

THE NEUROSCIENCE OF COACHING

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Neuroscience can shed light on the underlying mechanisms of coaching and provide important insights to facilitate development. These insights provide guideposts for a more effective, interactive coaching process that is most successful when it remains fluid, responsive, and centered on the client. In this article we introduce our general model, intentional change theory (ICT), and review findings from an initial brain-imaging study that examines neural differences between 2 approaches to coaching: 1 called *coaching with compassion* (i.e., coaching to the positive emotional attractor—PEA); and the more typical approach to coaching, called *coaching for compliance* (i.e., coaching to the negative emotional attractor—NEA). This study showed that PEA coaching activates networks and regions of the brain that are associated with big-picture thinking, engagement, motivation, stress regulation, and parasympathetic modulation. Next we discuss research on the opposing domains hypothesis, showing that brain regions responsible for analytic thinking exist in tension with brain regions essential for socially and emotionally connecting with others and understanding ethical issues and being open to new ideas and learning. We extend these findings to explore how neuroscience explains different forms of empathy. In the next section we discuss neuroscience findings relevant to creating a culture of coaching in organizations. Finally, we discuss a further neuroscientific study of coaching that solidifies our understanding of the mechanisms by which coaching can help personal development. At the conclusion of each of the sections we discuss how these insights from neuroscience help inform effective approaches to coaching.

Keywords: coaching, neuroscience, PEA, NEA, TPN

Intentional change theory (ITC) holds that engaging a person's ideal self or personal vision is an essential driver of sustained, desired change (Boyatzis, 2008). In addition to creating a motivation and purpose for activities, coaching to a personal vision is claimed to arouse the positive emotional attractor (PEA), which has components of activating the parasympathetic nervous system, the default mode network (DMN), and positive emotions (Boyatzis, Rochford, & Taylor, 2015). Because it includes activating the DMN, we are more able in the PEA to detect and perceive (i.e., to notice) new ideas and scan the environment for possibilities, and because we are more open to other people, a person would be more tuned to the coach (Raichle, 2010). The PEA state allows the person to be open to new ideas and creates a sense of safety that allows individuals to face, rather

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than avoid, difficult issues. Hence, it creates a tipping point that leads a person into the next stage of the ICT process.

Because of its importance to coaching, we are reviewing a previously published study of coaching that used functional magnetic resonance imaging (fMRI) and that provided findings consistent with the ICT model (Jack, Boyatzis, Khwaja, Passarelli, & Leckie, 2013).¹ In this study, participants were 20 sophomores (10 female) at a major Midwestern research university. Before scanning, each participant received two different coaching sessions from two different coaches, advanced doctoral students in their 30s (one female coach and one male coach), conducted in a naturalistic manner outside the scanner. The PEA coaching consisted of 30 min of a coach asking them to articulate their personal vision, or what their ideal life and work would be 10 to 15 years in the future. The negative emotional attractor (NEA) coaching was also 30 min in duration and conducted by the other trained coach. However, instead of focusing on the participants' own aspirations and dreams, it focused on the challenges the participants faced in meeting the expectations currently placed upon them. It consisted of 30 min of asking the participants questions such as how they were doing in their courses, were they able to do all of their homework, were they managing their time well, and so forth. The two coaching sessions were provided on sequential days. The order in which each subject received the PEA and NEA coaching sessions was randomly assigned, and factors such as whether the female coach provided PEA coaching and gender match of the PEA coach with the participant were fully counterbalanced and randomly assigned, so could not explain the final averaged findings.

After the naturalistic coaching sessions, participants were sent an online questionnaire by an independent third researcher—the same person who had initially enrolled the participants in the study and who served as their principle point of contact. This questionnaire was a manipulation check, to assess how participants had perceived the individuals coaching in these different styles. Although many participants had informally remarked to each coach at the end of the coaching sessions that they found them to be helpful and were grateful for their time, the questionnaire was arm's length from the coaches and probed participant's perceptions in more detail. The PEA coach was perceived to be considerably more inspirational and also more trusting and caring. Meanwhile, the NEA coach induced feelings of guilt and obligation and was perceived as slightly more abrasive. These different coaching styles produced an effect on participants' perceptions that were robust and widespread. They were not just significant overall but also past the threshold for significance for 8 of the 13 individual questions. The most notable difference between the two coaching styles was the degree to which the PEA coach was regarded as more personally inspiring. This difference was large in effect size and corresponded to a 2-point difference on a 7-point Likert scale.

Three to 5 days after the coaching sessions were completed, participants came to the brain scanner. Investigating a process like coaching in the brain scanner is challenging. Social interactions are hard to capture within the constraints imposed by fMRI experimental design, creating a powerful tension between desire for ecological validity and the need to follow scientific principles (Schilbach et al., 2013). Nonetheless, we were able to construct a design that went further than any work prior or since in its ability to validly mimic a coaching interaction. Participants were played audio and video clips that showed a head and shoulder view, similar to a video conference view, of one of the two coaches making a coaching-related statement. The participant then provided a response by pressing a key, and after the response, a brief video clip was played in which the coach thanked the participant for the response. While participants were aware these exchanges were contrived, they built on their vivid recent experience with each coach, which were entirely naturalistic and ecologically valid. Hence, the interactive exchanges mimicked and felt like social exchanges with each coach. They provided us with a small window that reasonably approximated a genuine

¹If the reader is not familiar with neuroimaging studies, the sample sizes are small compared with psychological studies. Because of the costs, the sample sizes are often 8 to 15. Confidence in the results is pursued with replication and forward inference (i.e., rigorous theory and hypothesis testing) rather than large sample sizes.

coaching interaction. We could see how the brain is engaged when participants interact with a PEA and with a NEA coach.

We found a number of differences in how the brain responded to the PEA versus the NEA coach; these were broadly highly consistent with ICT. Most prominently, we found that PEA coaching produced more activation in widespread areas of lateral visual cortex. This is consistent with the claim that PEA coaching encourages participants to engage their visual imagination, suggesting that “visioning” is indeed a highly appropriate term for what this type of coaching involves. Also in line with predictions from ICT, PEA coaching demonstrated greater engagement of brain areas associated with motivation (ventral striatum/nucleus accumbens) and in brain regions involved in parasympathetic modulation of stress responses (ventral medial prefrontal cortex, vmPFC), and it produced a left-dominant asymmetry in frontal activation that has previously been associated with positive affect and greater approach rather than avoidance motivation (Brookshire & Casasanto, 2012; Davidson, 1992; Spielberg et al., 2008). Finally PEA coaching produced greater activity in medial parietal cortex, a key node of a larger network known as the DMN that is involved in creating a sense of social and emotional connection. As will be explained in more detail in the next section, the DMN enables a person to be open to new ideas, people, and moral concerns (Boyatzis, Rochford, & Jack, 2014; Jack et al., 2012).

NEA coaching, by contrast, produced greater activity in a region associated with sympathetic stress response (para-cingulate cortex) and in a medial prefrontal region associated with self-consciousness.

Consider the following implications for coaching.

These results suggest that coaching to the PEA, which is also called *coaching with compassion* (Boyatzis, Smith, & Beveridge, 2013) or *coaching to one's personal vision and dreams*, is more likely to activate neural mechanisms that encourage the individual to be motivated, willing to tackle difficulties, and open to new ideas and the coach. Coaching to the NEA is called *coaching for compliance* because, while this frequently adopted approach to coaching is well-intentioned, it is a problem-centered approach that emphasizes external forces, agendas, and constraints that have been imposed on the participant. In contrast to PEA coaching, which evokes a sense of possibility and self-empowerment, NEA coaching tends to encourage stressful self-conscious thoughts of being judged and having obligations placed upon one. Hence, NEA coaching puts participants in a defensive posture that decreases motivation and makes it harder for them to approach and embrace change—no matter how much they may desire change in the abstract.

Whether coaching is being delivered by a professional coach or it is a form of helper guidance offered by a manager, parent, teacher, doctor, nurse, or therapist, these results suggest that the best way to engage a mind-set that will lead to sustained effort in learning or change is to coach in a manner that first engages and then sustains the individual's own vision of his or her dreams and aspirations. In contrast, many coaches (or helpers/managers) focus from the start on the problems and challenges that an individual faces and then coach in a manner that ends up being driven by their own expectations and their desire to fix or resolve the issues for the other person. Although this approach is well intentioned, in practice it tends to activate a mind-set that results in defensiveness and the closing down of the individual's perceptual, cognitive, and motivated openness to change. In other words, it only increases the psychological burden on someone who is already feeling challenged by life circumstances.

