NEUROMANAGEMENT

People and Organizations

Edited by Michela Balconi

LED Edizioni Universitarie di Lettere Economia Diritto

IrcCAN
International Research Center for Cognitive Applied Neuroscience

ISSN 2724-3540
ISBN 978-88-7916-952-3

LED Edizioni Universitarie di Lettere Economia Diritto
Via Cervignano 4 - 20137 Milano
https://www.lededizioni.com
https://www.ledonline.it/neuropsychologicaltrends/

Printed by Logo

Index

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Leader brains? How to discover them, how to empower them

Michela Balconi [1,2]

[1] *International Research Center for Cognitive Applied Neuroscience (IrcCAN), Catholic University of the Sacred Heart, Milan, Italy*

[2] *Research Unit in Affective and Social Neuroscience, Department of Psychology, Catholic University of the Sacred Heart, Milan, Italy*

DOI: https://dx.doi.org/10.7359/952-2020-bal2 michela.balconi@unicatt.it

---

1. Leadership and neuroleadership

We can define the overall leadership capacity as a form of social capital that involves the sharedness, distributedness, and connectivity of members of the entity. To begin, Pearce and Conger (2003) defined shared leadership in terms of a dynamic process of mutual influence among peers or individuals at differing hierarchical levels in an organization.

Considering the complexity of organizational dynamics, and the presence of mechanisms related to emotions, goals, intentions, expectations, and cognitive bias, recent research in the field of leadership has increasingly embodied a neuroscientific approach.

Indeed, social and affective neuroscience developed and increasingly perfected its methods to permit a broader and more in depth understanding of the way people interact with each other, including empathic and emotional mechanisms and leadership style (Balconi & Canavesio, 2013a; Balconi & Canavesio, 2013b; Balconi, Cassioli, Fronda, & Vanutelli, 2019; Balconi & Vanutelli, 2017; Balconi, Venturella, Fronda, & Vanutelli, 2019, 2020; Paulus et al., 2009; Vanutelli, Gatti, Angioletti, & Balconi, 2017).

In this research field, during the last years, some different approaches, aimed to identify effective leadership profiles, have outlined the most salient features and development trajectories. In particular, two models have spread widely: the "inspirational" leader model (Waldman, Wang, Hannah, & Balthazard, 2017) and the "generative" leader model (Balconi, Fronda, Natale, & Rimoldi, 2017b; Venturella & Balconi, 2017).

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

2. The "inspirational" leader

Various theories share the view that outstanding leaders go beyond simple performance-versus-reward transactions and have a deep impact on their followers and their organizations, including the potential to be a major force in realizing new visions and change. Inspirational leadership behavior was defined as a type of behavior that is emphasized in many of today's contemporary leadership theories, such as transformational, charismatic, and visionary paradigms. Inspirational leaders articulate a vision that is based on strongly held ideological values that cause people to become energized and to identify with the vision (e.g., Conger & Kanungo, 1998). The ability to inspire is considered fundamental to establishing a high degree of follower confidence, intrinsic motivation, and trust and admiration in the leader.

More specifically, vision can be delineated in terms of a socialized versus personalized continuum. Socialized vision is characterized by such elements as altruism and social responsibility, the inclusion of empowered followers as a necessary component to organizational success, and a focus on serving the interests and goals of the group (House & Howell, 1992). Therefore, socialized vision leads to outcomes and processes that benefit followers as well as outside stakeholders such as the larger community or even nation in which a firm resides. In contrast, personalized vision is largely narcissistic and is characterized by self-interest, an over-emphasis on the leader (rather than others) in achieving organizational outcomes, and an obsession with authority and achieving dominance over competition.

In a recent research, functional Magnetic Resonance Imaging (fMRI) was used to examine the neuroscientific substrates of leader followers' responses as a function of (a) inspirational statements (inspirational collective oriented vs. non-inspirational personal oriented; Howell & Shamir, 2005) and (b) shared group membership between followers and leaders (Haslam, Reicher, & Platow, 2011). This approach provided a more comprehensive picture of the link between leaders and followers with a view to shedding light on the neurological mechanisms that underlie followers' responses to inspirational leadership. Second, it extends previous research on the neuroscience of leadership that has provided evidence from electroencephalogram (EEG) data of the role of varying degrees of general brain connectivity and leadership effectiveness (Waldman, Balthazard, & Peterson, 2011). Through the application of fMRI, the research was able to examine the role of more detailed and precise brain areas and mechanisms that are involved in the processing of inspirational leader messages.

In this respect, categorization of self and others in terms of a relevant shared social identity (e.g., as "us leadership scholars") is the basis for social influence and the cornerstone of leadership and followership processes. For instance, research has indicated that when followers perceive themselves to share group membership with a given leader, they are more likely (a) to be influenced by the leader's proposals, (b) to support the leader, (c) to perceive the leader as charismatic, and (d) to respond creatively to what the leader

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

has to say. Similarly, it was suggested that the neural networks involved in controlling semantic processing will be differentially implicated in followers' responses to collective-oriented inspirational messages as a function of the shared group membership between leader and follower. Research in cognitive psychology has shown that people tend to have a preference to encode information that is in agreement with their existing beliefs, a phenomenon known as confirmation bias (Nickerson, 1998). In particular, people represent information in schemas (cognitive categories that represent prototypical instances of a given stimulus) and use these to selectively encode information to which they are exposed. Relevant to this study, previous research informed by leader categorization theory has shown that followers have schemas about what leaders are like that they then use to selectively encode information received from a particular leader (Shondrick, Dinh, & Lord, 2010).

