

Who's boss? Physiological measures during performance assessment

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Leadership in organizations consists of a complex process, which includes the inter-personal relationship with collaborators. By using a neuroscientific approach, we evaluated the effect of the presence of unidirectional versus reciprocal feedback (provided only by the leader or by both figures), as well as the assignment of a quantitative or just a qualitative assessment. Skin conductance level and response (SCL and SCR), as well as heart rate (HR), have been recorded during a role playing. Results revealed increased emotional engagement (SCL/SCR) during no rating and reciprocal condition, as well as a stressful response (increased HR) during rating and unidirectional condition.

1 | INTRODUCTION

Leadership in the organizational field consists of a multifaceted process that takes place in a complex environment (Hannah, Balthazard, Waldman, Jennings, & Thatcher, 2013). The leader continuously needs to make decisions and to manage the new and changing situations in the workplace, which require an amount of unpredictability and risk (Waldman, Balthazard, & Peterson, 2011). Such complexity does not include only the leader's cognitive ability and personality, but also the context, some specific features of the employees, and, more importantly,

the interpersonal relationship between these two figures, which consists of a reciprocal interplay. As revealed by a recent work (Venturella, Gatti, Vanutelli, & Balconi, 2017), indeed, it is very important to catch the complexity of social relations within a managerial context by also including communication and emotional factors. In this specific case, for example, it was found that the adoption of a cooperative leadership style was more engaging by the employees, as revealed by psychophysiological and electrophysiological indices during different steps of the conversational shifting, including appealing topics for both the parties involved, such as the company's mission, leader's or employee's personal change, etc.

Managers were required to use two different communication styles: authoritative versus cooperative. A conversational analysis permitted to identify main topics to interpret data. Results showed that the interview was more arousing for the employee than the manager. Greater delta and theta electroencephalogram bands could denote positive valence of personal interactions and company mission topics. Autonomic measures (skin conductance response [SCR] and heart rate [HR]) showed important information related to different leadership style. Results highlight the importance of applying neurosciences to organizational contexts exploring processes related to manager–employee dynamics and communicative style.

In fact, it has been previously underlined that a proficient relationship between the manager and the employee can directly affect the efficiency in organizations (Hannah et al., 2013). For example, it has been shown that more complex leaders show important managerial skills within their social environment, such as adaptive thinking, decisiveness, and positive action orientation (Hannah et al., 2013).

Also, it has been revealed that some interpersonal mechanisms involving attachment within meaningful relationship (as in mother–child or romantic couples) could have important effects over some psychological factors such as self-satisfaction (Brennan & Shaver, 1995; Simpson, 1990) and well-being (Blackburn & Epel, 2012; LeMoult, Chen, Folland-Ross, Burley, & Gotlib, 2015; Mikulincer & Shaver, 2012; Pietromonaco, Uchino, & Dunkel Schetter, 2013). Interestingly, it has been hypothesized that similar phenomena could take place in the managerial field about the formation of significant work relationships and positive social dynamics.

For example, the moment of performance assessment could be very delicate for the organizational and interpersonal balance due to the presence of a hierarchy. At this regard, an interesting issue relates to a different style of assessment, which can be quantitative or qualitative. In detail, it is possible to combine a narrative (qualitative) evaluation together with a numerical one (quantitative), which is the rating. Introduced in the organizational practice for supporting the employees to reinforce their performance (Dixon, Rock, & Ochsner, 2010), rating's efficacy has received inconsistent findings. In a previous meta-analysis Kluger and DeNisi (1996) found that feedback evaluations led to performance improvement only in 41% of the time, and to a worsening in 38% of the cases. A more recent approach, instead, tried to underline how a qualitative evaluation could be more efficient for employees, because it was found that they pay more attention in the case of narrative instead of quantitative statements (Smither & Walker, 2004). A possible interpretation of this process was proposed by Rock (2008), who suggested that status perception and ranking could be undermined by rating assignment, thus leading to fear, negative emotions, and avoidance. Considering the importance to maintain a positive and healthy work environment at the workplace, such evidence is of great interest.

