Neuromanagement.
What about emotion and communication?

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ABSTRACT

A recent flourishing of research is carried out jointly by psychologists and neuroscientists on management field. The new-born research field of Management Neuroscience involves a new kind of scientist and the ultimate goal of this research domain is to open the "black-box" to understand the behavioral and neural processes through which humans set communication and translate these behaviors into optimal choices. This paper aims to bring forward new results and fresh insights into this matter, taking into account both communication and the emotional components of this process. Starting by a distinction between conscious and unconscious mental processes, we see non-verbal components and their fundamental role in communicative process modulation. Finally verbal communication is treated with suggestions relevant for managers in regulating communication inside the company.

Keywords: Neuroscience; Neuromanagement; Emotion; Facial expression, Communication; Neuroscientific instruments

1. Neuromanagement. What about emotion and communication?

A recent flourishing of research is carried out jointly by psychologists and neuroscientists on management field. This association of competences has led toward original approaches to investigate the mechanisms involved in the way the agents collect processes and uses information to act in different contexts. The new-born research field of Management Neuroscience involves a new kind of scientist and the ultimate goal of this research domain is to open the "black-box" to understand the behavioral and neural processes through which humans set communication and translate these behaviors into optimal choices.

This paper aims to bring forward new results and fresh insights into this matter, taking into account both communication and the emotional components of this process. Indeed the topics of the present paper cover a broad field dealing with the mechanisms of communication, emotion and neuroscience. Neuroscience offers an ample range of techniques and paradigms to be applied to management research. Generally, the management field has much to gain by taking a multidisciplinary approach to its questions. Neuroimaging (such as functional Magnetic Resonance, fMRI) has received much attention. However many other techniques may be useful to management researchers. As previously shown, measurements of changes in brain electrical activity, such as electroencephalography (EEG) and electromyography (EMG), furnish better temporal resolution at the expense of poorer spatial resolution (Balconi & Pozzoli, 2008). Newer methods based on near-infrared technology (Near-Infrared Spectroscopy, NIRS) show good temporal and spatial resolution in a dynamic field-related context than fMRI. Moreover, Transcranial Magnetic Stimulation (TMS) can better explain from a causal point of view the relationship between decisional processes and neural correlates. Thus, neuroscience offers a wide range of techniques and paradigms to be applied to management research. Simultaneous EEG or NIRS recordings of several brains have recently opened a new field, called Hyperscanning. Hyperscanning is a recent paradigm in neuroscience which consists in the simultaneous cerebral activity recording of two or more subjects involved in interactive tasks (Balconi & Vanutelli, 2016). This measure allows to explore inter-personal brain mechanisms generated by social interactions: previous studies showed that the mutual adaptation of two interactive brains results in brain synchrony, and cooperative tasks like communication processes are one of the best examples of possible applications of such technique. These mechanisms cannot be captured by conventional single-subject recordings (Vanutelli, Crivelli & Balconi, 2015) and regarding these methodological considerations, hyperscanning technique could be useful to highlight the neural synchronization of two interactive participants during joint activities like communication.

A further consideration will be in favor of the role of neuroscientific approach and methods to explore the unconscious process in human behavior. Indeed, to understand how emotions work and how they interface with empathic and communication processes, it is relevant to consider the relationship between conscious and unconscious components in daily behavior.

