

Physical Activity – The Basis of Learning and Creativity

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Abstract

Learning and knowledge – a result of learning – are cornerstones of both the future professional career of every individual and of the economic future of a country: Knowledge is the necessary precursor of creativity, and creativity is vital for successful innovation.

Physical activity is an important part of learning and supports the learning process. In innovation-intensive companies, not only the immediate physical effects are of interest, but also the social and psychological effects of movement must be taken into consideration.

Physical activity influences creativity and thus innovation. This may happen in three different ways:

First, physical activity effects learning ability and cognitive performance. The blood flow to the brain and thus, the oxygen and nutrient supplies are increased. The increased synthesis of neurotransmitters has a positive effect on memory. Impressions that are absorbed over several sensory channels are memorized for a longer period of time. Second, social effects of physical activity are important: Moderate physical activity leads to more contacts with others, implicit knowledge can be exchanged much more intensively. Also, the more people one knows and the more encounters between people with different knowledge take place, the better the access is to expertise. Both promote creative work. Third, physical activity has psychological effects. The increased synthesis of neurotransmitters regulates and improves our state of mood. Physical Activity improves mental equilibrium.

The design of workplaces and the architecture of buildings are important factors for improving the behavior of activity and thus for creating better learning conditions. As a result, creativity and innovation may be enhanced. The investment in a activity-friendly working environment is paying off and leads to a higher efficiency.

1. Introduction

Even in ancient times, scholars recognized that activity and learning are interconnected. Greek philosophers and scholars mediated and taught while walking. Physical activity improves one's concentration and supports intellectual work: Medieval monasteries had fixed hours for walking together.

Today it is unusual to incorporate activity into work. Physical activity and working are usually seen as opposites. But even more than in ancient times, learning has a great importance in professional life. What we are and what we will be is a result of our learning. The ability to learn fast and keep that knowledge is an advantage in the modern work environment. Knowledge is an important resource in our knowledge-driven economies, where innovation is a key driver. However, knowledge may not be the exclusive indicator for innovation in developed countries: a comparison of the results of the 2009 PISA (Programme for International Student Assessment) survey **Errore. L'origine riferimento non è stata trovata.** with the 2009 Global Innovation Index **Errore. L'origine riferimento non è stata trovata.** shows that the countries who rank highest in the PISA study are not necessarily those with the highest innovation activity.

Nevertheless, knowledge is a necessary condition for creativity. A wide range of factors influences creativity in organizations, but knowledge seems to play important role. Knowledge and knowledge



creation are significant sources of creativity **Errore. L'origine riferimento non è stata trovata.** and thus of successful innovation. Creativity and innovation are related with a means-end relationship: Innovation is essential for the growth and competitiveness of companies **Errore. L'origine riferimento non è stata trovata.** In the 20th century, technological advancement, driven by innovation, was a key factor for the extraordinary economic growth **Errore. L'origine riferimento non è stata trovata.**

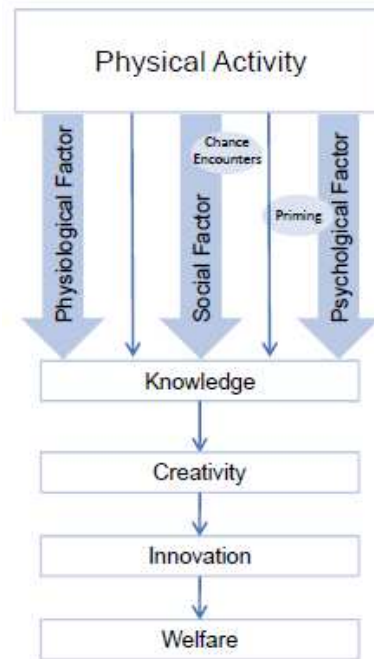


Fig.1. Relation between physical activity and creativity

2. Three creativity-promoting factors of physical activity

Physical activity can be divided into three types: Targeted mobility, non-targeted mobility and organized physical activity. Targeted mobility means a activity towards a specific place or object, e.g. going to the photocopier or having lunch in a restaurant. Non-targeted mobility is characterized by having no specific destination, like taking a walk. Organized physical activity is mostly a training session, offered by employers or self-organized by employees.

