One-third of the group received stimulation to the left lateral prefrontal cortex; one-third to the right lateral prefrontal cortex; and one-third, the control group, received a sham stimulation. After the stimulation, the volunteers were asked to make choices between smaller, immediate rewards or larger, later rewards. Those subjects whose left lateral prefrontal cortex had been disrupted by the simulation, increased choices of immediate rewards over larger delayed rewards; both those receiving the sham simulation and those whose right lateral prefrontal cortex had been stimulated, did not.

Wanless *et al.* (2011) showed us that self-regulation can be formally trained as well as measured at a young age. The study involved children ages three to six years of age in four countries. The study showed that children who regularly participated in a Simon Says-type game designed to improve self-regulation (called the Head-Toes-Knees-Shoulders task) improved their academic achievement. Importantly, and the primary intent of the study, academic gains were seen in students in countries already known to have stronger self-regulation than US students (Taiwan, China and South Korea).

Ego depletion

Ego-depletion theory assumes that activities requiring self-control consume a limited mental resource, the so-called "limited resource" theory (Baumeister, Muraven, & Tice, 2000). According to the theory, even relatively small exertions lead to a reduction in this mental resource, and self-control-related tasks and activities carried out immediately after such exertions will demonstrate diminished performance. In the past year, several studies tested this general proposition from a number of perspectives. Within the greater discipline, there has been some conjecture that ego depletion is merely a result of fatigue.

> ...there has been some conjecture that ego depletion is merely a result of fatigue.

In a study involving a group of participants half of whom were sleep deprived, Vohs, Glass, Maddox, & Markman (2011) found that performance on a task requiring self-control was influenced by whether the participant had completed a prior task requiring self-control and not by whether the participant was sleep deprived, lending support to the limited resource model. In two interesting studies where the experiential task involved focusing on an emotion, Hill, DelPriore, and Vaughan (2011) (envy) and Xu, Beguea, and Bushman (2011) (guilt) both found that depleted participants (brought about through experiments intended to elicit the specific emotion of interest) showed lower self-regulatory ability during subsequent acts of volition.

Prior research has shown that money in the form of actual cash rewards can counteract ego depletion...

Prior research has shown that money in the form of actual cash rewards can counteract ego depletion (Muraven & Slessareva, 2003). Boucher and Kofos (2012) went an additional step and found that the *idea* of money similarly buffers ego depletion effects. With implications for employee motivation, the research team found that the concept of money evokes a focus on individual goals and performance, and confers the feelings of efficacy needed to confront challenges and attain important outcomes. Interestingly, the idea of money did not impart extra self-control ability among non-depleted participants; that is, money-primed non-depleted participants did no better than neutral-primed non-depleted participants on subsequent self-control-related tasks and activities.

In a study with potentially broad applications, Fennis (2011) looked to the impact of ego depletion on perspective taking and its associated prosocial behavior (willingness to assist others). Prior research has found that perspective taking requires the self-regulatory energy to override the tendency to maintain an egocentric perspective. Fennis showed that compared to non-depleted participants, depleted participants showed considerably reduced willingness to undertake perspective taking and the prosocial behaviors associated with it.

...perspective taking requires the self-regulatory energy to override the tendency to maintain an egocentric perspective.

Although the independent bodies of research supporting self-awareness, self-regulation and mindfulness have grown substantially over the past decade, research formally linking them together is moving more slowly. An important question in that regard, for example, is whether self-regulatory failure resulting from ego depletion can be circumvented. Alberts, Martijn, and De Vries (2011) looked specifically at whether ego depletion can be circumvented by increasing self-awareness. Building on research developed independently in the areas of self-regulation (ego depletion) and self-awareness, the research team showed that non-depleted and depleted participants who had been given a self-awareness prime performed equally well on a subsequent task and considerably better than depleted participants who had received a neutral prime. An interesting question in the application of this research, and one that leads us into the next section is: What role does or could mindfulness play as a "self-awareness prime?"

