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How to improve the efficiency of our brain?

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Abstract. The efficiency of the brain greatly contributes to a person's intelligence quotient (IQ), which may ultimately affect one's social status. Neurophysiological processes and IQ change during a person's lifetime and depend on a number of factors, including fluid and crystallized intelligence, diet, physical activity and sleep. As described in the literature, the level of fluid intelligence decreases with age. This process can be delayed by implementing mental exercises and physical factors in one's lifestyle. The SOMECO concept developed in Germany and described in this paper emphasizes the importance of following the most current scientific research in maintaining overall mental health.

Keywords. brain, SOMECO concept, mental health

In today's world, the efficiency of brain function is expressed by a person's level of intelligence. A large number of publications have indicated the factors important for maintaining and increasing the level of intelligence, or preventing it from decreasing with age. It is worth noting that the intelligence quotient (IQ) is not a constant value and changes during a person's lifetime (Carroll 1993). In today's world, employers place a high value on the pace and accuracy of work and a high level of intelligence, and the employees translate these values into measurable financial benefits (Flynn 1987).

Zwan (2011) in the Scottish Mental Survey of 1932 presented results of a very interesting study showing changes in IQ occurring with age (Fig. 1). That study included the entire population (87498) of 11-year old Scottish children in 1932. The data collected in 1932 was compared with a survey conducted 70 years later among 500 people who participated in the first survey. It was noted that the IQ of children in the first study changed during their lifetime. Individuals whose IQ during the first study was at the level of intellectual disability, had shown an increase to about average, and the participants with IQ above average during the initial study had changed to the level of intellectual disability in the second study.

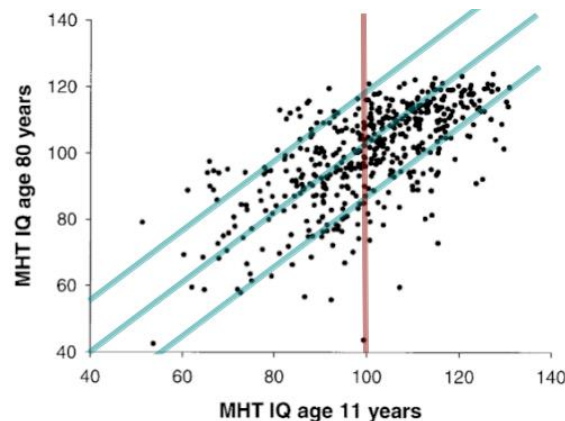


Figure 1: IQ variation with age in Scottish Mental Survey (Zwan 2011).

Such a significant change in IQ during a person's lifetime is possible and may result from the structure of intelligence. Cattell (1963) described and distinguished two areas of intelligence:

- Fluid intelligence also called cognitive intelligence, or non-learned intelligence, describes the speed of mental processes or the speed and quality of the transmission of nerve impulses among neurons. This intelligence is applied in solving non-verbal tasks (e.g., stacking blocks) and vocabulary tests (e.g., testing the number of known words); it decreases slowly with age (*brain alopecia*) and is compensated by:
- Crystallized intelligence that is described as available knowledge and the skills to use this knowledge. It can be measured by vocabulary tests, arithmetical tests, and tests of general knowledge.

Age-related neurophysiological processes, such as the speed of information transmission along nerve fibers, and the speed of neural communication, influence the level of fluid intelligence. Studies have shown that these changes usually occur around the age of 45-50 and cause a gradual decrease in mental fitness (Lehrl, Sturm 2013). This process can be delayed by implementing mental exercises and physical factors in one's lifestyle, as confirmed by Lehrl and Fisher (1988a).

Other studies (Bourne et al 2007, Whitaker 2008) show a relationship between effective work of the brain and a person's social status. In his study, Murray (1998) examined the level of intelligence and income of nearly 13,000 18 year olds. He re-examined the same group after fourteen years, and showed that an increase in the level of intelligence corresponded to an increase in income. Murray's study indicated that even if the level of intelligence and income of the respondents were similar at the starting point, after 14 years those with the highest level of intelligence earned the highest income.