If you are in the position of being a helper or manager *and* deeply believe that the person is doing something wrong and has to change, you have two choices. First, you may keep it to yourself, knowing that if you push it as an agenda of yours on the other person, and particularly if you allow your strong feelings to show in your conversation, the only thing you will do is make it *less* likely that any change will occur. Indeed, if the individual already feels that you do not judge him or her positively, then your pushing this agenda will tend to encourage that person to start acting in opposition to you, an unfortunate dynamic that naturally arises out of the individual's psychological need to protect one's sense of self-worth from perceived external threats.

Alternatively, you can put aside your concerns for the time being and first engage the person in a discussion of his or her ideal self and personal vision. This will give you a clearer view of what

motivates the individual, which may open up opportunities for collaboration. In addition, it will help the person enter the PEA state and become psychologically open to change. Once someone feels deeply heard and feels social connection and support, then he or she becomes motivated to change. Hence, rather than becoming oppositional, the person will be eager to listen to your perspective as an act of social reciprocation. It is at this point, when asking for help in ideas about how to get closer to his or her own vision, that you will find the person open and motivated to hear your ideas or insights.

In summary, it is a common mistake to assume that just because your intentions are good (i.e., because you are committed to an individual's growth or benefit) that this will be sufficient for your ideas and suggestions to be received positively and acted upon. The individual's sense of self-worth and self-determination is, in our opinion, his or her most important and valuable possession, which overshadows any specific behavior or goal the person might desire. ICT explains why the coach should take the time to respect and make use of this central motivation, so it can be leveraged to produce change for the individual's benefit. Care is needed to avoid quick fixes for problems, as this type of coaching inadvertently works against this key motivation. When considered in the context of a broader psychological perspective, neuroscience helps to illuminate why PEA coaching, that is, coaching with compassion or coaching to a personal vision, is more effective than NEA coaching, that is, aiming directly at identifying and fixing problems or coaching for compliance.

In addition to understanding the theory and practice of these two approaches to coaching, it would be useful to delve into the deeper mechanisms by which they each affect both the coach and the coachee instantaneously—that is, in terms of neural-network activation. It would help to answer the question about whether these effects of coaching with compassion and coaching for compliance merely operate at the psychological and behavioral level or if there is something that differentiates them and their impact at the psychophysiological-interaction level.

Opposing Domains

Advances in brain-imaging technology started to invigorate research in cognitive neuroscience in the 1990s, which was designated by President George H. W. Bush as the “Decade of the Brain.” As the field expanded, the field was initially focused mostly on studying more “cognitive” tasks, such as perception, motor control, attention, working memory, and problem-solving tasks. A clear pattern began to emerge. It was found that most of these cognitive tasks—from more basic perception and motor tasks to highly abstract tasks including mathematical, logical, and scientific reasoning—all tended to activate an overlapping set of brain regions (Corbetta et al., 1998; Duncan & Owen, 2000; Fischer, Mikhael, Tenenbaum, & Kanwisher, 2016; Goel, 2007; Jack et al., 2012; Martin & Weisberg, 2003; Shulman et al., 1997). These brain regions were also found to be important for general intelligence (Prabhakaran, Smith, Desmond, Glover, & Gabrieli, 1997). Hence, this network was often characterized as being responsible for reasoning in general (e.g., Duncan & Owen, 2000). It also came to be known as the *task-positive network* (TPN), because, at the time, it seemed to researchers that this network was active whenever participants engaged in any task (Fox et al., 2005; Shulman et al., 1997).

Over the last 15 years, the most rapidly expanding area in cognitive neuroscience has been in social and affective neuroscience. This work builds upon and extends work in psychology concerning social and emotional cognition, including our capacities to regulate our emotions and our ability to “read” or understand other minds. Although the field of social and affective neuroscience started with a few seminal publications (e.g., Gallagher, Jack, Roepstorff, & Frith, 2002), the degree of interest and number of publications grew rapidly. As it did, another striking pattern began to emerge, namely that a quite different set of brain regions tended to be most involved in social and emotional cognition (Amodio & Frith, 2006; Bzdok et al., 2012; Denny, Kober, Wager, & Ochsner, 2012; Jack et al., 2012, 2013; Reniers et al., 2012; Schilbach, Eickhoff, Rotarska-Jagiela, Fink, & Vogeley, 2008; Van Overwalle, 2009, 2011). These brain areas are often referred to as the *social brain*.

The identification of the social brain proved that the first network, the TPN, does not “corner the market” on human reasoning. Rather, it shows that humans have two different capacities for

reasoning, or ways of understanding: one that is geared toward social and emotional understanding and can be broadly characterized as empathic reasoning; and a second that is needed for focused attention and nonsocial problem solving and can be broadly characterized as analytic reasoning (Jack et al., 2012).

The TPN and DMN are both highly evolved and occupy a larger percentage of the cortical surface in humans compared to other animals. However, the TPN is particularly expanded in the human compared with nonhuman primates, while the DMN is relatively well developed in these highly social nonhuman species (Hill et al., 2010). The two networks occupy similar amounts of cortex, although some estimates suggest the social brain occupies slightly more of human cortex (Jack et al., 2012)—this is a striking observation given how much more attention is paid in education and training to refining analytic as opposed to social and emotional skills.

Each of these networks comprise a number of regions that contribute different functions. The TPN occupies lateral parietal and prefrontal regions, whereas the DMN predominantly involves midline structures, including posterior cingulate, the medial parietal cortex, dorsomedial prefrontal cortex (dmPFC), and ventromedial prefrontal cortex (vmPFC), and, on the lateral surface, the temporo-parietal junction. Further description of the networks and their relevance to organizational behavior can be found in earlier publications (Boyatzis, Rochford, & Jack, 2014).

The division of the brain between empathic and analytic ways of understanding is truly striking and has been demonstrated in many different ways. For instance, a recent study looked at where the meanings of different types of words are stored in the brain; this was done by scanning participants while they listened to several hours of natural narrative stories (selections from *The Moth Radio Hour*). Without making any assumptions (i.e., using data-driven methods), Huth et al. (2016) demonstrated that the brain divides very clearly between social/emotional concepts (e.g., “communal,” “mental,” “social,” and “emotional”), stored in the DMN, and perceptual/analytic concepts (e.g., “visual,” “tactile,” “abstract,” and “numeric”), stored in the TPN.

However, it is not just that different brain areas are involved in empathic and analytic understanding. In the last 5 years, a third crucial discovery has been made. It has been found that analytic thinking not only engages the TPN but also tends to turn off the DMN—the brain regions essential for empathy. On the other hand, empathic thinking not only engages the DMN but also tends to turn off the TPN—the brain regions essential for logical thinking and task execution (Jack et al., 2012). In other words, these two domains of thinking are not just distinct but in some ways are fundamentally opposed to each other, hence the phrase “opposing domains.”

The tendency for these two networks to suppress each other is not absolute—it is possible to engage both. However, it does place a very significant and important constraint on cognition. A number of scientific observations illustrate the importance of this constraint for mental function. First, we know this tendency is a basic design feature of the system—that is, it exists across cultures and emerges as a result of the basic network connectivity of the brain (Fox et al., 2005; Jack et al., 2012; Sporns, 2014; Vincent et al., 2007). Second, we know that individuals with higher IQ show a greater tendency for these networks to suppress each other (Anticevic et al., 2012), whereas many mental disorders are marked by decreased tension between the networks (Anticevic et al., 2012; Broyd et al., 2009; Buckner et al., 2008). Third, we know that the two networks often interfere with each other: DMN activity during analytic cognition causes performance errors (Anticevic et al., 2012), and TPN activity during social cognition is associated with a distanced, disengaged, or instrumental view of others, including dehumanizing them (Jack, Dawson, & Norr, 2013). Fourth, evidence suggests a natural tendency for the brain to balance out activity between the networks over time. Pyka et al. (2009) found that the more the DMN was suppressed during a working memory task (in proportion to the cognitive load of the task), the greater the tendency for DMN activity to “bounce back” during the next break in the task.