...glucose may be one factor in ego depletion...

Finally, there is an intriguing argument emerging that says that glucose may be one factor in ego depletion but not the only factor. Job, Dweck, and Walton (2010) found that one's beliefs about willpower played a key role in whether willpower was influenced by glucose. Another study showed that thinking about something one values positively in between willpower tasks mitigates the glucose-depletion effect (Schmeichel & Vohs, 2009). A number of other studies are pointing to the role of both beliefs and the general threat/reward state of the brain as key factors in the ego depletion model. At the time of writing the debate continues on this topic.

Mindfulness

At NeuroLeadership Labs, we refer to mindfulness as the ability to directly experience the world in the present, in an accepting way. Sometimes we refer to it simply as 'direct experience'. Mindfulness as we discuss it here is not a Buddhist or religious capacity, but an innate human capacity that varies across populations, but can be increased with practice. In recent years, mindfulness has moved from being largely supported through anecdotal evidence to building a strong scientific foundation. The benefits of mindfulness are gaining empirical support in both psychology (e.g. Shapiro, Oman, Thoresen, Plante, & Flinders, 2008) and neuroscience (e.g. Tang *et al.*, 2007). The growing evidence suggests that mindfulness practice is associated with neuroplastic changes in the anterior cingulate cortex, insula, temporo-parietal junction, fronto-limbic network, and default mode network structures (Hölzel *et al.*, 2011). There is increasing work that explains the elements that make mindfulness effective, showing that it likely combines attention regulation, body awareness, emotion regulation (including reappraisal and exposure, extinction, and reconsolidation), and change in perspective on the self (Hölzel *et al.*, 2011).

> *Mindfulness as we discuss it here is not a Buddhist or religious capacity, but an innate human capacity that varies across populations...*

Several studies in the past year have produced findings that may assist practitioners in making mindfulness an integral part of personal and leadership development intervention strategies. Zeidan, Johnson, Gordon, & Goolkasian (2010) undertook a study to compare the effects of a brief mindfulness meditation intervention compared to a sham mindfulness meditation intervention. The study consisted of three groups (meditation, sham meditation, and a control), with each group undergoing three consecutive days of training for 20 minutes a day. The mindfulness meditation group was trained by a facilitator with eight years of training in mindfulness meditation interventions. Although they were told they were "meditating," the sham mindfulness meditation group received instruction based on relaxation techniques emphasizing breathing exercises. The control group was led to believe they were registering for mindfulness intervention, sat in a chair for 20 minutes each session, and were allowed to speak to one another. Each of the three groups was broken down into smaller groups of between five and eight participants to receive their training. Heart rate, blood pressure, and psychological variables (*Profile of Mood States, State Anxiety Inventory*) were assessed before and after the three-day intervention. The research team found that the mindfulness intervention was more effective at reducing negative mood, depression, fatigue, confusion and heart rate when compared to the sham meditation and control groups. The authors concluded that brief meditation training has beneficial effects on mood and cardiovascular variables that go beyond the demand characteristics of a sham meditation intervention.

> *"Is mindfulness a measurable quality in people who do not practice mindfulness-based meditation?"*

At the NeuroLeadership Labs, considerable research effort is placed on understanding how individual differences, particularly in self-regulatory ability, affect intervention strategies. In looking at all aspects of leadership and personal development, the beginning notion is that a particular characteristic or attribute is normally distributed across the population. Against this line of thinking, one hypothesis has been that the ability to be mindful is also normally distributed across non-meditators. If this hypothesis is true, then one would further hypothesize that the upper end of the distribution of non-meditators would compare favorably in level of mindfulness with that of meditators, at least with those meditators at the lower end of the distribution of meditators.