The observations described above led to further studies focused on the improvement of brain efficiency. Vast majority of those studies have shown a relationship between brain efficiency and one factor such as sleep, medication, or physical activity. However, a few studies have focused on brain function and its efficiency when exposed to several factors simultaneously. For example, in studies done through the EatFit program, physical activity combined with a specific diet translated into the participants' high intellectual fitness (Horowitz et al. 2004, Shilts et al. 2009). Other research focused on diet, the length and quality of sleep, physical activity, sensory function, and mental exercise as the key elements relevant to high brain function. They include:

- Diet (e.g., cold-water fish, rolled oats, green vegetables, rapeseed oil) and eating habits (thorough chewing before swallowing). Depending on whether a high level of mental functioning is required for a long or short period, different diets should be followed

(Benton and Nabb 2003). If the mental task requires longer time, it is beneficial to eat foods that are released more slowly, and thus provide the brain with essential nutrients for a longer time such as complex carbohydrates (bread, rice, pasta, whole-grain bread, potatoes, vegetables, and fruits, granola, rolled oats). If the mental work is shorter, the diet should be based on simple carbohydrates (grape sugar-glucose, honey, or fruit sugar-fructose) (Kim et al. 2010). The same study says that high fat-diet inhibits mental performance for many hours;

- Drinking water: recommended 2-2.5 liters / 24 hours. Drinking water is particularly important for physical activities due to high fluid loss, as well as in certain climatic conditions, when the body naturally loses more fluid because of sweating. The feeling of thirst is a signal of fluid loss, and indicates that fluid should have been given before feeling thirsty (Wagner et al. 2011);
- Physical activity such as long runs or team sports (e.g. soccer, football, or volleyball). Physical activity plays an important role in mental fitness, especially aerobic exercises, which allow greater oxygenation of the brain and contribute to its high efficiency. Hillman et al. (2008) and Martinez-Gomez et al. (2010) conducted interesting series of studies that demonstrated a significant role of physical activity (mainly aerobic) in academic achievements. Aberg et al. (2009) showed that average muscle strength and physical fitness (studied during long run) are essential for intellectual fitness.
- Sleep (uninterrupted sleep). Many studies conducted on sleep indicated that the quality and length of sleep is important for the rest of the nervous system, therefore, crucial for efficient mental functioning. A significant role is also attributed to midday napping (no longer than 30 minutes) that is very important for consolidation of the learned material and quick revitalizing of the nervous system. The first 2-3 minutes, during which about 15% of the information is consolidated, are particularly important for remembering the learned material. This phase of sleep is crucial for committing the content to memory, because in later stages of the nap, it takes about 25-27 minutes to remember a similar amount of material;
- Efficiency of special senses (primarily balance, vision, and hearing). Scientific research, primarily in the field of psychology, shows the role of proper functioning of sensory organs in determining the level of intelligence, efficient mental functioning, and in other aspects of mental health. Particularly noteworthy is the research on hearing and sight, as loss of these senses is easily noticeable, hence allows for immediate treatment and correction (Gerstmeyer and Lehl 2004).

Based on the above reports, Lehl (2013) developed the concept of SOMECO stairs. The concept applies the key factors for efficient functioning of the brain that in turn leads to a high level of intellectual efficiency, so important from the point of view of income and position in society (Figure 2).

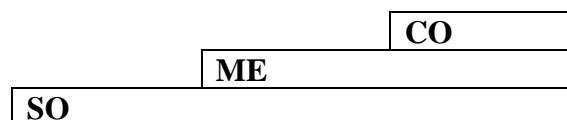


Figure 2. SOMECO stairs (see: Lehl, Sturm 2013).

Key elements of that concept include somatic/ physical efficiency (SO), which serves as a base for mental efficiency (ME), which in turn leads to a high mental and cognitive competence (CO).