However, while these networks generally interfere with each other, this is not to say that it is never effective to activate both networks at the same time. For instance, it is known that activating both networks simultaneously is important for creative insight (Beatty et al., 2014), for some forms of instrumental social cognition (French & Jack, 2014), and for some types of emotion regulation (Sillers, Weber, Wager, & Ochsner, 2015). The point is not that we should never activate both

networks at the same time or that doing so is necessarily bad provided it is not the norm. The important point is that it is a signature of mental health and good function for these networks to trade off most of the time and that when they do work together what they do tends to be limited in important ways (i.e., activating both networks together neither supports clear-headed analytic thinking, “cold logic,” nor supports true empathic understanding, “appreciating the humanity in others”).

The challenge for the vast majority of professional or complex tasks (some financial tasks, such as investing and trading, may be an exception) is that both networks play important roles but in very different ways (Boyatzis et al., 2014; Friedman, Jack, Rochford, & Boyatzis, 2015; Rochford, Jack, Boyatzis, & French, 2016). We need the TPN to solve problems, analyze things, make decisions, and focus (i.e., limit one’s awareness to focus attention on a task or issue). On the other hand, we need the DMN to be open to new ideas, scanning the environment for trends or patterns and being open to others and emotions, as well as moral concerns (i.e., being fair and just and promoting well-being, not the more analytic act of judging an action as right or wrong).

Because both domains of behavior are important, the most effective managers, leaders, and professionals are skilled at matching the balance of activity in these networks to the context (i.e., they have learned to use the appropriate resources of analytic thinking, empathic thinking, or occasionally a blend for the situation at hand). It is also hypothesized that effective managers can toggle or cycle back and forth between these two networks more rapidly and fluidly—allowing them to balance alternative perspectives and preventing them from getting stuck in a particular way of thinking.

The two domains relate to previously described learning styles and ways of thinking. In Kolb’s (2015) experiential learning theory, those with a preference for abstract conceptualization as a learning style tend to rely on the TPN, whereas those with a preference for concrete experience as a learning style tend to rely on the DMN. In relation to Epstein, Pacini, Denes-Raj, and Heier’s (1996) rational and experiential information-processing styles, those with a high need for cognition (analytic-rational thinking style) tend to rely on the TPN, whereas those with a preference for relying on their feelings (intuitive-experiential thinking style) tend to rely on the DMN. The degree to which more frequent or intense engagement of one network over the other results from socialization or individual dispositions is not known at this time. It is clear that cultural and contextual factors, including the immediately prior task, can influence the tendency to use one network over the other. At the same time, there appears to be small but reliable gender differences (male stronger for TPN, female for DMN) that are present throughout most, but not all, of the life span (Scheinost et al., 2015).

Organizational life tends to focus on TPN activation because of a predominant rhetoric and time spent on budgets, problem solving, and analytics with dashboards and metrics. As a result, individuals in many organizations become more focused on the TPN than is helpful or relevant. This can lead to a tendency to objectify others (e.g., thinking of them as human resources to be utilized or maximized). It can also result in growing norms, beliefs, and practices that inhibit innovation. By focusing on what is (i.e., not invented here), growing reluctance may occur to trying new ideas. When combined with pride and spirit de corps, it could lead to competition neglect and missing key movements in an industry or field because of inattention to the bigger picture (Camerer & Lovo, 1999).

While excessive time spent in the DMN may result in distraction and less progress toward specific goals, the opposite (i.e., excessive time spent in the TPN) may result in moral transgressions. It is not that the person thinks he or she is doing a “bad” thing, and they typically do know right from wrong, but that they have a deadened appreciation of the ethical significance of policies and actions. Hence, a TPN focused task-oriented leader will tend to prioritize short-term strategic advantage, instead of the longer-term and bigger-picture importance of achieving fairness and justice. For instance, they might make decisions that are expedient in terms of budget analysis but still not be best for the organization in the long term (Jack, Dawson, & Norr, 2013; Rochford, Jack, Boyatzis, & French, 2016).

Consider the following implications for coaching.

The fact that we have two major brain networks that are in tension with each other, and that each of them is essential for understanding and appreciating different aspects of the world, causes us to live in a divided world. The effects of this division can be seen at many levels, from whether spiritual and religious beliefs are adopted (Jack, Friedman, Taylor, & Boyatzis, 2016) to the types of intellectual work individuals are drawn to and feel have primary “authority” (Snow, 1959). Inevitably, this divide can also be seen in virtually all organizational cultures. In particular, it is important to appreciate how a client’s concerns may arise either because of a lack of fit between one’s preferred perspective and the organization’s dominant culture, or more specifically between one’s own perspective and that of a coworker, whether a superior, peer, or subordinate. Progress can be made on many organizational issues by identifying failures to balance between and respect each of these perspectives and by helping the client to see the other perspective or advocate for a better balance.

The coach should also be aware of his or her own preferences (e.g., by taking the Rational-Experiential Inventory, available online) and strive to find the appropriate balance for coaching. Put simply, coaching is most effective when the coach is highly DMN oriented—the focus is first and foremost on listening to and understanding the client. Adopting a TPN focus by attempting to “fix” a problem for your client may sometimes be effective in the short term; however, it does not enable the client to fix problems for themselves. It is better if the client is brought to a place where he or she takes the lead on fixing the problem by taking a TPN focus. The point of coaching with a DMN focus is to help clients to overcome the emotional blocks that lie in the way of their solving problems for themselves—problems that, if they were only emotionally open, they are most likely in a much better position to figure out than the coach. It is known from studies of depression and social threat that when individuals have unresolved emotional concerns, this causes their DMN to be occupied with ruminations that interfere with clear TPN decision making (Hamilton, Farmer, Fogelman, & Gotlib, 2015; Van Ast et al., 2016).

However, the primary focus of coaching should not be on understanding and listening to problems. It is not useful in coaching to focus predominantly on negative concerns or grievances. The goal is not just to activate the DMN early in the process but also to make sure that this DMN engagement is focused on positive forward-looking emotions (PEA) rather than negative backward-looking concerns. In this way, the individual not only feels heard but is also helped to become open to new ideas and the possibility of change. This is why creating a positive vision of the future is such a critical part of ICT theory. This process creates a tipping point to the remainder of the sustainable change process as described by ICT.

Once a change direction or desired end is identified and the person feels renewed, safe, and open—and even curious or eager—then ventures into the TPN with analytic moments and even using stress to adapt are likely wanted. However, the balance is probably quite different than most people assume. Research on positive and negative emotions suggests that a person, relationship, or group flourishes best when positive emotions feature with a frequency two to five times that of negative emotions (Boyatzis et al., 2015; Fredrickson, 2009; Gottman, Murray, Swanson, Tyson, & Swanson, 2002). This may explain why many types of traditional psychotherapy, which often tend to be backward-looking and focused on negative emotions, are much less effective than PEA coaching.

For example, when using data-based feedback, like a 360 or assessment-center results to help coach a person, showing him or her the data, graphs, or report will typically result in that person focusing on the gaps or weaknesses or negative comments. This is likely to activate the TPN as the individual tries to analyze it and the NEA while reacting in a defensive manner. At this point in a process, he or she is becoming increasingly closed to new possibilities. Although the person may admit the importance of using the feedback, the sustainability of any effort is diminished because of the stress and strain it adds. Our minds are tuned to protect us, and from an ecological perspective and even an evolutionary drive to survive, we are sensitive to detecting threatening cues from our surroundings. Added to the socialization in organizations to be prepared for attacks (or excessive demands from bosses), the result is typically a defensive posture about feedback (Boyatzis, et al., 2015).

By focusing on the person vision *before* presenting any feedback, you have a greater chance of creating a positive, strongly desired context for the feedback. That is, the context should be the vision and dreams of the client. However, even in this situation, the coach should focus early moments in the process of the data feedback on the person's strengths to further emphasize the PEA state and keep it going as long as possible. Then discussing the weaknesses or gaps in the context of one's dream and vision as well as strengths becomes a useful aspect of the TPN.