Hollis-Walker and Colosimo (2010) tested the hypothesis: "Is mindfulness a measurable quality in people who do not practice mindfulness-based meditation?" Further, they looked to see if mindfulness could also be a predictor of well-being among non-meditators as it is among meditators. They found that non-meditating participants who scored high on mindfulness also tended to score high on self-compassion, psychological well-being, agreeableness, extraversion, openness

and conscientiousness, and low on neuroticism, in line with the mindfulness literature describing meditators. They conjectured that non-meditating individuals high in this construct are better equipped to recognize, manage and resolve day-to-day conflicts, which promotes a healthy mind. The ability to notice moment-to-moment experience, with compassion, facilitates insight, clarity and acceptance. At the Labs, we see this study as saying that such individuals are at an advantage in recognizing an emotional conflict (more self-aware), and thus are able to utilize their self-regulatory abilities, and then to pause and plan (rather than fight or flight) in devising strategies for their management and resolution (as opposed to returning repeatedly to ingrained, maladaptive habits).

> *...more mindful participants were better able to recognize a broader range of stimuli sufficiently in advance to allow a more reasoned, flexible response...*

Coaches and other practitioners working in personal and leadership development have noticed that while individuals trained on a task will typically improve on that very task, other tasks, even very similar ones, often show little or no improvement. This is particularly troublesome in working to overcome a habit that has general as well as specific consequences. That is, training benefits often seem to be stimulus or content-specific rather than process-specific. At the NeuroLeadership Labs, we have seen that individuals typically adopt one of three self-regulation strategies in working to confront or change a habit: (1) setting a goal and garnering support; (2) fixing a "mental state" in advance of the stimulus that elicits the unproductive or unhealthy habitual response; and (3) through a process we have labeled "habitualization," physically or mentally practice a more productive or healthy response to a stimulus in the hopes of overriding an ingrained habit in the event the stimulus is confronted. This last strategy is similar to the setting of implementation intentions, as outlined by Dixon, Ochsner

and Rock (2010), in which specific, concrete new behaviors are defined. This is one of the more effective strategies for individual behavior change.

In each case, we observed that the strategies were situation or stimulus specific. In contrast, we observed that more mindful participants were better able to recognize a broader range of stimuli sufficiently in advance to allow a more reasoned, flexible response (something we labeled as "pause and plan"). On this basis, we began to see mindfulness as a far more effective strategy in terms of being able to provide the meditator with the ability to recognize and manage a broader array of stimuli – to provide process-specific learning.

Slagter, Davidson, and Lutz (2011) is the first study to consider whether neuroscience can provide important insights into the potential for mindfulness meditation training to both strengthen cognitive skills and, more importantly, to identify the factors that contribute to, and the mechanisms that underlie, process-specific learning. We believe this study, and the research it will certainly generate, are going to have a profound impact on the nature and direction of coaching strategies in personal and leadership development environments in the near future.

> *...it is evident that significant and impressive progress has been made in defining and detailing the developing field of neuroleadership.*

Conclusion

In bringing together and reflecting upon the breadth and depth of research in neuroscience and social psychology over the past year, it is evident that significant and impressive progress has been made in defining and detailing the developing field of neuroleadership. The applications of this research by neuroleadership scholars and practitioners are clarifying thinking, motivating creativity, inspiring learning, enhancing productivity and promoting well-being – making the difference we all anticipated just six short years ago when the discipline was first considered. Much work has been done; much is yet to begin.

Still, with the growing recognition of emotion's indispensible role in personal and leadership development, it is becoming increasingly evident that social psychologists, neuroscientists, organizational behavior and leadership theorists, and leadership practitioners need to be working together more closely to break down terminology barriers where they are needlessly inhibiting advancements in new thinking and applications. As we iterated last year, a functional co-mingling of concepts ranging from definitions to terminology to functioning models amongst these disciplines will serve to focus the usefulness of those tools and have the beneficial effect of accelerating "time-to-market" for working practitioners. With what we see in the research pipeline, and what we anticipate, there is a large body of compelling work forthcoming. In light of this anticipation and our expectations, perhaps the best advice we can give is still the same as we offered in our initial review and have offered in all subsequent reviews: "Now continues to be a good time to take a neuroscientist to lunch."

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