It was found that when people recalled memories associated with resonant rather than dissonant leaders, they showed greater activation in brain areas such as the bilateral insula, right inferior parietal lobe, and left superior temporal gyrus. Beyond this, however, previous neuroscience research has focused mainly on testing the neurological substrates of leaders' activities. In particular, research has used power spectral analysis measures based on EEG to differentiate the brain activity of leaders who have a complex representation of their self-concept from that of leaders with a less complex representation.

3. The "generative" leader

One of the most important focus of recent research was devoted to leadership and its different features, such as transformational (Ashkanasy, 2013) and generative leadership (Balconi et al., 2017b). For example, it was found that transformational leader behavior, to be effective, has to combine emotional balance and self-control, emotional understanding by the leader of the followers' needs, foresight and insight, communication skills (Balthazard, Waldman, Thatcher, & Hannah, 2012).

This interest is due to the extent to explore new ways of managing, which consider more supportive and interpersonal exchange. For example, the results of previous research showed how cooperative leadership has positive effects not only within the individual performance, but also within work group and organization (Judge & Piccolo, 2004). In particular, it has been observed that a more cooperative style of leadership encourages interactions between colleagues, thus bringing a greater performance of the individual and its commitment toward the company (Bass & Bass, 2009).

Previous neuroscience studies about cooperative leadership processes tried to detect the markers of a generative style of leadership, finding the activation of some brain areas that seem involved in the interaction processes. For example, the frontal lobes appear to be good predictors of functional leadership behaviors (Balthazard et al., 2012). This area, in

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

fact, appears to be involved in executive functioning and monitoring, such as self-regulation, planning and organization of behaviors. Furthermore, the frontal cortex integrates external and internal sensory information, organizing it temporally and transforming it into complex behavioral response patterns, which are the basis of the leadership processes (Case, 1992; Fuster, 1999). In fact, leaders need a great ability to regulate and monitor others' and their own behavior. Indeed, prefrontal cortex supports behavioral, affective, social and cognitive components during interpersonal exchange (Levitan, Hasey, & Sloman, 2000). Moreover, the recruitment of such regions was previously identified in cooperative social tasks during significant joint performance (Balconi, Crivelli, & Vanutelli, 2017a; Balconi, Pezard, Nandrino, & Vanutelli, 2017c; Balconi & Pozzoli, 2005). The involvement of these regions in social interactions highlights the use of top-down control mechanisms for particular emotional responses related to social events (Marsh, Blair, Jones, Soliman, & Blair, 2009).

A further level of analysis regards leader's communication modalities related to different styles of leadership. Specifically, concerning the authoritarian style of leadership, communication appears to be self-centered, leading to good productivity but often to the experimentation of unmotivated and dissatisfied states in employees that depend by the boss. On the contrary, the democratic and participative style of leadership is characterized by the co-participation in decision-making and by the involvement of others in communication, that is considered as a constructive part of the relationship, entail a greater level of motivation and satisfaction within the team.

On another side, several studies demonstrate that leaders' emotional expression can influence employees, motivating them (Balconi & Venturella, 2015). In particular, the choice of modalities and timing to inspire others through emotions requires a good level of emotional intelligence (Goleman, Boyatzis, & McKee, 2002). Indeed, leaders with high emotional intelligence can empathize better with employees and express their emotions during an interaction in a more appropriate way (Mayer, Salovey, & Caruso, 2008). One of the main advantages offered by the neuroscientific approach, that allows the knowledge of the deep brain processes related to a specific behavior, concern the fact that it is possible to interpret the implicit elements of individuals' mental processes intervening on them in a manner favorable way for the organizational context (Balconi & Vanutelli, 2016; Balconi, Finocchiaro, & Campanella, 2014). In this regard, the neuroscience tools that have been more frequently used to investigate implicit levels of behavior, such as: the EEG, a technique that allows recording brain electrical activity changes with an excellent temporal resolution; the functional Near-Infrared Spectroscopy (fNIRS), a tool based on near-infrared technology providing a measure of cerebral hemodynamic activity with good temporal and spatial resolution; the biofeedback, a system used to measure autonomic indices (skin conductance, heart rate, blood pressure, etc.), which provide information about individuals' arousal state and emotional engagement, as well as on the contribution of implicit mechanisms and automatic reactions in more complex processes; the Transcranial Magnetic Stimulation (TMS) which allows explaining in depth the neural

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

correlates of cognitive, emotional and communicative processes (Balconi & Venturella, 2015).