It has become evident, therefore, that a sound atmosphere based on empathy, reciprocal listening, and a solid communication can assume a regulatory function within organizational interpersonal dynamics, considering both a vertical direction between leaders and employees, but also a horizontal perspective among colleagues. This way, all the figures involved can be aware of how their emotional, cognitive, and psychological mechanisms could significantly influence others' reactions and behaviors, as well as the team's achievements.

To address these issues, we applied a neuroscientific approach. In fact, although research into leadership and managerial issues has been significantly explored from an organizational point of view, as we indicated before considering some recent research, our understanding of unaware reactions is still partial and incomplete. Indeed, only very few subjective and relational processes are consciously and easily accessible. By collecting only explicit data by questionnaires or interviews, in fact, conventional methods do not appear adequate any-more, because they are affected by several biases (Waldman et al., 2011). Conversely, neuroscience allows acquiring both “controlled”

and “automatic” mechanisms and provides a new point of view over the organization. More specifically, the field of social and affective neuroscience seems the most suitable in our case, because it is aimed at understanding the neural functioning during interpersonal relationships, the way people try to understand each other towards a common goal, empathic and emotional mechanisms, group dynamics, and so on. In our case, its declination to managerial issues has been termed neuromanagement, or organizational neuroscience, and defined as an applied form of social neuroscience towards those interpersonal behaviors that occur within organizational settings (Butler & Senior, 2007).

In the last years, this approach has been significantly embraced to investigate some important issues related to leadership. For example, some studies explored interpersonal manager–employee relationship (Buckingham & Coffman, 1999). Here, the authors considered the phenomenon by which people are usually more motivated, and subsequently perform better, if managers support their strengths, instead of stressing their weaknesses. However, although this work touched on the potentiality of neuroscience to answer some intriguing questions, only later studies duly adopted such methods. In detail, the leader's role was a great source of interest, with regard to transformational (Ashkanasy, 2013) and inspirational leadership (Waldman, Balthazard, Peterson, 2009). In this last case, for example, the authors explored the possibility to link electroencephalogram coherence to some specific attitudes of the leader during a vision task. It consisted of answering two questions about the future of their organizations, as follows: (a) “Can you please describe your current plans for your organization, as well as plans for the future?” and (b) “As you look towards the future, can you formulate a vision statement for your firm?” Then, statements have been coded from personalized to socialized visions. Results showed increased right frontal coherence in the case of socialized visionary communication. Such finding is important in that this capacity also has positive effects over followers' perceptions of the leader in charismatic terms.

However, previous work mainly focused on neuroimaging and the brain networks related to such dynamics (Balconi, Crivelli, & Vanutelli, 2017; Balconi, Gatti, & Vanutelli, 2018; Balconi, Pezard, Nandrino, & Vanutelli, 2017; Balconi, Vanutelli, & Gatti, 2018), whereas interpersonal components involving emotional responses could benefit also from other techniques about peripheral activity

recording such as electrodermal activity (EDA) and cardiovascular activity recording (HR). These methods, in fact, can easily detect some reactions related to specific interpersonal processes such as empathy (Levenson & Ruef, 1992) and affective behaviors (Adolphs, 2003; Levenson & Gottman, 1983; Vanutelli, Gatti, Angioletti, & Balconi, 2017). For example, differential emotional responses could be detected (Levenson, 1992), as well as the way people are connected each other (Chaspari et al., 2015; Vanutelli et al., 2017).

Moreover, autonomic activity recording is useful when dealing with ecological settings like these, because they are robust to movement artifacts, they can be acquired with inexpensive portable devices, they can be simply analyzed, and results are readily accessible (Balconi & Canavesio, 2013; Massaro & Pecchia, 2016). However, only a few previous works applied autonomic activity to neuromanagement in an ecological setting. Considering again the recent pilot study on leader–employee interactions (Balconi, 2017; Venturella et al., 2017), it was possible to better explore the moment of performance review of the employees by the managers and to find specific neurophysiological or psychophysiological markers of emotional and cognitive responses, as well as a comparison between authoritative and participative styles. However, the effects related to the feedback and its differential effect on different professional roles still need to be explored, as well as its interaction with the presence versus the absence of a quantitative rating.