All modern management concepts (for example lean management, total quality management and business process engineering) consider targeted mobility as the most effective way of improving the company's and the employees' efficiency during their working hours. Walking around with no specific destination may be fruitful, but the appearance of doing nothing is not perceived as effective in today's work atmosphere. And organized physical activities typically take place after work.



Fig.2. Physical activity can occur in three ways

Physical activity is mainly caused by our environment: Our immediate work environment affects our individual activity behavior. Lewin refers to the characteristic of the environment's invitation ("Aufforderungscharakter") of motivating individuals to act in a certain way **Errore. L'origine riferimento non è stata trovata.** An environment which encourages activity or a certain type of



behavior is said to have a positive effect on invitation. The characteristic of invitation deeply affects our behavior and our physical activity.

Physical activity may influence creativity in three different ways:

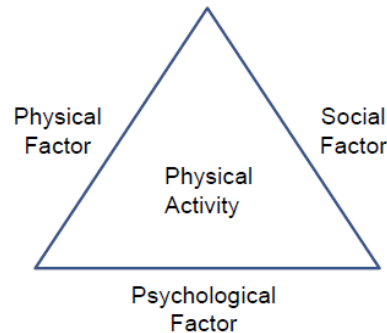


Fig.3. Three creativity-promoting factors of physical activity

2.1 Physical Factor

Moderate physical activity influences our learning ability and our cognitive performance. The blood flow to the brain increases, which results in a higher supply of oxygen and nutrients. **Errore. L'origine riferimento non è stata trovata.** **Errore. L'origine riferimento non è stata trovata.** **Errore. L'origine riferimento non è stata trovata.** An increased synthesis of neurotransmitters has a positive effect on the memory **Errore. L'origine riferimento non è stata trovata.** At birth, the brain consists of more than one hundred billion nerve cells. These nerve cells have to be linked. Stimuli through physical activity create and support these neuronal links. The more stimuli the brain has, the more complex the neuronal structure of the brain gets **Errore. L'origine riferimento non è stata trovata.** The function of the nerve cells is to store and process information. Physical activity supports the formation of networks in the brain. The development of thinking is closely related to physical activity. Information will remain in the memory longer **Errore. L'origine riferimento non è stata trovata.** In addition, knowledge, which is recorded by multiple sensory impressions, has longer lasting effects as well.

Attention and concentration are essential to successful learning. They occur at a sufficient neural activity in the brain and can be raised by physical activity **Errore. L'origine riferimento non è stata trovata.** **Errore. L'origine riferimento non è stata trovata.** In particular, the equilibrium system is responsible for our level of attention. **Errore. L'origine riferimento non è stata trovata.**

Flexibility is the key to creative thinking. For heavy problem solving, it is better to not continuously think about a particular problem but to relax, take a walk or sleep so that the unconscious thought process can proceed without stress **Errore. L'origine riferimento non è stata trovata.** When performing semiautomatic activities (e.g. swimming, walking or driving a car), people often reach the highest level of creativity, because some the mind is free to make connections among knowledge modules that are usually not made **Errore. L'origine riferimento non è stata trovata.** So creative thinking is often the result of both, conscious and unconscious thinking **Errore. L'origine riferimento non è stata trovata.**

To really perform well, we need both the left (analytical thinking) and the right part (emotional thinking) of the brain. The better the access is to both parts of the brain and the better their cooperation is, the more intelligent we can act. Physical activity activates the body and the brain and strengthens the part of the brain which supports the cooperation between the two halves **Errore. L'origine riferimento non è stata trovata.**

This symbolizes Mintzbergs famous metaphor: "Planning on the left side and managing on the right" **Errore. L'origine riferimento non è stata trovata.**, a metaphor heavily questioned by Herbert Simon (e.g. **Errore. L'origine riferimento non è stata trovata.**).