Another approach for neuroscientific applied research was then recently outlined: the hyperscanning paradigm. Recent studies have applied the hyperscanning paradigm to the leadership field, highlighting social neuroscience's potential for this domain. The best example of what has been called a "second person" social neuroscience (Schilbach, 2010) is the hyperscanning technique, a realistic and ecological paradigm that allows to simultaneously record the cortical activity from two or more participants interacting together. This way, people and their brain activities are no longer considered individually, but part of complex dynamics that continuously adjust and contaminate each other. The hyperscanning paradigms, therefore, consist in the simultaneous recording of two individuals' brain and/or body activity during a shared interactive task (Balconi & Vanutelli, 2016; Balconi, Gatti, & Vanutelli, 2018; Montague et al., 2002).

The two following examples synthesize some recent results based on hyperscanning applications on leadership domain.

3.1 Role of the leadership style in employees' assessment

From these reflections, a recent study shows that a hyperscanning paradigm was used to investigate interpersonal dynamics, and related psychophysiological correlates underlying an important phase of managerial direction regarding the employees' assessment. Considering the distinction between a cooperative or an authoritarian leadership style, particular attention was given to the communication between leader and employee.

Thanks to the simultaneous recording of EEG and biofeedback, behavioral and psychophysiological markers underlying leader-employee interaction were identified, with the final aim of identifying more functional and useful leadership styles. In particular, different patterns of neural synchronization were hypothesized in association with different leadership styles, company roles, and relevant issues that emerged from the assessment.

Specifically, the procedure included an assessment conducted by a manager with the involvement of one of his employees, carried out through the role-playing technique. In particular, managers were previously instructed on the leadership style to be adopted: some should have used a responsive and participative leadership style, while others should have used an authoritarian style of leadership characterized by a more directive communication.

During the assessment involving leader-employee dyads, cortical activity was recorded through two-portable EEG systems, while autonomic activity (such as heartbeat or skin conductance) was recorded using biofeedback. Among the various mechanisms identified, the ability of individuals to synthonize themselves during the interaction represents a critical point for the construction of solid and productive relationships (Balconi, Bortolotti, & Gonzaga, 2011; Balconi & Canavesio, 2013).

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

This literature, together with the evidence about the association between long-lasting high arousal levels and physiological distress, brings attention to the influence that a style of communication and leadership can have on workers' organism and health, as well as on the role of the leader in modulating the employees' stress levels. Considering this evidence, the presence of a charismatic and generative leader is usually associated with lower levels of stress; instead, the presence of an authoritarian leader is associated with a more stressful climate (De Hoogh & Den Hartog, 2008). To sum up, it has been shown that a functional and mutual understanding needs a certain level of consonance among participants, which can be prompted by empathic mechanisms (Preston & de Waal, 2002; Vanutelli & Balconi, 2015). Empathy refers to the capacity to perceive, understand and share others' affective response, as well as to respond accordingly (Balconi & Bortolotti, 2012; Balconi & Canavesio, 2013a). This ability is fundamental for social species like humans with the necessity to create meaningful social bonds, with subsequent positive effects such as self-satisfaction and mental and physical well-being and reduced personal distress.

3.2 Leader-employee emotional "interpersonal tuning"

A second main recent research question concerned if and how the presence of a quantitative rating in performance review could influence the relationship between the leader and employee. It was suggested that being scored could involve emotional and cognitive processes triggered by the perception of an asymmetrical dynamic and generate negative feelings. Traditionally, the rating was thought to help employees improving their performance (Dixon, Rock, & Ochsner, 2010), but in a meta-analysis, Kluger and DeNisi (1996) showed how feedback interventions were associated with performance improvement in less of half cases. More specifically, Rock (2008) has hypothesized the possibility of considering the evaluation as a threat because it foresees a judgment on the ranking and a subsequent sense of status. This represents a relevant point, considering that fear and threat involve a condition defined as social pain (Lieberman & Eisenberger, 2008), related to a more negative working condition. Starting from this, organizations recently tried to renew traditional management feedbacks in favor of new forms of performance assessment. A central point of this renewal derives from a possible differential effect of quantitative and qualitative feedback. In fact, as shown by Smither and Walker (2004), empirical findings revealed that a more qualitative (narrative) approach engages employees' attention more than quantitative comments.

Thus, in one our recent study we investigated if the use of a quantitative rating could impair inter-brain tuning, which can be considered a neural marker of interpersonal tuning.

Specifically, we found that a quantitative rating could induce a more negative reaction in the leader-employee dyad, with a significant effect on inter-brain tuning. The

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

findings emerged in the present research permitted to highlight new insights into the use of a social neuroscientific technique such as EEG hyperscanning to explore the presence of emotional tuning of leaders and employees interacting together during the performance review. The most important hint was that a review without a numerical rating was associated with more positive feelings, brain tuning, and increased dyadic engagement, as opposed to a quantitative judgment.

One relevant point for future research might be that the same paradigm could also be used in other organizational situations to assess individuals' or groups' engagement in company activities, to understand the natural condition in the company's life better. For example, starting from these initial evidence, future work could proceed to investigate further issues of interest, such as moral issues, group composition, gender and age effects, in order to evaluate the most functional and proficient settings at the workplace.

4. A matter of connectivity? From single brain to inter-brains connectivity

In many of the previous studies, the relationship between leaders and employees has been studied considering the behavioral mechanisms of synthonization, in order to highlight the most functional modalities to regulate the relationship. Recent analysis techniques of brain synthonization, called connectivity analysis, allow the study of the degree of "brain tuning" more directly. In this direction, it is both possible to consider the levels of higher neural tuning within the individual (single-brain connectivity) and to study how this connectivity increases and consolidates between the two brains (interaction analysis), offering a valid recording tool for measuring the level of synergy between two or more interacting individuals.