Varieties of Empathy and Emotion Regulation

The most basic form of empathy is emotional contagion—the sharing of the affective states of others. It is known, for instance, that experiencing pain oneself and observing others being subjected to painful stimuli evoke very similar patterns of brain activity (Morrison, Lloyd, di Pellegrino, & Roberts, 2004; Singer, 2006). These occur in relatively primitive brain areas, such as the insula and amygdala (evolutionarily old structures involved in visceral processing and in pain and fear processing, respectively) and in the para-cingulate cortex region associated with a sympathetic-nervous-system stress response mentioned in the previous section as being more engaged by NEA coaching (Lamm, Batson, & Decety, 2007).

Coaches should also be aware that the experience of becoming socially estranged or excluded also produces a very similar pattern of brain activity (Eisenberger & Lieberman, 2004). This insight is important because it is essential for coaches to understand that a common source of pain for clients is some form of social estrangement, such as the sense they have been judged negatively or disrespected, and this not only produces considerable distress but often also creates a sense of shame that causes individuals to socially hide or deny negative feelings that nonetheless preoccupy them. It is also important because one of the more crucial psychological functions of a coach is to offset pain and distress by providing a sense of social connection and acceptance that helps individuals feel safe and allows them to better tolerate distress. As we will discuss further, this sense of safety and offsetting of distress has been shown to be associated with engagement of the parasympathetic nervous system, which originates from the DMN, in particular the vmPFC (Eisenberger & Cole, 2012).

It is believed that some degree of sharing of emotion is essential for all empathy (Bernhardt & Singer, 2012; Decety & Michalska, 2010). However, emotional contagion need not lead to empathic behavior and often does not when the emotions being shared are very strong or distressing. In this case, unless the empathizing individual has a strong capacity to regulate the contagious emotion (e.g., through cognitive reappraisal or differentiation of self from other), the person will him- or herself become distressed and will tend to engage in thoughts (e.g., dehumanizing, blaming the victim) and behaviors (e.g., refusal to discuss the topic, exclusion of the individual) that help avoid the source of distress. Neural mechanisms associated with initial phases of these responses have been investigated and described (Lamm, Batson, & Decety, 2007).

When the empathizer is able to regulate his or her emotional response to the distressed individual so it does not become overwhelming, this provides room for the empathizer to feel empathic concern. This might be thought of as true empathy, because it motivates prosocial and helping behaviors. These behaviors are most effective when they are guided by a well-developed sense of social and emotional understanding. Social and emotional understanding is mediated by the network of brain areas discussed in the previous section—the DMN or social brain.

The DMN plays an important role in regulating more primitive limbic brain areas, which are responsible for being in an emotional state, such as the amygdala, insula, and ventral striatum. For instance, it is known that connectivity between regions in the DMN and limbic structures is altered in individuals who suffer from anxiety (Hahn et al., 2011; Kim, Gee, Loucks, Davis, & Whalen, 2011). Furthermore, there is excellent evidence that the DMN (in particular vmPFC) plays an important role in regulating emotions (Ochsner, Silvers, & Buhle, 2012) and specifically in regulating fear by learning to feel safe (Marstaller, Burianova, & Reutens, 2016). The degree to which emotion is regulated by the DMN, and in particular by the vmPFC, is an important factor for

explaining individual differences in emotion-regulation ability (Silvers, Wager, Weber, & Ochsner, 2015).

Although the DMN plays an essential role in emotion regulation, it is not the only network that is involved in this. Areas of the TPN are also important for some emotion-regulation strategies, including suppression, distancing, and cognitive reappraisal (Ochsner, Silvers, & Buhle, 2012). In particular, it appears that the TPN is particularly important for regulating high-intensity emotions (Silvers, Weber, Wager, & Ochsner, 2015). In line with the neuroscience, psychological research demonstrates that individuals who score higher on a measure of analytic reasoning (working memory capacity) are better able to regulate their emotions (Schmeichel, Volokhov, & Demaree, 2008). Similarly, our own unpublished studies find that measures of analytic thinking relate strongly to peer ratings of emotional self-control, whereas they do not relate to other social and emotional competencies.

This research and the work specifically on fear and anxiety processing (Marstaller, Burianova, & Reutens, 2016) reveal an important phenomenon that we have dubbed the *paradox of fear*. The paradox of fear is that stimuli or conditions that make us fearful or anxious push us into a “fight or flight” TPN mode: either because we use the TPN to go into a task-oriented problem-solving mode (a type of “fight”) or because we use the TPN to downregulate our emotion by suppressing or disengaging from it (a type of “flight”). These responses can be highly adaptive in the short term, especially when we are faced with a real threat. However, they do not help us constructively cope with the vast majority of fears and anxieties in modern life, which are often either more perceived than real in nature (i.e., there is no actual threat and, thus, the fear response is maladaptive) or, although real, social in nature (i.e., empathic responding would be more productive). Studies of safety learning and of individuals who suffer from clinical anxiety demonstrate that engaging the DMN represents the more effective long-term strategy for dealing with fear and anxiety. Animal studies show that the vmPFC plays a critical role in fear extinction, and this strategy may be thought of not so much as cognitive reappraisal (which involves distancing from emotion) as emotional reappraisal (i.e., rather than suppressing emotion, learning a new emotional response to a situation).

Consider the following implications for coaching.

Many of us are familiar with the quick spike of motivation that fear and anxiety can produce. It pushes us into the TPN and motivates immediate action. However, this strategy quickly depletes motivation and psychological resources, and when it occurs too frequently it leads to the chronic inflammatory stress-related conditions that are currently the greatest threat to health in the United States (Schneiderman, Ironson, & Siegel, 2005). Some people even have the mistaken view, or fear, that positive emotions, such as feeling safe and happy, will strip themselves or their subordinates of motivation. However, many studies show that individuals engaged in professional or complex tasks are actually less productive when they are directly incentivized by carrots and sticks, and more productive when they are motivated to make a positive contribution or by desire for personal mastery (Pink, 2009). The key point is that fear and anxiety act like stimulants—they can achieve a short-term boost, but over the longer term they decrease overall performance. Fear and anxiety shortcut the DMN and push us directly into the TPN. In contrast, sustained motivation comes from first developing a positive motivation in the DMN, then using that as the springboard to engage the TPN. This strategy reinforces, rather than depletes, our resources and sense of self.

The role of analytic TPN thinking in both emotion regulation and in more instrumental, or “socially distant,” forms of social cognition is also very important for coaches and managers to understand. The building of a trusting and caring relationship between the coach and the client is an essential aspect of coaching, which is key to the client feeling safe and open to change. However, as discussed in the previous section, merely feeling safe and understood is not enough for really effective coaching. It is also essential that the client is focused on positive forward-looking emotions that can motivate and sustain his or her change process.

Because effective coaches are predominantly in the DMN, and therefore open to the emotions of the client, they face a challenge. It is easy for the coach to get caught up in the problems, and associated negative emotions, that are often presented by the client. This may distress the coach and cause one of two problems: Either the coach may then stay in the DMN and start resonating with

the negative or difficult feelings of the client, creating a negative focus/tone to the coaching session, or a sense of urgency to remove the distress may lead the coach into a task-oriented TPN attempt to fix the problem for the client.

A more effective strategy is for the coach to be selective in his or her degree of empathic resonance. When negative emotions are being expressed, the coach should continue to listen; however, internally he or she should adopt a more distanced approach to the client, reminding one's self that the client's problems are not his or her own and that the best way to help the client is to avoid becoming distressed in order to have the emotional reserves needed to help the client move to more positive emotions. Hence, the coach selectively uses the TPN, just to get the distance necessary to be most helpful. French and Jack (2014) suggested a more extensive use of this distancing or "objectifying" strategy when individuals are engaged in high-conflict situations, such as layoffs or military combat conditions. However, unlike these situations, in coaching there is fortunately still an opportunity to fully connect with the client. Effective coaches create this opportunity by encouraging the client to envision a positive solution that helps resolve the problem. When positive emotions are being expressed, the coach can then fully empathize and resonate with the client (engaging the DMN and suppressing the TPN), so allowing the client to feel understood but in a way that selectively reinforces more positive emotions and hence constructive solutions. In this way, the coach can commit to helping the client in the manner that will prove most effective, while avoiding the trap of becoming too emotionally involved in the situation or attached to the outcome. This is better for the coach, who will not then suffer from depletion or compassion fatigue. It is important that the coach is aware that it is also better for the client. The consensus in the research community is now clear that venting of negative emotion is counterproductive, whereas refocusing on positive emotions is helpful (e.g., Dalebroux, Goldstein, & Winner, 2008).