2.2 Social Factor



Innovation, especially in knowledge-based industries, usually requires a high variety of knowledge. The needed convergence of different knowledge takes a long lead time because many different pieces of knowledge have to put together **Errore. L'origine riferimento non è stata trovata..** The more contacts exist between experts from various departments, the faster this process take place, the better the access is to expertise of other disciplines and the more unconventional ideas result. This is the basis of chance encounters stressed by many scholars of creativity **Errore. L'origine riferimento non è stata trovata..**

Because close co-workers tend to have the same focus and knowledge, knowledge transfer between distant workers with different expertise particularly facilitates new ideas by opening up new approaches to an existing problem **Errore. L'origine riferimento non è stata trovata.Errore. L'origine riferimento non è stata trovata..** Weak relations are more important for creativity than strong relations. Therefore, a useful design of a workplace layout may increase communication and thus knowledge transfer **Errore. L'origine riferimento non è stata trovata.,** even among distant people: More physical activity during work time increases the probability of chance encounters, which leads to more contacts with others and thus to more creative ideas.

2.3 Psychological Factor

Physical activity improves mental equilibrium. An increased synthesis of neurotransmitter regulates our mood states **Errore. L'origine riferimento non è stata trovata..** Through physical activity, metabolism is stimulated which influences hormonal processes, leading to an increase in mental and spiritual well-being **Errore. L'origine riferimento non è stata trovata..**

As is known, motivation is central for creativity **Errore. L'origine riferimento non è stata trovata..** In other words, even motivation – and thus creativity – can be influenced, among other things, by the physical and mental well-being of an individual. Whether well-being has a positive or negative impact remains open: Many very creative works were delivered under extreme stress: Van Gogh, Mozart, Bach..

| Factor | Effects | Impacts on Creativity |
|----------------------|--|--|
| Physiological Factor | Increased blood flow, increased supply of oxygen and nutrients | Increased cognitive brain performance |
| | Increased synthesis of neurotransmitters | Increased memory performance |
| | Creation and support of neuronal structure and neuronal activity | Longer lasting storage |
| | | Increased concentration and attention |
| | Stimulation of both conscious and unconscious thinking | new connections among knowledge moduls |
| | Improved cooperation of the right and left brain sides | Improved connection of analytical and emotional thinking |
| Social Factor | Increased contacts among different people | Increased combinations of different pieces of knowledge |
| | Chance encounters between people, who do not know each other | Access to other kind of knowledge Knowledge transfer between distant workers (weak relations) |
| Psychological Factor | Mental and spiritual well-being | Increased motivation |
| | Mood state | Balanced mental equilibrium Increased motivation |

Fig.4. Impacts of physical activity on creativity

3. Summary and Discussion

Physical activity is an important part of human learning and supports our learning processes in different ways: Physical, social and psychological factors are stated. Each of them promotes creativity, and therefore innovation, in its own way. In innovation-intensive companies, immediate physical effects are mostly of interest, but also the psychological and social effects of activity must be taken into consideration. In practice, these factors are often forgotten.

Not only do the processes during work influence the activity behavior, but also the organization of work, the design of workplaces and the architecture of buildings. These two last aspects are mostly neglected. Because of that, physical activity needs more attention when designing new buildings. The aspects of physical activity and chance encounters have to be taken into consideration when designing a new work environment. A sensory activating environment can increase concentration, the ability to learn and creativity. The result is higher work efficiency.

The design of workplaces and the architecture of buildings are important factors for improving the behavior of physical activity. A careful planning of working processes and workplaces is well worth the effort.

Especially schools try to take these findings into account. They usually do so in awareness of the physical effects of activity. They implement movement projects in the daily schedule or use special didactic approaches where physical activity is an integral part. However, these projects are mainly aimed at the physical aspects of activity exercise. In industry, the awareness of the connection between physical activity and learning is still not known. Especially companies characterized by high innovation are not aware how effectively they could support creative work by putting more emphasis on physical activity.

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