4.1. Single brain connectivity

Coherence is a way of measuring the interconnectedness of areas of the brain in a single subject. More simply, coherence is a way of tracking coordinated activity or communication between various areas of the brain. This makes coherence ideally suited for the examination of complex behavioral concepts such as inspirational leadership behavior, which are likely to require multiple parts of the brain (e.g., emotional and cognitive centers) to act jointly (Cacioppo, Berntson, & Nusbaum, 2008; Nolte, 2002).

Coherence is typically reported in the form of a percentage; for example, 90% coherence would indicate relatively high coherence (e.g., a high degree of coordinated activity between two parts of the brain), while 10% coherence would indicate relatively low coherence (e.g, less coordinated activity between two parts of the brain). Furthermore, coherence levels may indicate different behavioral phenomena for different locations in the

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

brain. For example, the presence of high coherence in the right hemisphere could suggest greater emotional balance and understanding through integration in the processes that manage emotional thought, including an understanding of one's own emotions as well as the emotions of others.

4.2. Inter-brain connectivity

Synchrony of neuro and psychophysiological responses has been found across a broad range of contexts and can be used to assess the strength of the coupling of the two signals for two or more systems in interaction (for a review see Balconi & Vanutelli, 2017).

Considering EEG activity, increased coherence was found during rhythm, music and motor synchronization (Kawasaki, Yamada, Ushiku, Miyauchi, & Yamaguchi, 2013; Konvalinka et al., 2014; Sänger, Müller, & Lindenberger, 2012), but also during cooperative activity with evidence from the Game Theory (Astolfi et al., 2012), or using computer-based paradigms in lab settings (Balconi & Vanutelli, 2016). For what concerns autonomic activity, hyperscanning was also applied, founding heart rate synchrony between spouses engaged in conversation (Gottman & Levenson, 1986), in dyads connected by touching (Chatel-Goldman, Congedo, Jutten, & Schwartz, 2014), during trust-based social interactions (Mitkidis, McGraw, Roepstorff, & Wallot, 2015), and group cohesion and team trust (Strang, Funke, Russell, Dukes, & Middendorf, 2014).

The hyperscanning paradigm, implemented with the use of different techniques, such as the fMRI, the fNIRS, the EEG and the magnetoencephalography (MEG), has allowed observing the inter-brain connectivity patterns. In particular, the term inter-brain connectivity refers to the synchronization of two oscillators that mutually regulate their rhythms in progress during an interaction, configuring themselves as fundamental indicators of brain processes and elements ongoing (Burgess, 2013; Rosenblum, Pikovsky , Kurths, Schäfer, & Tass, 2001).

Specifically, inter-brain connectivity processes are implemented when individuals perform complex behaviors that require coordinating their actions based on shared rules.

Indeed, inter-cerebral connectivity or "brain to brain" coupling is configured as an unconscious process that improves communication and understanding between the individuals involved in the interaction (Hasson, Ghazanfar, Galantucci, Garrod, & Keysers 2012). Inter-brain connectivity is an excellent indicator capable of providing information on cognitive processes (Fries, 2005; Varela, Lachaux, Rodriguez, & Martinerie, 2001) and promotes cooperative behaviors, empathic actions and the implementation of prosocial behaviors (Mogan, Fischer, & Bulbulia, 2017; Valdesolo & DeSteno, 2011).

Furthermore, inter-brain connectivity increases interactive behavioral synchrony (Dumas, Lachat, Martinerie, Nadel, & George, 2011; Hasson et al., 2012), offering itself as a neural basis of consciousness and promoting a greater feeling of involvement, of affinity, empathy and social closeness between individuals involved in the interaction or in carrying out a common action (Bevilacqua et al., 2019; Dikker et al., 2017).

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

5. Beyond leadership: future highlights on decision-making and risk

However, how can we extend the analysis of leadership potential to include the most recent applications of the leader-decision relationship, risk-taking, or confidence-building between leader and employee? In other words, we can also foresee research that goes beyond leadership phenomena per se. Some areas pertaining specifically to decision-making processes are evident.

First, neuroeconomics is an emerging transdisciplinary field that utilizes the measurement techniques of neuroscience to understand how leader makes economic decisions (Camerer, Loewenstein, & Prelec, 2005; Zak, 2007). One particular area of interest to neuroeconomists is how leader make decisions around trust (e.g., Zak, 2007).

Despite the large literature that exists on the importance of trust in organizations, we know very little about why some people choose to trust, or how they become trustworthy.

However, because decisions involving trust have been deemed to be largely an unconscious process, neurophysiological measurement during trust experiments has allowed researchers to gain insights into how people make decisions around trust, even when they themselves are unaware of how they make such decisions. Thus, organizational trust researchers may benefit from these findings and methodologies.