The activity related to the autonomic nervous system consists for example of cardiovascular measures (such as HR) or EDA, such as skin conductance level (SCL) and SCR. HR defines the number of heart beats per minute, which is based on the number of contractions of the ventricles. By a functional point of view, HR has previously been associated with the valence of the emotional response (Bradley & Lang, 2000; Sequeira, Hot, Silvert, & Delplanque, 2009), with a significant acceleration especially in response to aversive situations (Nagai, Critchley, Featherstone, Trimble, & Dolan, 2004; Palomba, Angrilli, & Mini, 1997; Solbakk, Reinvang, Svebak, Nielsen, & Sundet, 2005). SCL and SCR, instead, reflect small changes in electrical activity of the skin generated by the sweat glands. These two measures are sensitive to tonic and transient modulation of arousal responses, respectively, which has been associated with emotion intensity: SCL reflects the general degree of activation (Malmö, 1959) whereas SCR is typically used as an objective measure of

emotional processing and attention (Damasio, 1994; Frith & Allen, 1983; Öhman & Soares, 1994; Soares & Öhman, 1993) in response to specific events or stimuli.

In the present research, we used these indices to explore the specific moment of annual review as an example situation of manager–employee interaction. In detail, we aimed at investigating in depth the differential responses provided by two professionals because of their organizational role (role variable) during a critical moment such as the evaluation. Also, although previous research mainly focused on the employee's assessment (Venturella et al., 2017), we were interested in investigating also the process by which the employee assesses his/her boss. In fact, we meant to investigate the differential effects related to the presence of a unidirectional (where only the leader provides a feedback) or a reciprocal (where both the leader and the employee give an evaluation) assessment (feedback variable) according to the different institutional role. Also, we aimed at comparing two different conditions, which are the presence and absence of a quantitative rating (rating variable).

To summarize, in the present study, we aimed at investigating the interpersonal organizational dynamics related to job evaluation through autonomic recording in paired manager–employee dyads. Managers and employees were asked to simulate an interview where they were required to produce an evaluation of the efficacy of the other's job performance. In some cases, only the manager was required to assess the employee's performance, whereas in other cases, the employee could replicate and disclose his/her opinion about the boss. This way, it was possible to consider both the effects related to the role and to unidirectional or reciprocal feedback.

Two distinct conditions have been thus compared, which are the presence and absence of a quantitative rating about performance. In addition, feedback variable was modulated, with the presence of a feedback given by both the component of the dyad (leader and employer) or only in the case of one component of the dyad (leader). According to what was discussed so far, we expected a more positive emotional condition in the absence of a quantitative rating in the form of increased electrodermal responses (increased SCR and SCL). On the other hand, we hypothesized a more negative and stressful response from the employees when being rated, with increased HR measure, which was found to be a specific marker of immediate and unpleasant situations. Moreover, a significant positive effect was supposed for no rating condition in both leader and

employee and mainly when they were permitted to give feedback (presence of feedback for both leader and employer, with higher emotional engagement and increased SCR and SCL), in contrast with rating condition, which will show increased stressful effect in both leader and employer when they give or receive feedback.

2 | METHODS

2.1 | Sample

A sample of 10 dyads (20 subjects; $M = 43.13$; $SD = 8.02$; 83% male) was recruited for the study. The gender differences with a higher contribution by males were foreseen in order to reflect the real gender composition. Each dyad was composed of a leader and an employee, who was subjected to evaluation or, in other cases, was the evaluator of his/her leader, and vice versa. For six dyads, the evaluation process was characterized by the presence of a quantitative rating, and for four dyads, by no rating. Subjects came from different companies belonging to different market fields: a transport company, a technology services company, and a training agency. Because we were only interested in the interpersonal engagement between the leader and the employee, we did not distinguish among different kinds of companies for the present analysis. All subjects had normal or corrected to no normal visual acuity. A history of psychiatric or neurological diseases, the presence of cognitive or sensory deficits, ongoing concurrent therapies based on psychoactive drugs, or clinically relevant stress level were all reasons for exclusion from recruitment. All participants voluntarily submitted to the experiment after being informed about the research objectives expressed by the informed consent.