Creating a Culture of Coaching

The book *How to Win Friends and Influence People* has been an inspiration for sales people and managers since Dale Carnegie wrote it in 1936. Yet the underlying assumption is that you can learn techniques to win people over to join you in some activity, side with you on a decision, or buy something you are selling. The approach was challenged by some in the 1960s and 1970s as crass and pushy—not genuine. The last 10 or more years has witnessed a stream of research in the leadership field called *authentic leadership*. It captures a set of characteristics the noted psychotherapist Carl Rogers promoted in the 1960s as necessary for an effective therapist and later for a good person (Rogers, 1961). Carnegie's approach reflects the more distanced or instrumental style of social cognition discussed in earlier sections, which is because of the activation of both the TPN and the DMN in tandem. In contrast, Rogers' approach reflects true empathy, in which the DMN is engaged and the TPN in suppressed.

Boyatzis and McKee (2005) claimed that effective leadership relationships are characterized as resonant rather than dissonant relationships. The parties feel in sync or in tune with each other. In contrast, dissonant leaders and relationships are often experienced as more instrumental, negative, or diminishing to each person. There is an effort by one person to do something to the other.

Effective coaching relationships have been shown to be more resonant (Van Oosten, 2013). The four experiences often associated with being in these relationships are hope through vision, caring through compassion, awareness through mindfulness, and joy through playfulness (Boyatzis & McKee, 2005; playfulness was added later, after 2009, when the research was consistent enough to include it). The design of the experimental arousal in the fMRI study described in the next section is based on this concept, which is a key part of ICT (Boyatzis, 2008). Additional coaching studies have further explored this and found that more resonant and PEA-embedded relationships result in more positive feelings about change, more committed goals, and more psychological energy expressed toward a future vision (Howard, 2015; Passarelli, 2015). In a study of banking executives, Van Oosten (2013) found that coaching relationships characterized by more PEA than NEA (i.e., more hope, compassion, and mindfulness) amplified the impact of emotional and social intelligence on effectiveness measures and engagement of executives in their work.

In an fMRI study of executives' reflections on moments in their lives with resonant versus dissonant leaders, Boyatzis et al. (2012) found that resonant leaders invoked many elements of the DMN even years after an event in all of the resonant relationships. However, only about one-third of the dissonant relationships invoked the same brain regions. The remainder of the dissonant relationships actually suppressed these DMN regions.

Consider the following implications for coaching.

Coaches need to focus on the quality of the relationship they are building with each person they are coaching. They need to be careful not to invoke the TPN too often, either because of a goal or problem-solving focus or a need to distance themselves from the client to avoid contagious distress from negative emotions. Engaging the TPN too often prevents a genuine social connection, and feelings of safety and trust, from emerging. This may be the most direct implication of the differences between what has been called *instrumental coaching or mentoring* and relational approaches. The former are helping the person by opening doors, making connections, or getting resources—all quite instrumental. The latter take a client-focused, relationship-based approach. And the latter, we contend as a result of understanding the neural mechanisms invoked, are more likely to help the other person engage in a sustained effort at learning or change.

Beyond one-on-one coaching, this issue may predict when and why peer coaching cannot only be effective but may sometimes be more sustained than working with a professional coach. Peer coaching, whether one-on-one or in small groups, functions like what used to be called *support groups*, or more frequently now called *study teams*. A small group of people, peers who may or may not be friends before the formation of the group, get together to help each other. The focus is wide, not just on work but on life in general. The quality of the relationships will reveal itself to be the most important factor in these groups working and sustaining their membership. Most organizations cannot afford to hire a sufficient number of professional coaches for all of their managers, let alone all professionals and other staff. Many organizations do not even offer the services to all executive-level managers. Under these constraints, peer coaching might be the only method to bring the benefits of coaching to large numbers of people in an organization. It also might hold the promise of changing organizational norms and culture if sufficient numbers of people engage in them. Peer coaching can be a transformative practice for the coach, providing the individual with valuable insight into how effective relationship-based approaches are and so helping to transform their overall management style to resonant leadership.

The Power to Change

Coaching aims to help individuals change their behavior. Yet behavior change can be tremendously difficult to achieve. This is highly evident, for instance, in the field of health care, where the issue is pressing because most of the cost of health care in the United States is spent on treating diseases that are entirely lifestyle-dependent and preventable. Hence, the National Institutes of Health have now devoted considerable effort and money to developing evidence-based approaches to behavior change (Ory, Lee Smith, Mier, & Wernicke, 2010).

One area of research in behavior change has been to look at the neural mechanisms that predict successful change in real-world behavior (Berkman & Falk, 2013). Although this is a newly emerging field of research, there is already some remarkable convergence—a number of studies have identified regions in the DMN, and particularly activation of the vmPFC, as being highly predictive of future behavior change (Chua et al., 2011; Chua, Liberzon, Welsh, & Strecher, 2009; Falk, Berkman, Mann, Harrison, & Lieberman, 2010; Falk, Berkman, Whalen, & Lieberman, 2011; Falk, O'Donnell, & Lieberman, 2012; Klucharev, Smidts, & Fernandez, 2008; Wang et al., 2013). This research fits well with research reviewed in an earlier section on the importance of safety learning, which leads to greater engagement of the parasympathetic nervous system and helps individuals tolerate the stress associated with change. This type of learning also involves the DMN and in particular the vmPFC (Eisenberger & Cole, 2012; Marstaller, Burianova, & Reutens, 2016). The vmPFC and closely connected ventral striatum regions also play a key role in creating a sense of affective meaning (Roy, Shohamy, & Wager, 2012), which provides the sustained motivation for

change. These brain regions are also associated with finding positive meaning in negative experiences, a form of emotional reappraisal (Dore et al., 2016).

How does this research on behavior change relate to coaching? In the first section, we discussed initial evidence that the vmPFC and ventral striatum are more engaged by PEA than by standard NEA coaching. This was a very promising initial study that fit with hypotheses generated by ICT. However, that study was not able to provide an experimental demonstration of a causal effect of coaching on engagement of these important brain regions. To provide clearer evidence for this, we conducted a second fMRI study several years later (Passarelli, Jack, Boyatzis, & Dawson, 2015). In the second study, 50 subjects, seniors and juniors, 25 males and 25 females, were given coaching sessions and a subsequent fMRI. To go beyond replication of the earlier findings, the design of this study included samples receiving the NEA coaching session only, the PEA coaching session only, two PEA coaching sessions, and three PEA coaching sessions (as before, each session was 30 min in duration). Because the number of PEA coaching sessions each participant would receive was randomly assigned, this allowed us to conduct a formal scientific test of the causal effect of repeated sessions on recruitment of these brain regions. More specifically, we were able to test for the existence of a dose-dependent effect of coaching on brain activation—a key criterion for establishing causation in epidemiological studies as outlined by Hill (1965).

As in the earlier study, a survey was sent to participants to assess their perception of the coaches. This confirmed subjects' reactions to the person doing the PEA and the one doing the NEA coaching. In this study, one of the coaches was the same as in the earlier study, and the other was a coach also in his 30s. Again, as in the last study, 3 to 5 days later, subjects were brought to the scanner where they were exposed to video statements made by the two coaches.

When we compared average neural responses to the two coaches in the scanner, the findings were extremely similar to the first study. Hence, we were able to replicate the first study with a larger sample, which was also much larger than the norm for brain-imaging studies (50 instead of 20 participants). However, as mentioned above, this study also allowed us to go further. Rather than just looking at the immediate effect of being coached in the PEA or NEA style, it allowed us to also examine the effect of prior coaching sessions. The findings were striking. We found a clear dose-dependent effect of prior PEA coaching on activity in the vmPFC and ventral striatum. The effect was not only highly significant but also linear and highly uniform, such that average response in these brain regions increased with each prior PEA coaching session. Furthermore, in line with findings that the vmPFC can help us to find positive meaning in negative emotional experiences, we also found a similar (but slightly less pronounced) increase in vmPFC activity when participants were responding to the NEA coach—as a function of the number of prior PEA coaching sessions. This finding is important, as it shows how first building a positive vision can help protect us from the stress of thinking about more painful topics—in other words, it can help us face our issues.