Secondly, research might address potential neurophysiological differences between leaders who tend to pursue bolder or riskier alternatives and those who are more conservative or risk-averse in their decision making. For example, Ashkanasy (2003) discussed the neurological basis of the "freezing response" or the tendency to "freeze with fear." Referring to the work of LeDoux (1995), Ashkanasy described how the fear response appears to involve linkages between the cortex or thalamus and the limbic areas, specifically the amygdala. Therefore, it is possible that specific aspects of brain activity may identify strategic decision makers who are risk-averse, in that such individuals are more prone to the freezing response when considering potentially bold or risky decisions. Third, moral judgment is also relevant to decision-making. Neuroimaging has established that locations in the frontal cortex are involved in moral judgment and evaluations of fairness, as well as morally based emotions such as compassion, indignation, and guilt.

6. Some critical points?

As we have seen, one of the primary aims of neuroleadership is to identify what constitutes a good leader from a neuroscientific perspective. This inquiry ranges from examining the cognitive processes of effective leaders to searching for neural correlates of innate leadership ability. The search for leadership indicators is exemplified by the investigation whether an individual's leadership style could be identified based on EEG activity. Moreover, one

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

highly worthwhile goal of neuroleadership is to find new ways to improve leadership skills and implement organizational change. Changing habits is difficult and changing the habits of many individuals within an organization can be an overwhelming challenge. It was underlined that neuroleadership can help us find better strategies to effect change through a more thorough understanding of the circuitry underlying learning and habit formation.

They call attention to the role of focus, attention, and expectation in learning and discuss how attitudes and behaviours are most efficiently changed through the facilitation of moments of insight.

One adjunctive goal is to directly manipulate brain activity to strengthen certain ways of thinking through use of TMS or transcranial Direct Current Stimulation (tDCS). This may eventually prove useful in certain less intrusive methods of brain activity alteration, programs based on EEG-guided neurofeedback, are already in use. In such programs, participants watch a display of their EEG activity and are taught behavioural strategies to maintain this activity in desired patterns.

However, some researcher noted a few important points about these studies. Firstly, the behaviours trained with neurofeedback should be chosen carefully to reflect skills needed within a real workplace environment, resulting neuroplasticity can be reversible or may not always couple to desired behavioural changes, and clinical and business applications of expensive and advanced technologies are particularly susceptible to placebo effects, rendering them easily exploitable applications such as preventing clinician burn-out. There are, thus, practical and ethical considerations to take into account.

As neuroscience has increasingly called into question the conscious control of behaviour, neuroscience have gained interest in uncovering the unconscious processes that interfere with workplace relations and effective management. Unconscious biases have wide-ranging impacts on health management, from disparities in care delivery, to bullying among staff members, to resistance in adopting new protocols.

The hope is that research on implicit attitudes and unconscious biases may explain the contradictions that arise between self-reported attitudes and behavioural outcomes and why logical discourse is often ineffective in eliciting change.

References

Ashkanasy, N. M. (2003), Emotions in organizations: a multi-level perspective, in Dansereau, F. & Yammarino, F. J. (Ed.), *Research in Multi-Level Issues* (vol. 2, pp. 9–54), Emerald Group Publishing Limited, Bingley. doi: 10.1016/S1475-9144(03)02002-2

Ashkanasy, N. M. (2013). Neuroscience and leadership: take care not to throw the baby out with the bathwater. *Journal of Management Inquiry*, *22*(3), 311–313.

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

doi: 10.1177/1056492613478519

Astolfi, L., Toppi, J., Borghini, G., Vecchiato, G., He, E. J., Roy, A., ... & Babiloni, F. (2012). Cortical activity and functional hyperconnectivity by simultaneous EEG recordings from interacting couples of professional pilots. *Conference of the IEEE Engineering in Medicine and Biology Society,* pp. 4752–4755. doi: 10.1109/EMBC.2012.6347029

Balconi, M., & Bortolotti, A. (2012). Empathy in cooperative versus non-cooperative situations: the contribution of self-report measures and autonomic responses. *Applied Psychophysiology and Biofeedback*, *37*(3), 161–169. doi: 10.1007/s10484-012-9188-z

Balconi, M., Bortolotti, A., & Gonzaga, L. (2011). Emotional face recognition, EMG response, and medial prefrontal activity in empathic behaviour. *Neuroscience Research*, *71*(3), 251–259. doi: 10.1016/j.neures.2011.07.1833

Balconi, M., & Canavesio, Y. (2013a). Emotional contagion and trait empathy in prosocial behavior in young people: the contribution of autonomic (facial feedback) and balanced emotional empathy scale (BEES) measures. *Journal of Clinical and Experimental Neuropsychology*, *35*(1), 41–48. doi: 10.1080/13803395.2012.742492

Balconi, M., & Canavesio, Y. (2013b). High-frequency rTMS improves facial mimicry and detection responses in an empathic emotional task. *Neuroscience*, *236*, 12–20. doi: 10.1016/j.neuroscience.2012.12.059

Balconi, M., Cassioli, F., Fronda, G., & Vanutelli, M. E. (2019). Cooperative leadership in hyperscanning. Brain and body synchrony during manager-employee interactions. *Neuropsychological Trends*. doi: 10.7358/neur-2019-026-bal2