2.2 | Procedure

Subjects were asked to simulate an interview using the role-playing technique, which was anyhow focused on real evaluations during the interaction between the subject in their companies' buildings to guarantee the ecological validity of the study. During the interview, the leader was asked to

evaluate his/her employee about his/her work performance, and, in some cases, the employee was asked to evaluate his/her leader. The role changing was implemented to isolate the role of being assessed from the role played in the company (leader or employee). The interview time intervals were not given; thus, each dyad could take the necessary time. Every interview was video-recorded for the entire session, and the two individuals could easily interact face to face, seating next to each other. During the whole interview development, autonomic measures were continuously recorded. The total duration of the interview was about 1 hr.

Within a wider evaluation, a quantitative rating was also asked in the rating condition. For the performance evaluation, a five-point scale was used, from 1 (completely inadequate skills for the role) to 5 (excellent skills, at the highest level in every situation). Avoiding the use of rating was, instead, the feature of the no rating condition, in which participants had simply to explain by words the observations made about the performance for the same skills treated in the rating condition. A final self-perception debriefing was provided at the end of the interview to verify the reciprocal evaluation of the interaction context and the qualitative feedback by participants. This procedure was designed to understand if subjects really got into the part and had pertinent self-perception and metacognitive insights about the experience, and subsequently, if they could be taken into account for successive analysis. This phase of debriefing was conducted as an additional qualitative interview in which participants could express their thoughts and emotions about the experience. The ultimate goal of this procedure was to verify the general perception of the task as well as the features of the social interactions. Moreover, textual/communicative data could thus be used to better qualify and frame the psychophysiological data.

2.3 | Autonomic measures recording

For each dyad component's autonomic measures recording, two different devices were used. Biopac MP 150 system (Biopac Systems Inc., USA) continuously recorded ECG in lead1 from two electrodes positioned on the lower wrist, with the positive pole on the left arm and the negative pole on the right one. The ECG signal was sampled at 1,000 Hz with the Biopac Acknowledge 3.7.1 software (Biopac Systems Inc., USA) and was converted to HR (beats per minute, bpm). The signal was lowpass filtered at 35 Hz and highpass filtered at 0.05 Hz. The electrodes for SCR and SCL

(electrodermal activity or the electrical conductance of the skin expressed in μS) were placed on the palm of the nondominant hand according to a bipolar montage. The signal was sampled at 1,000 Hz and lowpass filtered at 10 Hz.

3 | RESULTS

To explore if and how the psychophysiological indices varied according to the different experimental variables, three-way analyses of variance were applied to psychophysiological (SCR, SCL, HR) measures as dependent variables, one each, with rating (rating, rating/no rating), reciprocal feedback (RF, yes/no), and role (role, leader/employee) as independent variables. Greenhouse–Geisser correction of degrees of freedom was applied to analysis of variance outcomes when needed. Simple effects for significant interactions were further checked via pairwise comparisons (contrast analyses for repeated measure), and Bonferroni correction was used to reduce multiple comparisons potential biases. Furthermore, the normality of the data distribution was preliminarily assessed by checking kurtosis and asymmetry indices. Only statistically significant results will be discussed (Figure 1).