As indicated in Figure 3, each SOMECO level includes further subcomponents. The SO area includes appropriate diet, physical activity, sleep, and sensory performance. The ME area

includes appropriately selected mental exercises and the ability to appropriately select information, while the level of CO are techniques of effective information processing allowing for a high level of mental fitness.

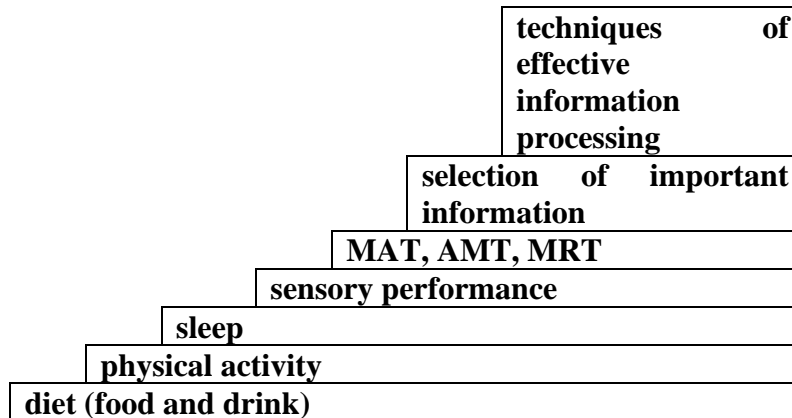


Figure 3: Detailed structure of the SOMECO and its subcomponents stairs

Among mental exercises, special attention should be given to those adapted to the natural biological rhythm. It is assumed that in the mental cycle of activity there are cyclical changes observed during physical training, i.e. warm-up, the training itself, and calming down of the body after completing physical tasks. These exercises, applied at the right phase of the mental cycle, are called MAT (Mental Activation Training), AMT (Adaptive Mental Training), and MRT (Mental Relaxation Training), and they overlap with the mental activity cycle. In this cycle, repeated every 30-60 minutes, there is a short time of entering high level of intellectual fitness (about 2-3 minutes), the longest period of staying at this level (up to 50 minutes), and then the stage of calming down, necessary for mental rest (about 2-3 minutes).

Studies by Colom et al. (2007) and Gieseke et al. (2011) prove that the systematic use of MAT, AMT, and MRT exercises improve both mental performance and efficiency, becoming the basis for high effectiveness of work both in primary and secondary school, at university, and at work. Examples of MAT and AMT mental exercises used in the SOMECO stairs system are presented in Table 1 and Table 2.

Table 1. MAT exercise: the numbers can be read in both directions – each line two times (speed of reading at the discretion of the reader).

373	86896902105384963922049273160237237698209421
561	58193029465610185050214869457826574858616533
031	67310503148694960859271406188975302546715130
973	72079120537906875693018429056868219497393501

Tab. 2. AMT exercise: the characters can be read in both directions – each line two times (speed of reading and lack of mistakes are important).

031	67310503148694960859271406188975302546715130
zms	Skzumwhhfhanrnzmsickaldsmzblcavenritousjfgndjasjaq
\$R8	A&\$()AF8\$R8HZ/FS9∂§\$/K”\$3578R\$G\$7BN&AW\$5
TLD	GRDLTJKLPURWOAPLTZEDSEGJLILÓWQADGTLDBHGS

The 13-week study conducted in Germany on a group of 43-67 year-old people, with different levels of education, showed that the use of comprehensive support for intellectual skills is highly effective (Lehrl and Fischer 1988b). There was a clear improvement in mental fitness in participants with secondary and higher education after completion of the project. In the case of participants with a low level of education, after the initial increase in mental fitness (up to 7 weeks), a decrease in motivation to continue this study was observed, leading to a decrease in intellectual fitness as compared to the initial level. In his study, Springer et al. (2005) confirmed the results presented above.

In conclusion, the efficiency of brain function is significantly influenced by simultaneous application of several factors such as sleep, diet, physical activity, and mental exercises. All are important for a high level of mental health, therefore, contributing to personal and professional life satisfaction and success.

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