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Motivation: neurophysiology of the pleasure of working

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1. Pleasure of working and economic-financial indicators

In 2004, Caterpillar (Corporate Leadership Council, 2004) had saved 8.8 million dollars in a single *Business Unit - International Manufacturing Facility* with an intervention of a few months on staff's motivation and engagement. These results allowed to understand the importance of those "intangible" factors, previously unconsidered, that decrease the level of *attrition* (a sense of perceived wear and tear) from 1.00 to 0.41, reduce the absenteeism from 1.0 to 0.61, and the overtime worked from 1.00 to 0.26. Therefore, this evidence has underlined that motivated and engaged people represent the necessary basis for building productive and performing organizations, demonstrating that those skills, commonly defined as "soft", have a "hard" impact on the income statement. In light of this evidence, the "Caterpillar case" represents a striking example of what neuroscience, a few years later, was able to prove by examining, with the use of sophisticated technologies and tools, the relationship between different dimensions: emotion and cognition, motivation and level of attention, creativity and focus, and the quality of thought. In particular, from neuroscientific investigations it has emerged that workers' performance and well-being are closely correlated to individual motivational drives and the type of relationship with the organizational context and the work performed.

Moreover, also engagement appears to influence the workers' performance and the state of well-being. In particular, Rutledge (2005) has provided the most exhaustive definition of the engagement construct, considered as the willingness of individuals to act in a way that follows organizational interests, feeling themselves attracted (e.g., "I want to do this job"), dedicated (e.g., "I am committed to the success of my work") and enthusiastic (e.g., "I like what I do during my work"). Therefore, in the last 40 years, some psycho-social research, conducted in social and work psychology, has documented all those factors that can favor motivation or induce demotivation in workers.

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Furthermore, more recently, the same evidence has been inspected by neuroscientific research using neurometry, intended as the measurement of the neurophysiological processes underlying motivated behaviors. In particular, the interest of neuroscientific observations within the company field is finalized to identify the organizational, relational, and social factors that increase the physiological, emotional, and cognitive components underlying motivation and increase the level of workers' engagement and passion, providing energic and adequate performance and recovering after falls or mistakes.

2. Aims: attraction or avoidance?

The term motivation, deriving from the Latin word "motus", in the sense of movement, refers to a set of neurophysiological processes underlying the act of voluntary actions finalized to achieve a specific goal. Specifically, motivation appears to be guided by an approach or avoidance behavior. The approach behavior pushes individuals to move close to other people, objects, experiences, or events considered good and reliable. On the contrary, avoidance behavior pushes individuals to move away from things or people considered as harmful.

In other words, we move closer to pleasure or the promise of gratification and move away from painful or fearful experiences. Indeed, some stimuli universally fuel approach or avoidance produced responses that lead individuals to get closer to what meets their basic needs, such as food, heat if it is cold, or water if they are thirsty. On the contrary, individuals quickly move away from what is perceived as frightening.

These different behavioral responses are due to the involvement of brain's mechanisms that, in response to the expectation of a reward or enjoyment, not only move towards the object but also produce an action or behavior; while the perception of fear or loss generates inaction. Indeed, individuals are biologically pushed to produce actions according to the expectation of good things.

In particular, from a neurophysiological perspective, these two types of behavioral dispositions are supported by specific cerebral circuits: the "reward" one and the "pain" one. Specifically, this latter cerebral circuit was activated by painful and unpleasant events and stimuli and produces a greater consumption of energy, a state of malaise, an increase of stress levels, a growth of resentments and defenses states, which have apparent repercussions in the company context, visible from the data on absenteeism and illness. On the contrary, some stimuli take particular meaning and value at the level of the specific organizational context or the history of single individuals, that, transformed into objectives, feed the motivation towards their achievement. Motivational drives, distributed everywhere in individuals' brains, are just not supported by economic issues, but by many levels that the organization can use to make people involved, even under challenging conditions or concerning the need to reset their skills.