For what concerns SCR, significant effects emerged for rating main effect ($F [1, 19] = 8.43, p \leq 0.001, \eta^2 = 0.38$) and for rating \times role \times RF interaction ($F [1, 19] = 8.02, p \leq 0.001, \eta^2 = 0.36$). To better understand how the role and the presence of rating and of a reciprocal feedback modulated SCR response, post hoc statistical comparisons were performed. Such procedure revealed a significant increased SCR for the no rating condition (irrespective of the institutional role) as compared to rating condition (respectively $F [1,$

$19] = 9.55, p \leq 0.001, \eta^2 = 0.41; F [1, 19] = 8.31, p \leq 0.001,$

$\eta^2 = 0.37$). In addition, for the no rating condition, a further increase was revealed in presence of RF compared with absence of RF (for both leader and employee; respectively $F [1, 19] = 7.90, p \leq 0.001, \eta^2 = 0.35; F [1, 19] = 9.98, p \leq 0.001, \eta^2 = 0.42$). Finally, within these conditions involving

the absence of a quantitative rating and the presence of a reciprocal feedback, the effect was even more prominent for the employee than the leader ($F [1, 19] = 9.02, p \leq 0.001, \eta^2 = 0.40$; Figure 2a).

Similar results were also found for SCL, with rating main effect being significant ($F [1, 19] = 7.78, p \leq 0.001, \eta^2 = 0.36$), with higher SCL for no rating condition. In addition, rating \times role \times RF interaction effect was significant ($F [1, 19] = 7.50, p \leq 0.001, \eta^2 = 0.36$). As shown by post hoc procedure, higher values emerged in the no rating condition than the rating one (respectively $F [1, 19] = 8.40, p \leq 0.001, \eta^2 = 0.38$; $F [1, 19] = 9.19, p \leq 0.001, \eta^2 = 0.41$), specifically in the case of RF for the employee than the leader ($F [1, 19] = 9.11, p \leq 0.001, \eta^2 = 0.40$; Figure 2b).

About HR, rating \times role \times RF interaction effect was significant ($F [1, 19] = 7.90, p \leq 0.001, \eta^2 = 0.36$). Specifically, significant differences were found between the leader and the employee: In fact, the employee showed higher HR than the leader in the case of rating condition and in the absence of RF ($F [1, 19] = 8.34, p \leq 0.001, \eta^2 = 0.40$; Figure 2c).

No other standard comparison was statistically significant.

4 | DISCUSSION

The present work aimed, by applying a neuroscientific frame, to investigate the psychophysiological responses of leaders and employees during unidirectional or reciprocal performance evaluation. Three different variables have been considered, which are the organizational role (role variable), the differential effects related to feedback (feedback variable), which could be provided by both the components of the dyad (leader and employer) or only in the case of one component (leader), and the presence or absence of a quantitative rating (rating variable). Such variables have been included considering their potential effect on the psychophysiological wellbeing at the workplace.

A first significant result concerned the rating variable: Indeed, increased electrodermal responses (both SCR and SCL) emerged in the absence of a quantitative rating, whereas during rating condition, increased HR was observed.

Second, a rating \times feedback \times role effect also emerged in a way that, in the absence of rating, the reciprocal assessment was characterized by higher responses with respect to the unidirectional situation for both the leader and the employee, but especially for this last one, in terms of SCR and SCL. In parallel, increased HR responses emerged for the employee during the rating condition when there was not the possibility to replicate to the feedback.