This second study also extended our prior research in other ways, because we were also able to add a second element to the design. We wanted to follow up on our hypothesis, suggested by the first study, that PEA coaching helps us to be more perceptually and cognitively open (i.e., to take a bigger-picture view). To do this, we added a separate part to the experiment; participants were asked to respond to visual stimuli (navon figures—large letters made up of smaller letters), and in separate blocks were asked either to focus in on the local fine details (the smaller letters) or to focus on the global big picture (the large letters). We then compared neural regions sensitive to these different types of visual attention and also neural regions sensitive to the difference between PEA and NEA coaching. Again, the follow-up study strongly supported our prior hypotheses. We found substantial overlap between PEA coaching and global perception and between NEA coaching and local perception (Passarelli et al., 2015).

Consider the following implications for coaching.

To sustain the effort at learning or change, a person must make an effort and a sustained effort. With competing demands and pressure, unless a change is deeply desired, it will atrophy in importance. New Year's Eve resolutions fall into this category. Such goals, like exercising more often, are more a reflection of a person's ought self, what they should do or how they should change (Boyatzis, 2008). Unfortunately, it is this motivation that most health-care providers and most

coaches tend to evoke. However, this approach pushes people into the NEA that not only reduces their motivation but also their perceptual field and openness. If the effort is merely instrumental (i.e., it is needed to achieve or do something else, or to please others, rather than being desired as an end in itself), the change or learning will diminish over time.

Effective coaching involves first asking the participant to take a broader, more forward-looking and positively focused view. This is important because otherwise individuals tend to get caught up in the negative issues that seem important at the time but that can be seen to be inconsequential in a broader context. A broader focus allows individuals to see what really matters most to them and then to turn this into a vision that can motivate them going forward and provide them with a stronger sense of meaning in life. This in turn allows individuals to cope better with the stress of change and to sustain their personal development.

References

- Amodio, D. M., & Frith, C. D. (2006). Meeting of minds: The medial frontal cortex and social cognition. *Nature Reviews Neuroscience*, 7, 268–277. <http://dx.doi.org/10.1038/nrn1884>
- Anticevic, A., Cole, M. W., Murray, J. D., Corlett, P. R., Wang, X. J., & Krystal, J. H. (2012). The role of default network deactivation in cognition and disease. *Trends in Cognitive Sciences*, 16, 584–592. <http://dx.doi.org/10.1016/j.tics.2012.10.008>
- Beaty, R. E., Benedek, M., Wilkins, R. W., Jauk, E., Fink, A., Silvia, P. J., . . . Neubauer, A. C. (2014). Creativity and the default network: A functional connectivity analysis of the creative brain at rest. *Neuropsychologia*, 64, 92–98. <http://dx.doi.org/10.1016/j.neuropsychologia.2014.09.019>
- Berkman, E. T., & Falk, E. B. (2013). Beyond brain mapping: Using neural measures to predict real-world outcomes. *Current Directions in Psychological Science*, 22, 45–50. <http://dx.doi.org/10.1177/0963721412469394>
- Bernhardt, B. C., & Singer, T. (2012). The neural basis of empathy. *Annual Review of Neuroscience*, 35, 1–23. <http://dx.doi.org/10.1146/annurev-neuro-062111-150536>
- Boyatzis, R. E. (2008). Leadership development from a complexity perspective. *Consulting Psychology Journal: Practice and Research*, 60, 298–313. <http://dx.doi.org/10.1037/1065-9293.60.4.298>
- Boyatzis, R. E., & McKee, A. (2005). *Resonant leadership: Renewing yourself and connecting with others through mindfulness, hope, and compassion*. Boston, MA: Harvard Business School Press.
- Boyatzis, R. E., Passarelli, A. M., Koenig, K., Lowe, M., Mathew, B., Stoller, J. K., & Phillips, M. (2012). Examination of the neural substrates activated in memories of experiences with resonant and dissonant leaders. *The Leadership Quarterly*, 23, 259–272. <http://dx.doi.org/10.1016/j.leaqua.2011.08.003>
- Boyatzis, R. E., Rochford, K., & Jack, A. I. (2014). Antagonistic neural networks underlying differentiated leadership roles. *Frontiers in Human Neuroscience*, 8, 114. <http://dx.doi.org/10.3389/fnhum.2014.00114>
- Boyatzis, R. E., Rochford, K., & Taylor, S. N. (2015). The role of the positive emotional attractor in vision and shared vision: Toward effective leadership, relationships, and engagement. *Frontiers in Psychology*, 6, 670. <http://dx.doi.org/10.3389/fpsyg.2015.00670>
- Boyatzis, R. E., Smith, M. L., & Beveridge, A. J. (2013). Coaching with compassion: Inspiring health, well-being, and development in organizations. *The Journal of Applied Behavioral Science*, 49, 153–178. <http://dx.doi.org/10.1177/0021886312462236>
- Brookshire, G., & Casasanto, D. (2012). Motivation and motor control: Hemispheric specialization for approach motivation reverses with handedness. *PLoS ONE*, 7, e36036. <http://dx.doi.org/10.1371/journal.pone.0036036>
- Broyd, S. J., Demanuele, C., Debener, S., Helps, S. K., James, C. J., & Sonuga-Barke, E. J. (2009). Default-mode brain dysfunction in mental disorders: A systematic review. *Neuroscience and Biobehavioral Reviews*, 33, 279–296. <http://dx.doi.org/10.1016/j.neubiorev.2008.09.002>
- Buckner, R. L., Andrews-Hanna, J. R., & Schacter, D. L. (2008). The brain's default network. *Annals of the New York Academy of Sciences*, 1124, 1–38. <http://dx.doi.org/10.1196/annals.1440.011>
- Bzdok, D., Schilbach, L., Vogeley, K., Schneider, K., Laird, A. R., Langner, R., & Eickhoff, S. B. (2012). Parsing the neural correlates of moral cognition: ALE meta-analysis on morality, theory of mind, and empathy. *Brain Structure and Function*, 217, 783–796. <http://dx.doi.org/10.1007/s00429-012-0380-y>
- Camerer, C., & Lovallo, D. (1999). Overconfidence and excess entry: An experimental approach. *The American Economic Review*, 89, 306–318. <http://dx.doi.org/10.1257/aer.89.1.306>
- Chua, H. F., Ho, S. S., Jasinska, A. J., Polk, T. A., Welsh, R. C., Liberzon, I., & Strecher, V. J. (2011). Self-related neural response to tailored smoking-cessation messages predicts quitting. *Nature Neuroscience*, 14, 426–427. <http://dx.doi.org/10.1038/nn.2761>