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3. The neurophysiological components of motivation: the reward circuit

To better understand the physiological nature of motivation, it is useful to observe what happens in the brain during the execution of voluntary actions and what mechanisms are involved in approach and avoidance behavior. In particular, the primary mechanism underlying motivation is called the "reward system" (McClure, York, & Montague, 2004), that consists in a cerebral circuit connecting the prefrontal regions, involved in higher thought functions, with the basal ganglia, a subcortical area of the limbic/emotional system, and the thalamus. The reward system modulates the brain's activity in these frontal structures, involved in decisions and behavioral choices, affecting the increase or decrease of the probability that a specific behavior is acted out. In particular, the act of a motivated behavior is generated by a physiological activation associated with the expectation of a reward or something of gratifying or pleasuring.

Specifically, dopamine can be considered the fundamental neurotransmitter activated by motivating and primary stimuli, such as sex or food.

Moreover, other gratifications are considered as psychological: for example, receiving a "like" on some social platform or a recognition from one's manager, eating chocolate, or receiving an unexpected economic reward. Therefore, several different stimuli activate the release of dopamine providing pleasure.

Specifically, on the one hand, pleasure can be elicited by "intrinsic" sources, consisting of things done for the sheer pleasure of doing them, without finalization and without a goal (playing, for example, is one of them). On the other hand, pleasure can be stimulated by extrinsic sources generated by some external reward, including money and other significant social "rewards" for individuals, as following reported.

Therefore, these intrinsic and extrinsic sources activate the reward system that connects different cerebral areas, such as:

- The striatum, involved in the reward system and supporting the reward forecast. Specifically, this cerebral structure is located bilaterally in the basal ganglia and is composed of two divided sections (ventral and dorsal ones). Both these sides receive dopaminergic inputs from two midbrain regions: the substantia nigra and the ventral tegmental area (VTA), where the dopaminergic system originates.
- The amygdala, that is involved in critical emotional signals and processes, connecting many cortical areas. These interconnections allow emotions to modulate many functions, such as memory, perception, and attention.
- The orbitofrontal cortex, located in frontal regions and connected to other structures, such as the amygdala, hippocampus, and insula, evaluates the motivational valence of stimuli.

Therefore, the connection between the emotional system, which perceives the stimuli and activates the correspondent physiological responses, and the cognitive one, which affects the quality of performance, is extremely active, and dopamine, in turn,

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promotes individuals' mental flexibility and attentional focus.

To this aim, recently, numerous neuroscientific researches has been conducted to observe this cerebral network's functioning in different contexts, using different tasks and various types of rewards.

4. The pleasure of committing

Intrinsic motivation can be described as a natural human drive to be curious and interested, seek challenges, exercise, or develop skills and knowledge by engaging with passion in activities not involving direct rewards, but the pleasure of doing them for the satisfaction experienced. As reported by different studies in this area (SDT - Self-Determination Theory, Ryan & Deci, 2017), intrinsic motivation appears to be directly related to the development of learning, the improvement of performance, creativity, and the generation of well-being.

In particular, an extensive review of Di Domenico and Ryan (2017) has shown that intrinsic motivation and exploratory behavior are phylogenetically linked to the dopaminergic system that governs the motivational drive.

Furthermore, these authors highlighted that intrinsic motivation is supported by a wide range of neural networks controlling different processes, such as the exploratory attitude, attentional control, and self-controlled cognition, consisting of effectively using available resources.

In particular, the "seeking system", consisting in the natural mammals' tendency to engage in different activities moved by curiosity, research, and the game itself, without a specific aim, is therefore linked to the release of dopamine, which promotes individuals' cognitive flexibility, creativity, and the exploration of new objects and contexts, a motivational source of energy and well-being that is still little valued in organizations.

