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Identification of Management Styles with the Use of ICT Support Instruments

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Abstract:

Purpose: *The article is an attempt to assess the possibilities of selected ICT support tools, in the process of examining the competences and predispositions of the management (command) staff in relation to management styles.*
Design/Approach: *The research was carried out with qualitative methods using STRD thermoregulatory scanning, static eye-tracking and data recording on passive RFID and NFC transponders. The research process concerned a pilot group of students of the Military Academy who were tested in isolated conditions and subjected to the influence of stressors.*
Findings: *The results of the research show that combining the research methodology and enriching it by other analytical devices from the IT group, make it increasingly possible to identify the attitudes of future commanders and managers. The ICT tools used in the research have been enriched during their implementation with new elements.*
Practical implications: *Organizations that want to focus their efforts on priorities such as role modeling, quick decision-making, vision definition or shaping leaders should increasingly use innovative methods of assessing the competences and predispositions of managerial (command) staff not only in the area of decision making. In connection with the above, it is reasonable to strive to develop a holistic model of personality on the basis of which it will be possible to interpret changes in neuroplasticity, and the method of such an examination is the Thermoregulatory Scanning Diagnostics - STRD.*
Originality/value: *Building efficient and at the same time complex ICT support tools for the assessment of managerial and command profiles is becoming one of the elements of the virtual world in the era of increasing intensity of matter, energy and information flows. Augmented reality is increasingly used in many areas of science, economy and medicine, combining the real world and virtual reality with the use of an interactive image in real time.*

Keywords: *Management decisions, management styles, eye-tracking, thermo-active scanning.*

JEL classification: *O3, O31, O32, O33.*

Paper type: *Pilot study in the form of an experiment.*

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1. Introduction

The tendency to make decisions in certain circumstances is due to the human personality, which in turn is due to heat regulation, neuroregulation and neuropsychomatics. When looking for the sources of decision-making processes resulting from the human personality, attention should be paid to the problem of systemic thermoregulation. Practice proves the effectiveness of diagnostic methods with the use of psychometric tools. The article is an attempt to evaluate the possibility of using scanning thermoregulatory diagnostics - STRD supplemented with eye-tracking diagnostics in the process of examining the competences and predispositions of management (command) staff in relation to management styles.

Known personality types (temperaments) classified by Hippocrates are defined as: sanguine (*lat. Sanguis - blood*), choleretic (*gr. Chole - bile*), melancholic (*gr. Mélanos - black + chol - bile)* and phlegmatic (*gr. - phlegm*) and are currently an insufficient classification in assessing human predisposition, competences or decision-making tendencies.

In scientific and research practice, a number of psychometric tools are used to study and describe personality. They facilitate diagnosis and differentiation, and allow to monitor changes in equal aspects of the personality. Commonly used tools of this type are: Minnesota Multidimensional Personality Inventory MMPI-2, Personality Inventory NEO-FFI, Eysenck Personality Questionnaire EPQ-R and Cattel 16PF Personality Questionnaire (Hall and Lindzey, 1990).

The latest research by Northwestern University scientists confirms that there are four types of personality in humans. These are: the reserved type, the type considered to be a role model, the non-average type and the egocentric type (Roberts, 2008). By far the most popular and used personality test has been the Myers-Briggs (MBTI) test, which is an extended concept by Carl Gustav Jung. The psychologist noted that people have certain tendencies regarding energy management (extraversion / introversion), how information is gathered (cognition / intuition), decision making (thinking / feeling), and dealing with the world around it (judgment / observation). Personality type depends on preferences in each of these four dimensions. According to modern psychologists, the analysis of data sets is a more reliable tool than the researcher's observational sense. According to L. A. Nunes Amaral, Big Data is an excellent tool for collecting and processing "personality data" and combining them with the existing psychological knowledge.

Analyzing huge data sets for repetitive patterns, the so-called “The big five”. This model includes five personality factors such as neuroticism, extraversion, openness to experience, agreeableness and diligence. These dimensions are treated as operational regulators defining the basic personality type and, in the context of research in the area of decisions, they determine the predispositions of potential decision makers (Nunes, 2018; Kambey *et al.,* 2018).

2. Literature Review

Literature distinguishes several or even a dozen or so styles of team management. Thus, there are many divisions into styles, among which there are generally known ones, such as: autocratic, democratic or liberal. The autocratic style refers to particularly deep managerial interference in making decisions, allocating tasks or having a strict attitude towards employees. The liberal style is its opposite and is based on the freedom of subordinates, especially their high decision-making power, and the democratic style is located somewhere in between and is based on the high decision-making power of the employee group, then the manager can propose alternative solutions and play an auxiliary role supporting the team. Over the years, new styles have been created, which are partly a hybrid of classic ones, but also new ones relating to coaching models, affiliate, prescriptive or those based on a process approach. Each style has its advantages and disadvantages. Depending on the needs and the person, everyone can present a different style that is more coherent for him, especially with regard to character traits, personality and competence. This means that people are looking for management styles that are in line with their nature. You can also develop the ability to manage in various ways, i.e., use the most advantageous styles in a given situation, i.e., adapt them to the team or the company's requirements (Bondarenko *et al.,* 2017; Havlicek *et al.,* 2013).