Balconi, M., Crivelli, D., & Vanutelli, M. E. (2017a). Why to cooperate is better than to compete: brain and personality components. *BMC Neuroscience*, *18*(1), 68. doi: 10.1186/s12868-017-0386-8

Balconi, M., Finocchiaro, R., & Campanella, S. (2014). Reward sensitivity, decisional bias, and metacognitive deficits in cocaine drug addiction. *Journal of Addiction Medicine*, *8*(6), 399–406. doi: 10.1097/ADM.0000000000000065

Balconi, M., Fronda, G., Natale, M. R., & Rimoldi, E. (2017b). Perchè la leadership generativa. Il contributo delle neuroscienze. *Ricerche di Psicologia*, *40*(3), 365–383. doi: 10.3280/RIP2017-003007

Balconi, M., Gatti, L., & Vanutelli, M. E. (2018). Cooperate or not cooperate EEG, autonomic, and behavioral correlates of ineffective joint strategies. *Brain and Behavior*, *8*(2), e00902. doi: 10.1002/brb3.902

Balconi, M., Pezard, L., Nandrino, J. L., & Vanutelli, M. E. (2017c). Two is better than one: the effects of strategic cooperation on intra-and inter-brain connectivity by fNIRS. *PloS One*, *12*(11), 1–17. doi: 10.1371/journal.pone.0187652

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Balconi, M., & Pozzoli, U. (2005). Morphed facial expressions elicited a N400 ERP effect: a domain-specific semantic module?. *Scandinavian Journal of Psychology*, *46*(6), 467–474. doi: 10.1111/j.1467-9450.2005.00478.x

Balconi, M., & Vanutelli, M. E. (2016). Competition in the brain. The contribution of EEG and fNIRS modulation and personality effects in social ranking. *Frontiers in Psychology*, *7*(10), 1587. doi: 10.3389/fpsyg.2016.01587

Balconi, M., & Vanutelli, M. E. (2017). Cooperation and competition with hyperscanning methods: review and future application to emotion domain. *Frontiers in Computational Neuroscience*, *11*, 86. doi: 10.3389/fncom.2017.00086

Balconi, M., & Venturella, I. (2015). Comunicazione, emozioni e neuromanagement, in Salati, M., Leoni, A., *Neuroscienze e management. Nuovi strumenti per la professione manageriale* (pp. 235–249) , Guerini Next srl, Milano.

Balconi, M., Venturella, I., Fronda, G., & Vanutelli, M. E. (2019). Who's boss? Physiological measures during performance assessment. *Managerial and Decision Economics*, *40*(2), 213–219. doi: 10.1002/mde.2997

Balconi, M., Venturella, I., Fronda, G., & Vanutelli, M. E. (2020). Leader-employee emotional "interpersonal tuning". An EEG coherence study. *Social Neuroscience*, *15*(2), 234–243. DOI: 10.1080/17470919.2019.1696226

Balthazard, P. A., Waldman, D. A., Thatcher, R. W., & Hannah, S. T. (2012). Differentiating transformational and non-transformational leaders on the basis of neurological imaging. *The Leadership Quarterly*, *23*(2), 244–258. doi: 10.1016/j.leaqua.2011.08.002

Bass, B. M., & Bass, R. (2009). *The Bass handbook of leadership: Theory, research, and managerial applications*. Simon and Schuster.

Bevilacqua, D., Davidesco, I., Wan, L., Chaloner, K., Rowland, J., Ding, M., ... & Dikker, S. (2019). Brain-to-brain synchrony and learning outcomes vary by student–teacher dynamics: evidence from a real-world classroom electroencephalography study. *Journal of Cognitive Neuroscience*, *31*(3), 401–411. doi: 10.1162/jocn_a_01274

Burgess, A. P. (2013). On the interpretation of synchronization in EEG hyperscanning studies: a cautionary note. *Frontiers in Human Neuroscience*, *7*, 881. doi: 10.3389/fnhum.2013.00881

Cacioppo, J. T., Berntson, G. G., & Nusbaum, H. C. (2008). Neuroimaging as a new tool in the toolbox of psychological science. *Current Directions in Psychological Science*, *17*(2), 62–67. doi: 10.1111/j.1467-8721.2008.00550.x

Camerer, C., Loewenstein, G., & Prelec, D. (2005). Neuroeconomics: how neuroscience can inform economics. *Journal of Economic Literature*, *43*(1), 9–64. doi: 10.1257/0022051053737843

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Case, R. (1992). The role of the frontal lobes in the regulation of cognitive development. *Brain and Cognition*, *20*(1), 51–73. doi: 10.1016/0278-2626(92)90061-P

Chatel-Goldman, J., Congedo, M., Jutten, C., & Schwartz, J. L. (2014). Touch increases autonomic coupling between romantic partners. *Frontiers in Behavioral Neuroscience*, *8*, 95. doi: 10.3389/fnbeh.2014.00095

Conger, J. A., & Kanungo, R. N. (1998). *Charismatic leadership in organizations*. Sage Publications.