Indeed, the natural individuals' desire to discover and investigate and the curiosity towards the new can be a potential learning reserve that can facilitate naturally changes, if they are not inhibited by the fear of making mistakes or exposing themselves. Another exciting factor considered by different studies is the "*undermining effect*", referring to the fact that an economic reward, associated to the performance of voluntary activities, can reduce the effort made by individuals. Indeed, if two groups are involved in voluntarily chosen gambling activities and an economic reward is proposed to one of them, a particular difference emerges (Murayama et al., 2010). Specifically, for the group economically rewarded, a reduction of the anterior striatum's activity, connected with the reward system, and of the prefrontal cortex, engaged in seeking solutions, occurs.

On the contrary, the choice to perform a voluntary activity provides a prolonged activation of both the cerebral areas involved in cognitive and emotional systems.

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This evidence highlights that the activities moved by an intrinsic motivation can predict the quality of performance, having significant implications for work's motivation.

Therefore, the management of motivation and engagement in the company context could be due to different types of rewards that influence both intrinsic and extrinsic motivations and provide the inclusion of forms of involvement based on voluntary activities with experimental or creative purposes.

For example, examining the agile working methodology, the gamification, that is significantly developing in business practices, or forms of group's intervention that require individuals to find innovative solutions to recurring or new problems, allow to observe the involvement as a visible phenomenon. Indeed, encouraging groups to collaborate on new projects, offering individuals the opportunity to choose what to dedicate to, involves the production of new ideas and solutions, in addition to commitment, which often exceeds expectations in results.

In different companies, modernly conceived, individuals have the opportunity to "play" concerning the creation of new projects or the experimentation of new ways for doing the same things, with results that sometimes transform the organizations themselves.

5. Organizational rewards: not only for money

From a neuroscientific point of view, what "extrinsic" rewards do have organizations to motivate their workers? Certainly, the most commonly used are the economic rewards that have a motivating effect, often more on the performance' quantity rather than the quality.

Furthermore, economic rewards alone are not enough to positively impact the engagement and well-being of the workers. Indeed, various factors and conditions lead our brains to experience pleasure, rejoice, motivation, and engagement. Therefore, companies have a wide variety of interventions available to ensure high levels of motivation in individuals. Following, a selection of different interventions, from the oldest research to date, is reported.

5.1 Social Reward

The definition of "social reward" includes all those forms of motivation related to acting in a social context. The quality of individuals' social interaction and the expectations generated by working in the company with managers, collaborators, colleagues, and customers can be a source of great motivation or, on the contrary, generate frustration activating the "pain" circuit, which involves a workers' avoidance behavior and demotivation eliciting negative emotions, resentment, anger, frustration, that hinder the necessary organizational collaboration. Indeed, social life events, the interdependence with

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colleagues, or relationships with managers or internal clients can represent workers' demotivation sources. On the contrary, the ability of the organization, groups, managers, and people to become activators of others' social rewards can increase the workers' motivation and well-being.

Therefore, individuals' social brains appear to be very sensitive to different types of intentional or accidental social recognition or non-recognition that can cause long-term stress or increase individuals' motivation and engagement. For example, in Caterpillar's intervention, mentioned at the beginning of this chapter, the changes in individuals' engagement were caused by interventions regarding the modality and quality of the vertical and horizontal company's interactions. Indeed, often, the companies, even the medium-sized, are characterized by relational distances between areas and offices, or within the same functions. These distances, which over the years have become real "labels", have undermined collaborative approaches, fluid communications, and targeted interactions, constituting itself as walls that have compromised the achievement of different aims. These distances can be removed by training team building and team coaching interventions, allowing them to remove reciprocal labels and create contexts to know each other better and spend time together and open new spaces for relationships. Moreover, these training interventions reduce individuals' built-up defenses and changing inter-organizational dynamics, especially those involving the Leadership Teams, which have a huge impact on the company's atmosphere and organization. Indeed, when collaborating groups' social life becomes a reward, it represents itself as a primary motivation source.