2. Conscious and unconscious systems

Thanks to neurosciences we can highlight the impossibility and the risk to maintain the traditional separation between rationality and emotions. Damasio (1994) affirms that the ability to express and feel emotions is essential for rational behavior implementation. The advantages of physiological measurements to analyse the subjective behavior (Weinstein, Drozdenko & Weinstein, 1984) is that physiological responses can be recorded when respondents are directly participating in the behaviour, and, at the same time, these responses are difficult for subjects to be consciously controlled. Therefore, the "black-box" of the neural correlates of a behavior is analyzable thanks to the underlying brain-related deep processes, also in the case they are partly unknown to the very agent. Different decisional systems concur to create a free behavior, such as a *deliberative* (conscious and cognitively mediated) and an *intuitive* (mainly unconscious and emotionally mediated) *system* (Balconi, 2009, 2008; Deppe et al., 2005; Kahneman & Tversky, 1982; Loewenstein, 2000; Slovic, Finucane, Peters & MacGregor, 2004). Specifically, an affective (emotional response) and a cognitive (mental effort) point of view is adapt to reconsider the mechanism of decisions.. People are able to consciously think and deliberate, but in different processes they use automatic , fast mental ways and they are influenced by unconscious affective mechanisms (Balconi, Falbo & Brambilla, 2009; Balconi, Falbo & Conte, 2012; Balconi & Scioli, 2012). About the dichotomy *conscious vs. unconscious* contribution to decision, it was demonstrated that the controlled processes are serial, deliberative and often associated to a subjective perception of effort. Moreover, generally they are localized in the frontal area of the brain. On the other hand, the automatic processes are multitasking, they are out of consciousness and they don't need a particular effort, so they are faster than the controlled processes. The posterior (occipital), superior (parietal) and lateral (temporal) areas of the brain are involved in these automatic and quick mechanisms (Lieberman, McBratney & Krovitz, 2002). Many studies have also reported that cognitive processes are influnced by emotions (Scott & Cervone, 2002) because affective conditions are used by people as salient information ready to formulate evaluations and judgements (*affect as information*). The affective processes motivate the approach or the avoidance of a behaviour, so they comprehend emotions, drives and motivational situations, while the cognitive processes are related more to true or false issues. Among the recent theories about emotion, the Russell's circumflex model proposed an *appraisal process* able to explain that each emotion represents a specific response to a particular kind of a significant event, evaluated by the subject in line with his motivational significance and his main goals (Balconi, Finocchiaro & Canavesio, 2015). This appraisal process is governed by two principles: the *arousing power* (high or low) and the *valence* (positive or negative) of the emotional stimulus. Arousal implicit measures come from *psychophysiological autonomic indices* (skin conductance, heart rate, blood pressure, and so on). In particular, electrodermal activity (EDA) is considered a valid and sensitive indicator of variation in phasic arousal, that is the behavioural response to specific stimulus arousal (Groeppel-Klein, 2005). For valence, neurosciences comes in handy with another tool: electroencephalography that gives us information about cortical activity and, in this case, about cortical activity lateralization.

Distinct cortical functions are related, in facts, to the two hemispheres, that is a right and left lateralization effect was found. Emotion recognition by face is firstly differentiated by emotion production. But at once, no clear resolution on the final model that best fits with all the experimental literature is assumable, and it is now clear that the search for a single, bipolar principle that would encompass the functional properties of the two hemispheres would be futile. Nevertheless, following a description of the functional neuroanatomy of the approach and withdrawal systems, differences in brain activation were found and their relation to affective style was described. Moreover, the *valence hypothesis* assumed in its first version that right and left specialization respectively for negative and positive emotions, independent of processing modes. The dimension of pleasantness would be critical in the hemispheric involvement in emotions: withdrawal is connected with the right, whereas approach behavior is connected with left (Balconi & Lucchiari, 2008; Balconi & Mazza, 2009). Successively it was proposed that hemispheric specialization according to the valence is observed only for the expression of emotion, while the perception of emotion is assumed to be located in right posterior regions. On the contrary, various investigations have proposed that the right is dominant in emotion expressions and perception, regardless of valence.

What is the evidence for these assumptions? A first observation is that emotional processing involves strategies (nonverbal, integrative, holistic) and functions (pattern perception, visuospatial organization) that are specific of the right. On the contrary, left is more involved in activation and focal attention. A second point is that the right is more linked to subcortical structures which are fundamental for arousal and intention. Due to their processing features, the right is more prone to nonverbal (emotional) processing and the left more to verbal (linguistic) processing.

