

## THE INFLUENCE OF TRAINING OF COGNITIVE FUNCTIONS ON SUSCEPTIBILITY TO VISUAL ILLUSIONS

Recently the interests have been extensively focused on the cognitive trainings efficiency, that are supposed to improve cognitive functioning such as memory, attention, reasoning as well as mental speed. The effectiveness of trainings, particularly at longer perspective and in a transfer on not previously trained cognitive functions, like intelligence, is controversial. Nevertheless, there are a few studies that show the efficacy of trainings. E.g., Susanne Jaeggi showed that three week memory training positively affected intelligence level in college students. What is crucial for this project, training of perception seems to be also effective. E.g., Adrian Owen indicated improvement in perceptual tasks that required stimuli differentiation and their spatial localization. However, there are not enough data about longer effects and a transfer on different cognitive processes is rare and limited. Although visual illusions phenomena are common in western culture the influence of cognitive trainings on resistance to visual illusions have not been investigated yet. It is assumed that illusions stem from not optimal cognitive functioning thus, its improvement may increase resistance to illusions. It is difficult to overestimate such a possibility, particularly when consider threatening human errors that result from perceptual illusions e.g., in aviation (military pilots, dron's operators) in sport (horseback riding, skiing, motor sports and steeplechase) in medicine (surgery, radiology). It would be irrational to ignore this aspect particularly if visual illusions may be a potential factor in aircraft disaster (pilots faults).

Generally we distinguish five groups of perceptual illusions that are based on certain cognitive rules: shape and direction, size contrast, overestimation and underestimation, frame of reference, whereas Jacques Ninio stresses that brain using a meter, a compass and an angle bar makes errors that result in geometrical illusions: metric and those related to orientation (direction). Typical metric illusions are: contrast and assimilation, i.e. Ebbinghaus, Ponzo, Miller-Lyer). Orientation illusions are: Zollner, Poggendorff and Roelofs effect.

There are difficulties in precisely showing psychological mechanisms of illusions formation. Some experiments revealed that Witkin's FDI style is responsible for vulnerability to perceptual illusions. E.g., Witkin and Goodenough noted that negative correlation between EFT performance speed and susceptibility to the context illusion in which vertical rod surrounded by a tilted frame is perceived as slightly deviation from a vertical position. Field dependent participants are less prone to illusions. Walter and Dassonville explained these behavioral relations using common neural correlates approach that link both information processing while performing Embedded Figures Test and a presentation of the mentioned above illusions. fMRI studies give solid bases to infer that a common core may be placed in both hemispheres a dorsal-posterior part of the parietal cortex and precuneus. Moreover, it was found that field independent person's attention is engaged more than during tasks inducing geometrical illusions. In fMRI studies on information processing while performing EFT a set of positive correlations between processing speed and activity of certain cortical areas was found. The author's studies in which FDI was tested using EFT showed that field dependent participants are more prone to most of perceptual illusions as compared to field independent participants.

Illusions are treated mostly as a wrong perception, particularly when there is lack of data, stimulus is degraded, elements are atypically connected or familiar patterns are invisible. It may result from physical features (a stimulus) or from cognitive aspects (a wrongly applied rule). On this basis sensory and perceptual illusions may be distinguished. Another approach assumes that if all people are vulnerable to illusions, then illusions are natural for cognitive functioning. A perceptual system processes information corrected in "normal" or in "distorted" perception. Thus, illusions arise as a consequence of latent data correction) that was automatically processed by a perceptual system. We assume that illusions arise when a tested hypothesis (mental model of a certain situation), despite its inadequate to reality, is adopted.

To sum up, there is lack of research reports on cognitive trainings effectiveness on cognitive style (field dependence – independence) which is a relatively stable predisposition to certain behaviors and is formed in childhood however, may change with age and may manifest in decrease of certain cognitive functions (e.g., with age there is decrease in memory performance, spatial skills, mental rotation, reasoning, visual scanning). Only few studies have focused on increasing resistance to visual illusions using cognitive trainings which seems to be more sophisticated than looking for the relationship between trainings and intelligence (e.g. Jaeggi). It should be stressed that this type of research play a crucial role e.g., in aviation where perceptual illusions (peripheral and central) can cause spatial disorientation. Aviation simulators were used to train certain behaviors under the influence of illusions.

Our research plan consists of three stages. First serve to cognitive diagnose and select of participants to cognitive trainings. In this stage we will diagnose vulnerability to visual illusions, cognitive style (FDI) and cognitive functioning. Next we will elaborate and perform 6 week cognitive trainings aimed at improving certain cognitive processes considering main predictors for illusions. Four groups will perform a different versions of cognitive training related to modules that highly advanced cognitive functions. The fifth group will serve as control one. After completing trainings, both the efficiency of trainings and their influence on cognitive style as well as perceptual illusions resistance will be examined.

We expect to affect resistance to perceptual illusions by using cognitive trainings in field dependent individuals). The stronger effect of reception and perception training as well as attention training is supposed to be obtained for shape and direction illusions as well as frame of reference.

Besides theoretical elaboration of cognitive trainings that may cause increase in field independence (general higher resistance to illusions), the research may also have implication toward better understanding of human functioning in various occupational situations that require special skills in visuo-spatial functioning (e.g., drons' operators, surgeons who use laparoscopic tools, pilots, architects).