- Chua, H. F., Liberzon, I., Welsh, R. C., & Strecher, V. J. (2009). Neural correlates of message tailoring and self-relatedness in smoking cessation programming. *Biological Psychiatry*, 65, 165–168. <http://dx.doi.org/10.1016/j.biopsych.2008.08.030>
- Corbetta, M., Akbudak, E., Conturo, T. E., Snyder, A. Z., Ollinger, J. M., Drury, H. A., . . . Shulman, G. L. (1998). A common network of functional areas for attention and eye movements. *Neuron*, 21, 761–773. [http://dx.doi.org/10.1016/S0896-6273\(00\)80593-0](http://dx.doi.org/10.1016/S0896-6273(00)80593-0)
- Dalebroux, A., Goldstein, T. R., & Winner, E. (2008). Short-term mood repair through art-making: Attention redeployment is more effective than venting. *Motivation and Emotion*, 32, 288–295. <http://dx.doi.org/10.1007/s11031-008-9105-1>
- Davidson, R. J. (1992). Anterior cerebral asymmetry and the nature of emotion. *Brain and Cognition*, 20, 125–151. [http://dx.doi.org/10.1016/0278-2626\(92\)90065-T](http://dx.doi.org/10.1016/0278-2626(92)90065-T)
- Decety, J., & Michalska, K. J. (2010). Neurodevelopmental changes in the circuits underlying empathy and sympathy from childhood to adulthood. *Developmental Science*, 13, 886–899. <http://dx.doi.org/10.1111/j.1467-7687.2009.00940.x>
- Denny, B. T., Kober, H., Wager, T. D., & Ochsner, K. N. (2012). A meta-analysis of functional neuroimaging studies of self and other judgments reveals a spatial gradient for mentalizing in medial prefrontal cortex. *Journal of Cognitive Neuroscience*, 24, 1742–1752. http://dx.doi.org/10.1162/jocn_a_00233
- Dore, B. P., Boccagno, C., Burr, D., Hubbard, A., Long, K., Weber, J., . . . Ochsner, K. N. (2016). Finding positive meaning in negative experiences engages ventral striatal and ventromedial prefrontal reward regions. *Journal of Cognitive Neuroscience*, 29, 235–244.
- Duncan, J., & Owen, A. M. (2000). Common regions of the human frontal lobe recruited by diverse cognitive demands. *Trends in Neurosciences*, 23, 475–483. [http://dx.doi.org/10.1016/S0166-2236\(00\)01633-7](http://dx.doi.org/10.1016/S0166-2236(00)01633-7)
- Eisenberger, N. I., & Cole, S. W. (2012). Social neuroscience and health: Neurophysiological mechanisms linking social ties with physical health. *Nature Neuroscience*, 15, 669–674. <http://dx.doi.org/10.1038/nn.3086nn>
- Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, 8, 294–300. <http://dx.doi.org/10.1016/j.tics.2004.05.010>
- Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology*, 71, 390–405. <http://dx.doi.org/10.1037/0022-3514.71.2.390>
- Falk, E. B., Berkman, E. T., Mann, T., Harrison, B., & Lieberman, M. D. (2010). Predicting persuasion-induced behavior change from the brain. *The Journal of Neuroscience*, 30, 8421–8424. <http://dx.doi.org/10.1523/JNEUROSCI.0063-10.2010>
- Falk, E. B., Berkman, E. T., Whalen, D., & Lieberman, M. D. (2011). Neural activity during health messaging predicts reductions in smoking above and beyond self-report. *Health Psychology*, 30, 177–185. <http://dx.doi.org/10.1037/a0022259>
- Falk, E. B., O'Donnell, M. B., & Lieberman, M. D. (2012). Getting the word out: Neural correlates of enthusiastic message propagation. *Frontiers in Human Neuroscience*, 6, 313. <http://dx.doi.org/10.3389/fnhum.2012.00313>
- Fischer, J., Mikhael, J. G., Tenenbaum, J. B., & Kanwisher, N. (2016). Functional neuroanatomy of intuitive physical inference. *Proceedings of the National Academy of Sciences of the United States of America*, 113, E5072–E5081. <http://dx.doi.org/10.1073/pnas.1610344113>
- Fox, M. D., Snyder, A. Z., Vincent, J. L., Corbetta, M., Van Essen, D. C., & Raichle, M. E. (2005). The human brain is intrinsically organized into dynamic, anti-correlated functional networks. *Proceedings of the National Academy of Sciences of the United States of America*, 102, 9673–9678. <http://dx.doi.org/10.1073/pnas>
- Fredrickson, B. (2009). *Positivity: Top-notch research reveals the 3 to 1 ratio that will change your life*. New York, NY: Crown Publishing Group.
- French, S. E., & Jack, A. I. (2014). Dehumanizing the enemy: The intersection of neuroethics and military ethics. In D. Whetham (Ed.), *The responsibility to protect: Alternative perspectives* (pp. 169–175). Leiden, the Netherlands: Martinus Nijhoff.
- Friedman, J., Jack, A. I., Rochford, K., & Boyatzis, R. (2015). Antagonistic neural networks underlying organizational behavior. *Monographs in Leadership and Management*, 7, 115–141.
- Gallagher, H. L., Jack, A. I., Roepstorff, A., & Frith, C. D. (2002). Imaging the intentional stance in a competitive game. *NeuroImage*, 16, 814–821.
- Goel, V. (2007). Anatomy of deductive reasoning. *Trends in Cognitive Sciences*, 11, 435–441.
- Gottman, J. M., Murray, J. D., Swanson, C. C., Tyson, R., & Swanson, K. R. (2002). *The mathematics of marriage: Dynamic non-linear models*. Cambridge, MA: MIT Press.

- Hahn, A., Stein, P., Windischberger, C., Weissenbacher, A., Spindelegger, C., Moser, E., . . . Lanzenberger, R. (2011). Reduced resting-state functional connectivity between amygdala and orbitofrontal cortex in social anxiety disorder. *NeuroImage*, 56, 881–889. <http://dx.doi.org/10.1016/j.neuroimage.2011.02.064>
- Hamilton, J. P., Farmer, M., Fogelman, P., & Gotlib, I. H. (2015). Depressive rumination, the default-mode network, and the dark matter of clinical neuroscience. *Biological Psychiatry*, 78, 224–230. ISSN: 0006–3223; <http://dx.doi.org/10.1016/j.biopsych.2015.02.020>
- Hill, A. B. (1965). The environment and disease: Association or causation? *Proceedings of the Royal Society of Medicine*, 58, 295–300.
- Hill, J., Inder, T., Neil, J., Dierker, D., Harwell, J., & Van Essen, D. (2010). Similar patterns of cortical expansion during human development and evolution. *Proceedings of the National Academy of Sciences of the United States of America*, 107, 13135–13140. <http://dx.doi.org/10.1073/pnas.1001229107>
- Howard, A. (2015). Coaching to vision of mid-career dentists. *Frontiers in Psychology*, 5, 1335.
- Huth, A. G., de Heer, W. A., Griffiths, T. L., Theunissen, F. E., & Gallant, J. L. (2016). Natural speech reveals the semantic maps that tile human cerebral cortex. *Nature*, 532, 453–458. <http://dx.doi.org/10.1038/nature17637>
- Jack, A. I., Boyatzis, R. E., Khawaja, M. S., Passarelli, A. M., & Leckie, R. L. (2013). Visioning in the brain: An fMRI study of inspirational coaching and mentoring. *Social Neuroscience*, 8, 369–384. <http://dx.doi.org/10.1080/17470919.2013.808259>
- Jack, A. I., Dawson, A. J., Begany, K. L., Leckie, R. L., Barry, K. P., Ciccio, A. H., & Snyder, A. Z. (2012). fMRI reveals reciprocal inhibition between social and physical cognitive domains. *NeuroImage*, 66C, 385–401. <http://dx.doi.org/10.1016/j.neuroimage.2012.10.061>
- Jack, A. I., Dawson, A. J., & Norr, M. E. (2013). Seeing human: Distinct and overlapping neural signatures associated with two forms of dehumanization. *NeuroImage*, 79, 313–328. <http://dx.doi.org/10.1016/j.neuroimage.2013.04.109>
- Jack, A. I., Friedman, J., Taylor, S., & Boyatzis, R. E. (2016). Why do you believe in God? Relationships between religious belief, analytic thinking, mentalizing and moral concern. *PLoS ONE*, 11, e0149989.
- Kim, M. J., Gee, D. G., Loucks, R. A., Davis, F. C., & Whalen, P. J. (2011). Anxiety dissociates dorsal and ventral medial prefrontal cortex functional connectivity with the amygdala at rest. *Cerebral Cortex*, 21, 1667–1673. <http://dx.doi.org/10.1093/cercor/bhq237>
- Klucharev, V., Smidts, A., & Fernández, G. (2008). Brain mechanisms of persuasion: How ‘expert power’ modulates memory and attitudes. *Social Cognitive and Affective Neuroscience*, 3, 353–366. <http://dx.doi.org/10.1093/scan/nsn022>
- Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.
- Lamm, C., Batson, C. D., & Decety, J. (2007). The neural substrate of human empathy: Effects of perspective-taking and cognitive appraisal. *Journal of Cognitive Neuroscience*, 19, 42–58. <http://dx.doi.org/10.1162/jocn.2007.19.1.42>
- Marstaller, L., Burianová, H., & Reutens, D. C. (2016). Dynamic competition between large-scale functional networks differentiates fear conditioning and extinction in humans. *NeuroImage*, 134, 314–319. <http://dx.doi.org/10.1016/j.neuroimage.2016.04.008>
- Martin, A., & Weisberg, J. (2003). Neural foundations for understanding social and mechanical concepts. *Cognitive Neuropsychology*, 20, 575–587. <http://dx.doi.org/10.1080/02643290342000005>
- Morrison, I., Lloyd, D., di Pellegrino, G., & Roberts, N. (2004). Vicarious responses to pain in anterior cingulate cortex: Is empathy a multisensory issue? *Cognitive, Affective & Behavioral Neuroscience*, 4, 270–278. <http://dx.doi.org/10.3758/CABN.4.2.270>
- Ochsner, K. N., Silvers, J. A., & Buhle, J. T. (2012). Functional imaging studies of emotion regulation: A synthetic review and evolving model of the cognitive control of emotion. *Annals of the New York Academy of Sciences*, 1251, E1–E24. <http://dx.doi.org/10.1111/j.1749-6632.2012.06751.x>
- Ory, M. G., Lee Smith, M., Mier, N., & Wernicke, M. M. (2010). The science of sustaining health behavior change: The health maintenance consortium. *American Journal of Health Behavior*, 34, 647–659. <http://dx.doi.org/10.5993/AJHB.34.6.2>
- Passarelli, A. (2015). The neuro-emotional basis of developing leaders through personal vision. *Frontiers in Psychology*, 5, 1335.
- Passarelli, A., Jack, A., Boyatzis, R. E., & Dawson, A. J. (2015). *Neuroimaging reveals link between vision and coaching for intentional change*. Presented at the Annual Meeting of the Academy of Management, 2015.
- Pink, D. H. (2009). *Drive: The surprising truth about what motivates us*. New York, NY: Riverhead Books.
- Prabhakaran, V., Smith, J. A., Desmond, J. E., Glover, G. H., & Gabrieli, J. D. (1997). Neural substrates of fluid