3. Non-verbal communication and facial expression

Management has a great interest in communication processes knowledge because of the presence of this type of process at various levels of management field, starting by vertical communication between leaders and employees to peers communication, between colleagues. Communication is the main instrument to share practices in a company and leaders have long understood that communication is the key of their company success. For some time researchers and psychologists affirm that a good leader's function was to create a certain "social climate" in the group, and that, this climate, influenced the mood of the group members including its performance (Lewin, Lippit & White, 1939). A transformational leader has a good balance between productivity and satisfaction among group members. We know also that leaders with higher emotional intelligence can also empathize more effectively with the emotion of employees and express more emotionally appropriate interactions and reactions (Mayer & Salovey, 1997). Empathy, the ability in empathize with others' emotions, refers to both cognitive and emotional processes that allow us to mentally represent other people's mental and affective processes and to produce an actual reaction coherent with others' behaviors (Balconi & Canavesio, 2013; Spinella, 2005). Evidences by literature suggest a close relationship between the experience of emotional empathy and the ability to recognize facial emotions. The emotional states experienced by others are recognizable by reading their facial expressions (Balconi & Lucchiari, 2005; Balconi & Pozzoli, 2009; Hofelich & Preston, 2012).

Non-verbal components have a fundamental role in communicative process modulation. A relevant example is facial expression. It has to be observed that facial expressions of emotion do not probably subserve exclusively an emotional purpose, but, on the contrary, they can be related to different functions. In fact a broad domain of information can be conveyed through facial displays. Between the others, facial expressions enable us to communicate effectively with the other person, in conjunction with spoken words as well as other nonverbal acts (such as gesture, vocal components, body postural etc.). Among the expressive elements that contributed to the communication of emotion, facial expressions are considered as communicative signals, central features of social behavior of most nonhuman primate and powerful stimuli in human communication. Recent research has examined whether people with higher dispositional empathy are better at recognizing facial expressions of emotion (Andréasson & Dimberg, 2008; Balconi & Bortolotti, 2011). In fact empathic personality measures have been considered valid criteria for the evaluation of the presence of structural differences in emotional behavior (Besel, 2007; de Wied, van Boxtel, Zaalberg, Goudena & Matthys, 2006). Moreover, there is evidence of interindividual differences in empathic cerebral activations (Hein & Singer, 2008; Jabbi, Swart & Keysers, 2007). These differences in neural activity appear to correlate with measures of behavioral trait empathy assessed through questionnaires like the Balanced Emotional Empathy Scale (BEES; Mehrabian, 1996; Mehrabian & Epstein, 1972), which is a measure of the vicarious emotional qualities of empathy that examines the emotional "primeval" level of interpersonal interactions, and a measure of one's tendency to empathize with the emotional experiences of others. According to several results, higher scores obtained by subjects in this questionnaire should be associated with higher activation levels of the anterior insula and anterior cingulate cortex (Hein & Singer, 2008; Jabbi et al., 2007). Saarela et al. (2007) found that the activation of the anterior insula and inferior frontal gyrus region in subjects who viewed provoked pain faces was positively correlated with the BEES.

Additionally, a significant relationship are found between empathic response and Gray's model of behavioral motivational system (Gray, 1981). Gray suggests that the two behavioral systems, the behavioral activation system (BAS) and the behavioral inhibition system (BIS), have their own specific emotional quality: the latter for positive affects (conditioned reinforcement stimuli, rewarding stimuli), with greater left frontal cortical activation, and the former for negative affect (fear, anxiety, negative stimuli), with greater right frontal cortical activation. Moreover, higher-BAS subjects should be more attentive to positive conditions, where they can reinforce their positive attitude toward appetitive external cues. Higher-BIS subjects, instead, are found to be more responsive to negative, threatening situations, with significant attention focused on emotionally negative cues. (Balconi, Falbo & Conte, 2012; Everhart & Harrison, 2000; Heller, 1993; Mardaga, Laloyaux & Hansenne, 2006).