De Hoogh, A. H., & Den Hartog, D. N. (2008). Ethical and despotic leadership, relationships with leader's social responsibility, top management team effectiveness and subordinates' optimism: A multi-method study. *The Leadership Quarterly*, *19*(3), 297–311. doi: 10.1016/j.leaqua.2008.03.002

Dikker, S., Wan, L., Davidesco, I., Kaggen, L., Oostrik, M., McClintock, J., ... & Poeppel, D. (2017). Brain-to-brain synchrony tracks real-world dynamic group interactions in the classroom. *Current Biology*, *27*(9), 1375–1380. doi: 10.1016/j.cub.2017.04.002

Dixon, P., Rock, D., & Ochsner, K. (2010). Turn the 360 around. *NeuroLeadership Journal*, *3*, 78–86.

Dumas, G., Lachat, F., Martinerie, J., Nadel, J., & George, N. (2011). From social behaviour to brain synchronization: review and perspectives in hyperscanning. *Irbm*, *32*(1), 48–53. doi: 10.1016/j.irbm.2011.01.002

Fries, P. (2005). A mechanism for cognitive dynamics: neuronal communication through neuronal coherence. *Trends in Cognitive Sciences*, *9*(10), 474–480. doi: 10.1016/j.tics.2005.08.011

Fuster, J. M. (1999). Synopsis of function and dysfunction of the frontal lobe. *Acta Psychiatrica Scandinavica*, *99*(Suppl 395), 51–57. doi: 10.1111/j.1600-0447.1999.tb05983.x

Goleman, D., Boyatzis, R. E., & McKee, A. (2002). The new leaders: transforming the art of leadership into the science of results. *International Journal of Information Management*, *23*(3), 273–274. doi: 10.1016/S0268-4012(03)00031-8

Gottman, J. M., & Levenson, R. W. (1986). Assessing the role of emotion in marriage. *Behavioral Assessment*, *8*(1), 31–48.

Haslam, S. A., Reicher, S. D., & Platow, M. J. (2011). *The new psychology of leadership: Identity. Influence and Power*. Psychology Press.

Hasson, U., Ghazanfar, A. A., Galantucci, B., Garrod, S., & Keysers, C. (2012). Brain-to-brain coupling: a mechanism for creating and sharing a social world. *Trends in Cognitive Sciences*, *16*(2), 114–121. doi: 10.1016/j.tics.2011.12.007

House, R. J., & Howell, J. M. (1992). Personality and charismatic leadership. *The Leadership Quarterly*, *3*(2), 81–108. doi: 10.1016/1048-9843(92)90028-E

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Howell, J. M., & Shamir, B. (2005). The role of followers in the charismatic leadership process: relationships and their consequences. *Academy of Management Review*, *30*(1), 96–112. doi: 10.2307/20159097

Judge, T. A., & Piccolo, R. F. (2004). Transformational and transactional leadership: a meta-analytic test of their relative validity. *Journal of Applied Psychology*, *89*(5), 755–768. doi: 10.1037/0021-9010.89.5.755

Kawasaki, M., Yamada, Y., Ushiku, Y., Miyauchi, E., & Yamaguchi, Y. (2013). Inter-brain synchronization during coordination of speech rhythm in human-to-human social interaction. *Scientific Reports*, *3*(1), 1–8. doi: 10.1038/srep01692

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*(2), 254–284. doi: 10.1037/0033-2909.119.2.254

Konvalinka, I., Bauer, M., Stahlhut, C., Hansen, L. K., Roepstorff, A., & Frith, C. D. (2014). Frontal alpha oscillations distinguish leaders from followers: multivariate decoding of mutually interacting brains. *Neuroimage*, *94*, 79–88. doi: 10.1016/j.neuroimage.2014.03.003

LeDoux, J. E. (1995). Emotion: clues from the brain. *Annual Review of Psychology*, *46*(1), 209–235. doi: 10.1146/annurev.ps.46.020195.001233

Levitan, R. D., Hasey, G., & Sloman, L. (2000). Major depression and the involuntary defeat strategy: biological correlates. In L. Sloman & P. Gilbert (Eds.), *Subordination and defeat: An evolutionary approach to mood disorders and their therapy* (p. 95–118). Lawrence Erlbaum Associates Publishers.

Lieberman, M. D., & Eisenberger, N. I. (2008). The pains and pleasures of social life: a social cognitive neuroscience approach. *NeuroLeadership Journal*, *1*(1), 38–43.

Marsh, A. A., Blair, K. S., Jones, M. M., Soliman, N., & Blair, R. J. R. (2009). Dominance and submission: the ventrolateral prefrontal cortex and responses to status cues. *Journal of Cognitive Neuroscience*, *21*(4), 713–724. doi: 10.1162/jocn.2009.21052

Mayer, J. D., Salovey, P., & Caruso, D. R. (2008). Emotional intelligence: new ability or eclectic traits?. *American Psychologist*, *63*(6), 503–517. doi: 10.1037/0003066X.63.6.503

Mitkidis, P., McGraw, J. J., Roepstorff, A., & Wallot, S. (2015). Building trust: heart rate synchrony and arousal during joint action increased by public goods game. *Physiology & Behavior*, *149*, 101–106. doi: 10.1016/j.physbeh.2015.05.033

Mogan, R., Fischer, R., & Bulbulia, J. A. (2017). To be in synchrony or not? A meta-analysis of synchrony's effects on behavior, perception, cognition and affect. *Journal of Experimental Social Psychology*, *72*, 13–20. doi: 10.1016/j.jesp.2017.03.009

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Montague, P. R., Berns, G. S., Cohen, J. D., McClure, S. M., Pagnoni, G., Dhamala, M., ... & Fisher, R. E. (2002). Hyperscanning: simultaneous fMRI during linked social interactions. *Neuroimage*, *16*(4), 1159–1164. doi: 10.1006/nimg.2002.1150

Nickerson, R. S. (1998). Confirmation bias: a ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175–220. doi: 10.1037/1089-2680.2.2.175

Nolte, J. (2002). *The human brain: an introduction to its functional anatomy*. St. Louis: Mosby.