For about twenty years, neuroscientific research has built the basis for the most recent acquisitions, as discussed in the next paragraphs. A synthesis of some types of social rewards, derived from the results of various research, is reported:

- Social recognition is motivating. Indeed, recognition causes the activation of the ventral striatum. For example, being told "congratulations, you did a good job" by the boss activates the reward system and provides a motivational incentive. Otherwise, the reward system is activated, to a lesser extent, when a computer provides positive feedback.
- Some research confirms that cooperation engages different reward circuit areas, including the nucleus accumbens, the caudate nucleus, and the medial prefrontal cortex. Other research reports that the reward provided by the success in a task performed with other individuals, rather than with a computer, increases the striatum's activity.
- Some studies show that an obtained reward, better than expected, increases the ventral striatum activity more than a high reward in itself. It means that offering an economic reward for a job that exceeds the person's expectation has a more motivating recognition value than the economic reward per se, even if it is high.
- Individuals are often motivated to engage in actions for others' well-being (Bolino & Grant, 2016), in terms of acting a prosocial behavior. Indeed, having a prosocial impact, or the experience of making a difference in others' lives, through one's work,

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activates the reward circuit. Therefore, inter-organizational initiatives aimed at connecting people to their internal or external customers, oriented to become aware about the purpose or impact of a service on the others' work or the final customer, are useful for motivational purposes. Altruistic motivation is supported by neural circuits and can lead individuals to cooperate and help each other.

- In particular, Izuma, Saito, and Sadato (2008) have studied the bases of economic and social rewards, through an experiment involving 19 subjects. The results have shown that having a good reputation involves the same neural circuit, explored using functional magnetic resonance imaging (fMRI), activated by monetary rewards. Therefore, having a good social reputation, consisting of a social positioning recognized as valuable within one's group, motivates itself. This evidence leads to reflect creatively on interventions that provide people with visibility concerning the aims achieved and positively influence individuals or groups' reputation.
- A significant number of researches, including that of Zaki and Mitchell (2011), has shown that unfair decisions involve the activity of the anterior insula, which appears to be connected with the subjective experience of worthlessness' feeling belonging to the "Pain" circuit. Simultaneously, the activity of the part of the insula supporting iniquity predicts individuals' reluctance to make unfair choices. Indeed, the sensitivity to inequity is very pronounced in individuals, and the perception of being in an unfair system leads to disengagement.
- On the contrary, Tabibnia and Lieberman (2007) have observed that the perception of equity is motivating in itself and involves the reward circuit (e.g., it activates the same cerebral system activated by an economic win or eating ice cream!).

5.2 Choice reinforces resilience and learning

Today, the organizational life has to deal with a fast change of paradigm. Indeed, the experience of Covid-19 has forced companies to work remotely.

In some cases, companies have only moved computers and people; in other cases, companies, that have already started smartworking processes, have extended the new paradigm to a broader population. Indeed, smartworking is correlated to a real cultural reversal of the management and leadership logic related to the transition from an organization based on direct control to one based on people's trust and autonomy. In this change of scenery, it is therefore particularly important to highlight some neuroscientific studies that have observed the positive impact that autonomous decision-making can have on motivation, engagement, and, above all, on performance.

Murayama and colleagues (2015), for example, have investigated, with the use of fMRI, the neural correlates underlying self-determined choices and their effects on performance and learning. To this aim, two experimental groups were asked to perform a task, providing to the first group the possibility of deciding certain conditions (choice), differently from the second one (no-choice). This different condition allows observing

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significant differences between the two groups related to various considered factors. The results demonstrate, first of all, that the "choice" condition improved the task's performance, even if the choice has not a direct impact on the possibility of facing and solving the task.

Also, other essential results have emerged regarding the relationship between choice condition and performance. In particular, in the "no-choice" condition, differently from the "choice" one, the negative feedback associated with individuals' failures decreases the activity of the ventromedial prefrontal cortex (vmPFC).

As demonstrated by this study, the vmPFC area's activity, which covers a fundamental role in performance, intervenes only in the presence of a self-determined choice, canceling the demotivation associated with failures.

Indeed, the resilience of this cerebral area of the prefrontal cortex is significantly correlated with a performance increase.