In addition, individuals with greater tendency to reciprocate emotional facial expressions scored higher on an empathy questionnaire (Krause, Enticott, Zangen & Fitzgerald, 2012; Lee, Dolan, & Critchley, 2008; Sonnby-Borgström, 2002), suggesting that personality aspects of emotional empathy linked to autonomic processes. Indeed, some emotional reactions are supposed to be the starting point of the empathic processes (Moore, Gorodnitsky & Pineda, 2012). Between the others, facial muscle reactions are assumed to be related to emotional responses and hence the electrical activity of the facial muscle (electromyography - EMG) should be related to emotional empathy. Specifically, activity of corrugator supercilii muscle (muscle above the eyes responsible for frowning), and that of zygomaticus major muscle (mouth muscle responsible for smiling), are useful measures of empathic emotional response. Activity of corrugator muscle is generally related to negative stimuli, while activity of zygomatic muscle is related to positive stimuli (Bradley, Codispoti, Cuthbert & Lang, 2001). Concerning empathy, low trait empathy subjects show less corrugator EMG activity than moderate and high empathy subjects (Balconi & Bortolotti, 2012; Westbury & Neumann, 2008).

4. From non-verbal to verbal communication

Recently, Stephens et al. (2010) Showed that brain activity is synchronized between the listener and the speaker when the speaker's voice was aurally presented to the listener. Furthermore, Cui et al. (2012) establish functional near-infrared spectroscopy (fNIRS) can be used to measure brain activity simultaneously in two people engaging in nonverbal tasks. Thus, a study of Jiang and coll. (2012) uses fNIRS-based hyperscanning to examine the neural features of face-to-face verbal communication within at naturalistic context. In this study two partners involved in a communication will align their representations by imitating each other's choice of grammatical forms (Pickering & Garrod, 2004). Recent studies suggest that behavioral synchronization between partners may rely on the neural synchronization between their brains (Hasson, Ghazanfar, Galantucci, Garrod & Keysers, 2012) and there it was found that successful communication between speakers and listeners resulted in a temporally coupled neural response pattern that decreased if the speakers spoke a language unknown to the listeners (Stephens, Silbert & Hasson, 2010).

This study extends previous evidence by showing significant neural synchronization in the left Inferior Frontal Cortex (IFC) during face to face communication but not the other types of communication like back to back communication. Compared with back to back, face to face communication involves verbal signal transmission and also nonverbal signal transmission. This multimodal information would facilitate the alignment of behavior between partners at various levels of communication, resulting in higher-level neural synchronization during face to face communication (Belin, Fecteau & Bédard, 2004; Corina & Knapp, 2006). One possible explanation for this facilitation effect is the function of the action–perception system (Garrod & Pickering, 2004; Rizzolatti & Craighero, 2004; Hari & Kujala, 2009). Previous evidence has shown that the left IFC, in addition to several other brain regions, is the site where mirror neurons are located (Rizzolatti & Arbib, 1998). The mirror neurons respond to observations of an action, to a sound associated with that action, or even to observations of mouth-communicative gestures (Kohler et al., 2002; Ferrari et al., 2003). This result indicated that the left IFC might be involved in such an action–perception system and also that it might specifically provide a necessary bridge for human face-to-face communication (Fogassi & Ferrari, 2007). This findings suggest that the human brain is evolutionarily adapted to face-to-face communication (Boaz & Almquist, 1997; Kock, 2002). However, such technologies as telephone and e-mail have changed the role of traditional face-to-face communication. These type of suggestions are relevant for managers in regulating communication inside their companies, starting by their own communication style to communication technologies adopted inside the company.

5. Conclusions

To conclude: or what about the present and the future of emotion and communication in neuromanagement? We can consider the management neuroscience as the science of how the resources are allocated by individuals to control their behavior in social contexts, where the psychology and neuropsychology of individual behavior should underline and inform the management domain, as physics informs chemistry or neuroscience informs cognitive psychology. That is, neuromanagement seeks to use neuropsychology to inform management research while maintaining the emphasis on behavior structure. Moreover, whereas unification of management and neuroscience would preserve the distinctive emphasis on the specificity of the two domains, it slows for overcome the difficulty in inconsistency of predictions of most management models, by adopting more "empirical" and *data-driven* approaches. Actually, the novelty of neuroscience applied to management domain is the extensive use of experimental results from the laboratory and from the field,. This advance allows the investigation of the behavioural and neural mechanisms of emotion and communication without predict a sort of perfect rational individual, opening the "black-box" to include the processes implicated in the construction and implementation of a behavior, such as emotion and non-verbal communication.

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