Paulus, M. P., Potterat, E. G., Taylor, M. K., Van Orden, K. F., Bauman, J., Momen, N., ... & Swain, J. L. (2009). A neuroscience approach to optimizing brain resources for human performance in extreme environments. *Neuroscience & Biobehavioral Reviews*, *33*(7), 1080–1088. doi: 10.1016/j.neubiorev.2009.05.003

Pearce, C. L., & Conger, J. A. (2003). *Shared leadership: reframing the hows and whys of leadership.* Sage Publications.

Preston, S. D., & De Waal, F. B. (2002). Empathy: its ultimate and proximate bases. *Behavioral and Brain Sciences*, *25*(1), 1–20. doi: 10.1017/s0140525x02000018

Rock, D. (2008). SCARF: a brain-based model for collaborating with and influencing others. *NeuroLeadership Journal*, *1*(1), 44–52.

Rosenblum, M., Pikovsky, A., Kurths, J., Schäfer, C., & Tass, P. A. (2001). Phase synchronization: from theory to data analysis. *Handbook of Biological Physics*, *4*(279–321), 93–94. doi: 10.1016/S1383-8121(01)80012-9

Sänger, J., Müller, V., & Lindenberger, U. (2012). Intra-and interbrain synchronization and network properties when playing guitar in duets. *Frontiers in Human Neuroscience*, *6*, 312. doi: 10.3389/fnhum.2012.00312

Schilbach, L. (2010). A second-person approach to other minds. *Nature Reviews Neuroscience*, *11*(6), 449. doi: 10.1038/nrn2805-c1

Shondrick, S. J., Dinh, J. E., & Lord, R. G. (2010). Developments in implicit leadership theory and cognitive science: applications to improving measurement and understanding alternatives to hierarchical leadership. *The Leadership Quarterly*, *21*(6), 959–978. doi: 10.1016/j.leaqua.2010.10.004

Smither, J. W., & Walker, A. G. (2004). Are the characteristics of narrative comments related to improvement in multirater feedback ratings over time?. *Journal of Applied Psychology*, *89*(3), 575–581. doi: 10.1037/0021-9010.89.3.575

Strang, A. J., Funke, G. J., Russell, S. M., Dukes, A. W., & Middendorf, M. S. (2014). Physio-behavioral coupling in a cooperative team task: contributors and relations. *Journal of Experimental Psychology: Human Perception and Performance*, *40*(1), 145–158. doi: 10.1037/a0033125

Valdesolo, P., & DeSteno, D. (2011). Synchrony and the social tuning of compassion. *Emotion*, *11*(2), 262–266. doi: 10.1037/a0021302

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/

Vanutelli, M. E., & Balconi, M. (2015). Empathy and prosocial behaviours. Insights from intra-and inter-species interactions. *Rivista internazionale di Filosofia e Psicologia*, *6*(1), 88–109. doi: 10.4453/rifp.2015.0007

Vanutelli, M. E., Gatti, L., Angioletti, L., & Balconi, M. (2017). Affective synchrony and autonomic coupling during cooperation: a hyperscanning study. *BioMed Research International*, 2017, 3104564. doi: 10.1155/2017/3104564

Varela, F., Lachaux, J. P., Rodriguez, E., & Martinerie, J. (2001). The brainweb: phase synchronization and large-scale integration. *Nature Reviews Neuroscience*, *2*(4), 229–239. doi: 10.1038/35067550

Venturella, I., & Balconi, M. (2017). Neuromanagement e leadership. *Ricerche di Psicologia*, *40*(3), 337–348. doi:10.3280/RIP2017-003005

Waldman, D. A., Balthazard, P. A., & Peterson, S. J. (2011). Leadership and neuroscience: can we revolutionize the way that inspirational leaders are identified and developed?. *Academy of Management Perspectives*, *25*(1), 60–74. doi: 10.5465/amp.25.1.60

Waldman, D. A., Wang, D., Hannah, S. T., & Balthazard, P. A. (2017). A neurological and ideological perspective of ethical leadership. *Academy of Management Journal*, *60*(4), 1285–1306. doi: 10.5465/amj.2014.0644

Zak, P. J. (2007). The neuroeconomics of trust. In Franz, R. (Ed.), *Renaissance in behavioral economics* (pp. 31–47). Routledge.

M. Balconi (ed.), *Neuromanagement: People and Organizations*, Milano, LED, 2020
ISBN 978-88-7916-952-3 - https://www.ledonline.it/IrcCAN-Cognitive-applied-neuroscience/