For what concerns the first result, according to our hypotheses, it could be possible to interpret the increase in electrodermal indices as a higher emotional engagement between the two individuals. In fact, SCL and SCR responses are considered sensitive measures of tonic and transient modulation of sympathetic arousal responses, respectively. SCL reflects the general degree of activation and decreases during, for example, rest and sleep (Malmö, 1959). SCR, instead, is typically used as an objective measure of emotional processing and attention (Damasio, 1994; Frith & Allen, 1983; Öhman & Soares, 1994; Soares & Öhman, 1993). Although previous work underlined increased arousal activation for negative emotions with respect to positive ones (Cacioppo, Berntson, Larsen, Pohlmann, & Ito, 2000), further research found significant arousal modulation also during strong positive situations including pleasure (Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009), enthusiasm (Shiota, Neufeld, Yeung, Moser, & Perea, 2011), but also positive rewarding exchange (Sharpe, 2004). On the other hand, the rating condition was characterized by increased HR, which has been associated with the valence of the emotional response (Bradley & Lang, 2000; Sequeira et al., 2009), in particular during negative situations (Nagai et al., 2004; Palomba et al., 1997; Solbakk et al., 2005). Considering our hypothesis and what was already discussed by Rock (2008) about rating assignment, this specific condition seems related to negative and avoidant emotions. One possible interpretation is that the assignment of a ranking, and subsequently a comparative position, could be associated with insecurity and a threatening feeling. Thus, the increased electrodermal activity during the no rating condition characterized the physiological responses of both roles. This is of particular interest because the absence of the necessity to provide a rating could be beneficial and positive also for the leader, thus leading to a more symmetrical and cooperative social exchange. Moreover, aside from organizational research, this kind of affective synchrony was explored in previous social and clinical studies: In particular, similar methods have been applied to assess the quality of interaction

referred to mother–infant communication (Ham & Tronick, 2009), couples' affective exchange (Ekman et al., 2012), and psychotherapy research (Marci, Ham, Moran,

& Orr, 2007), where results revealed that the two parts had significantly more positive social–emotional responses during high auto-nomic concordance, which has thus become a key marker of social engagement (Hernandez, Riobo, Rozga, Abowd, & Picard, 2015). This idea can be applied to both the positive engagement related to increased electrodermal responses and the stressful condition of rating assignment (increased HR).

However, considering the second interaction effects, more detailed specificities can be observed. In fact, despite the presence of a similar profile in both roles, the employee proved to benefit more from a cooperative and symmetrical exchange. This was signaled by increased EDA during the no rating condition and by increased HR during the rating one. Such result is consistent with previous evidence: For example, Kreibig, Gendolla, and Scherer (2010) found increased sympathetic activation for those participants who received positive feedback on a challenging task, which can be interpreted as an enhanced motivational engagement.

Here, the positive effect was particularly evident when he or she could also reply to the assessment by providing a feedback to his/her leader, whereas the negative response was more pronounced in terms of increased HR during rating condition when there was not the possibility to give a feedback back to the leader. In fact, the employee is not usually allowed to express his/her feelings and to provide a significant and constructive feedback, which could be useful to diminish frustration and to promote motivation.

However, due to the unbalanced gender contribution in the present research, future research should better explain the role of this factor in explaining the results. In addition, in the present research, a clear comparison between the different organizational contexts was not conducted due to the limited number of subjects involved in the study. Therefore, a more systematic comparison between different companies' contexts should be considered to demonstrate the specific role of different “cultural” organizational phenomena.

5 | CONCLUSIONS

The present work permitted to shed light on the psychophysiological responses of leaders and employees by varying some variables of interest for the organizational context. In particular, the performance assessment was explored as a significant interpersonal moment, where the specific organizational role was considered, as well as the presence of a rating and of a unidirectional or reciprocal feedback. Results revealed increased emotional engagement during no rating and reciprocal condition, as well as a stressful response during rating and unidirectional condition. Such effects were more pronounced for the employee. The present findings highlight the importance to promote a cooperative and symmetrical relationship characterized by reciprocity and positive motivations.

In fact, it was possible to understand emotional reactions and their underlying neural and psychological mechanisms to learn how to decode and predict others' behaviors and choices. The results of the present study could be useful in order to offer relevant suggestions and insights to leaders who want to improve and transform their communication and emotions with the employees through more positive, constructive, and efficient relationships. That is, the acquired awareness of these implicit and underlying emotional markers of behaviors (like the psychophysiological factors) may support the development of new and effective skills to manage the interpersonal relationships, mainly when they are crucial to the organizational wellbeing. Thus, the neuroscientific method proved to be efficient in revealing implicit and unconscious responses and could be considered a valid tool in support of conventional methods based on explicit measures such as questionnaires, interviews, or focus groups.

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