- reasoning: An fMRI study of neocortical activation during performance of the Raven's Progressive Matrices Test. *Cognitive Psychology*, 33, 43–63. <http://dx.doi.org/10.1006/cogp.1997.0659>
- Pyka, M., Beckmann, C. F., Schöning, S., Hauke, S., Heider, D., Kugel, H., . . . Konrad, C. (2009). Impact of working memory load on fMRI resting state pattern in subsequent resting phases. *PLoS ONE*, 4, e7198. <http://dx.doi.org/10.1371/journal.pone.0007198>
- Raichle, M. E. (2010). Two views of brain function. *Trends in Cognitive Sciences*, 14, 180–190. <http://dx.doi.org/10.1016/j.tics.2010.01.008>
- Reniers, R. L., Corcoran, R., Völlm, B. A., Mashru, A., Howard, R., & Liddle, P. F. (2012). Moral decision-making, ToM, empathy and the default mode network. *Biological Psychology*, 90, 202–210. <http://dx.doi.org/10.1016/j.biopsycho.2012.03.009>
- Rochford, K. C., Jack, A. I., Boyatzis, R. E., & French, S. E. (2016). Ethical leadership as a balance between opposing neural networks. *Journal of Business Ethics*. Advance online publication. <http://dx.doi.org/10.1007/s10551-016-3264-x>
- Roy, M., Shohamy, D., & Wager, T. D. (2012). Ventromedial prefrontal-subcortical systems and the generation of affective meaning. *Trends in Cognitive Sciences*, 16, 147–156. <http://dx.doi.org/10.1016/j.tics.2012.01.005>
- Rogers, C. (1961). *On becoming a person: A therapist's view of psychotherapy*. New York, NY: Houghton Mifflin.
- Scheinost, D., Finn, E. S., Tokoglu, F., Shen, X., Papademetris, X., Hampson, M., & Constable, R. T. (2015). Sex differences in normal age trajectories of functional brain networks. *Human Brain Mapping*, 36, 1524–1535. <http://dx.doi.org/10.1002/hbm.22720>
- Schilbach, L., Eickhoff, S. B., Rotarska-Jagiela, A., Fink, G. R., & Vogeley, K. (2008). Minds at rest? Social cognition as the default mode of cognizing and its putative relationship to the “default system” of the brain. *Consciousness and Cognition*, 17, 457–467. <http://dx.doi.org/10.1016/j.concog.2008.03.013>
- Schilbach, L., Timmermans, B., Reddy, V., Costall, A., Bente, G., Schlicht, T., & Vogeley, K. (2013). Toward a second-person neuroscience. *Behavioral and Brain Sciences*, 36, 393–414. <http://dx.doi.org/10.1017/S0140525X12000660>
- Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology*, 95, 1526–1540. <http://dx.doi.org/10.1037/a0013345>
- Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and health: Psychological, behavioral, and biological determinants. [NIH-PA]. *Annual Review of Clinical Psychology*, 1, 607–628. <http://dx.doi.org/10.1146/annurev.clinpsy.1.102803.144141>
- Shulman, G. L., Fiez, J. A., Corbetta, M., Buckner, R. L., Miezin, F. M., Raichle, M. E., & Petersen, S. E. (1997). Common blood flow changes across visual tasks: II. Decreases in cerebral cortex. *Journal of Cognitive Neuroscience*, 9, 648–663.
- Silvers, J. A., Wager, T. D., Weber, J., & Ochsner, K. N. (2015). The neural bases of uninstructed negative emotion modulation. *Social Cognitive and Affective Neuroscience*, 10, 10–18. <http://dx.doi.org/10.1093/scan/nsu016>
- Silvers, J. A., Weber, J., Wager, T. D., & Ochsner, K. N. (2015). Bad and worse: Neural systems underlying reappraisal of high- and low-intensity negative emotions. *Social Cognitive and Affective Neuroscience*, 10, 172–179. <http://dx.doi.org/10.1093/scan/nsu043>
- Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. *Neuroscience and Biobehavioral Reviews*, 30, 855–863. <http://dx.doi.org/10.1016/j.neubiorev.2006.06.011>
- Snow, C. P. (1959). *The two cultures and the scientific revolution*. New York, NY: Cambridge University Press.
- Spielberg, J. M., Stewart, J. L., Levin, R. L., Miller, G. A., & Heller, W. (2008). Prefrontal cortex, emotion, and approach/withdrawal motivation. *Social and Personality Psychology Compass*, 2, 135–153. <http://dx.doi.org/10.1111/j.1751-9004.2007.00064.x>
- Sporns, O. (2014). Contributions and challenges for network models in cognitive neuroscience. *Nature Neuroscience*, 17, 652–660. <http://dx.doi.org/10.1038/nn.3690>
- Van Ast, V. A., Spicer, J., Smith, E. E., Schmer-Galunder, S., Liberzon, J., Abelson, J. L., & Wager, T. D. (2016). Brain mechanisms of social threat effects on working memory. *Cerebral Cortex*, 26, 544–556. <http://dx.doi.org/10.1093/cercor/bhu206>
- Van Oosten, E. (2013). *The impact of emotional intelligence and executive coaching on leader effectiveness* (Unpublished doctoral dissertation). Case Western Reserve University, Cleveland, OH.
- Van Overwalle, F. (2009). Social cognition and the brain: A meta-analysis. *Human Brain Mapping*, 30, 829–858. <http://dx.doi.org/10.1002/hbm.20547>

- Van Overwalle, F. (2010). A dissociation between social mentalizing and general reasoning. *NeuroImage*, 54, 1589–1599.
- Vincent, J. L., Patel, G. H., Fox, M. D., Snyder, A. Z., Baker, J. T., Van Essen, D. C., . . . Raichle, M. E. (2007). Intrinsic functional architecture in the anaesthetized monkey brain. *Nature*, 447, 83–86. <http://dx.doi.org/10.1038/nature05758>
- Wang, A. L., Ruparel, K., Loughead, J. W., Strasser, A. A., Blady, S. J., Lynch, K. G., . . . Langleben, D. D. (2013). Content matters: Neuroimaging investigation of brain and behavioral impact of televised anti-tobacco public service announcements. *The Journal of Neuroscience*, 33, 7420–7427. <http://dx.doi.org/10.1523/JNEUROSCI.3840-12.2013>

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