This research is also exemplifying of other research that highlights how the ability to think, the resilience and tolerance to frustration, fundamental characteristics for the development of new skills and knowledge, are more significant when people have the opportunity to exercise an autonomous choice with respect to important factors in managing a task or goal.

The possibility of deciding for themselves, the involvement in decision-making processes, when directly involved in an activity's area, has, therefore, a predictive power on individuals' motivation, assumption of responsibility, involvement, and performance.

6. Feedback that increase the desire to learn

In the last 20 years, companies have extensively used "feedback" that, often, provided in non-optimal ways, have produced more demotivation than motivation, to learn and improve performance. In this context, the integration of numerous evidences emerged by neuroscientific research allows observing how feedback provided incorrectly causes greater activation of the "pain" areas than those reward's one, decreasing individuals' involvement and learning.

In the next paragraphs, some of the most recent research, that can guide managerial practices encouraging individuals to develop a mind-set finalized to growth and continuous learning, are presented.

6.1 Giving feedback and valuing competence rather than incompetence

In a recent research using the EEG (Meng & Yang, 2017), some attention and engagement parameters were tested *concerning the opportunity offered to decide whether to receive feedback or not*. The test involved the assignment of the same task to two

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experimental groups placed in different conditions. The first group, contrary to the second one, was allowed to choose whether to receive feedback or not.

Some exciting results have emerged helping to understand the dynamics favorable to learning, through feedback:

- The success rate was higher for the group that had the opportunity to receive feedback.
- Being able to have feedback is itself a preferred condition over lack of choice. Participants have solicited a feedback in about two-thirds of the trials where they had the option of "choice", and the ability to ask for feedback was subjectively perceived as the most desirable condition.
- The opportunity of asking for a feedback is positively correlated, on a neurophysiological level, with greater attention during preparation for the task (greater motivation/engagement): the requested/chosen feedback increases the level of autonomous commitment and the active concentration during the execution of the task.

However, perhaps the most exciting finding of this research was that participants, with the choice of receiving formal feedback, tended to solicit them mainly in tests in which they predicted victory, avoiding negative feedback.

Indeed, negative feedback can affect individuals' confidence in their own abilities, and participants solicited feedback when they could still maintain confidence in their ability. Indeed, individuals tend to confirm and celebrate successes and avoid frustration.

6.2 Recognize the commitment to foster the challenge

Another research on the feedback's topic, which involved an EEG measurement, (Wang, Zhang, Li, & Meng, 2017) has found the attribution of more excellent subjective value to success concerning the presentation of positive feedback associated to activities requiring much effort, compared to that requiring a low effort. In particular, the following evidence has emerged:

- a high correlation between the effort invested and the anticipatory attention for performance's feedback regarding the working activity.
- an increasing subjective evaluation of the results/positive feedback about the effort made.

The results of this research underlined that the effort made can in itself represents a reward in terms of motivation, strengthening the personal expectation of a timely evaluation after the execution of demanding activity.

Therefore, the feedback should always be provided in conditions of great commitment to avoid loss of motivation or future disengagement.

6.3 Restore confidence in skills after failures

The results of a recent research (Fang et al., 2018) have provided neural evidence of the process underlying the desire to restore one's sense of competence after suffering

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frustration. Indeed, it was found that participants who experienced frustration in a testing task have a greater motivation to win in a subsequent task.

Sometimes it is necessary to put people in front of new activities or engage them in the challenges of overcoming their limits, which involve the experience of failure and consequent frustration. Indeed, confidence in one's skills could be threatened and, as a consequence, be discouraged the desire to try again.

However, precisely to safeguard the sense of confidence in one's abilities, it would be essential to make this work relatively simpler than the previous one, to offer the opportunity to remedy the loss of confidence experienced. Indeed, for individuals' general well-being, when the work is too demanding or challenging, providing positive and timely feedback or giving them the opportunity to decide, it can positively influence the maintenance of the pleasure of getting involved and the motivation to learn continuously.

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