Functioning within a certain style will therefore have an impact on the coordination of teamwork, solving current problems, setting goals for the organization and dividing tasks or initiating employee development. Therefore, being a team leader will be associated with a lot of responsibility. In general, management styles are embedded in several dimensions, including: the degree of employee participation in decision making; interacting with employees (frequent / infrequent / deep / shallow etc.); intensification of the control exercised (i.e. what is its frequency and how much is the leader's interference in the work of the subordinate); whether the employee has a "free hand" in certain activities, or whether the supervisor focuses more on tasks or more on people.

Therefore, it cannot be clearly stated that a given management style is better than another. McGregor's theory with the X and Y approach (McGregor, 1957), the approach of Blake and Mouton (Blake and Mouton, 1964), the styles of Lewin, Lippitt and White, or the concept of Goleman, contain elements that a good manager can skillfully use depending on the situation. It is important to know that style is the result of features, as well as the knowledge of the superior and subordinates, and the company's requirements. Knowledge of management styles is the basis for people holding managerial and leadership positions. It is also valuable information for employees, because they will then know what type of leader they are dealing with and thus they will be able to adapt their behavior to the requirements set for them. Observations show that managers, similarly to employees, most often present intermediate attitudes (intermediate styles).

Initially, it was believed that a manager should be able to apply a specific, best style in the organization. Today, it is rather claimed that a manager is the more effective the wider the repertoire of management styles he has and the better he can choose the most appropriate style for a given situation. Thus, the role of the manager is to learn about the styles and conditions of their application. In the concept of R. Tannenbaum and W. Schmidt, for example, the scale of possible behaviors of a manager depending on the person on whom the behaviors are focused was adopted. The management style is influenced by: the manager himself, subordinates, and the situation. Depending on these factors, the manager makes a decision and announces it, persuades to accept the decision, presents ideas and expects questions, presents approximate decisions that may change, reports the problem, expects suggestions and makes a decision, defines boundaries and proposes to the group to decide whether allows the group to make decisions within set limits. Dansereau's leader-member exchange theory suggested that the supervisor should treat individual subordinates differently and that the relationship between the supervisor and subordinates would evolve over time (Dansereau, 1975).

In addition to being task-oriented and people-oriented, some researchers have attempted to introduce a third dimension. P. Hersey and K.H. Blanchard in the evolutionary theory of management adopted the level of maturity of their subordinates as the third dimension, determined by their skills and motivation (the following styles were distinguished: autocratic, integrative, participatory and delegative). Later, Blanchard in collaboration with Hermes, redefined the styles and distinguished: selling, participating, instructing and delegating (Hersey and Blanchard, 1969). In practice, W. Reddin's model was better adopted, which distinguished efficiency as the third dimension (Reddin, 1970). New trends in management define the so-called The New Style is based on the 3-D rule, which means requiring, supporting and binding actions on the basis of feedback, and the basis of this style are: employee participation in management, information, vision creation, support, consultation and delegation of authority and responsibility.

It is not the author's intention to present in detail individual management styles, but to focus more on the functional approach based on the methodology of analyzing the personality, traits and predispositions of the respondents (cadets) in terms of their managerial abilities. Due to the fact that they are students of a military university, their leader profile is important from the research point of view. Thus, the thesis is based on the assumption that people with a specific personality profile, having appropriate (required competences), are able to achieve the assumed goals through the interpersonal influence exerted on others in a given situation. The author assumes that this can be effectively achieved through the study and use of interpersonal relationships (research on the dominance of the neurotransmitter - GABA), techniques involving the understanding of human factors, observation of communication processes (using an eye tracker), interpersonal and intergroup behaviors, and organizational dynamics.

3. Research Approach

The topic discussed in the publication focuses on the analysis of the usefulness of ICT tools for the diagnosis of selected biomedical processes and their relationship with personality types, the tendency to make decisions under risk conditions, and as a result, to a potential assessment of leadership styles / leadership.

During the research, a comprehensive program for assessing the natural potential and current capabilities of potential commanders or managers was used - IEMSS - (Integrated Enterprise Management Support System) based on the neuroleader concept. This system allows you to examine not only attitudes, but also the cause of stress or reduced work efficiency. Analysis of managerial attitudes with the use of the IEMSS system, which uses the instruments of thermoactive scanning and significantly supports personnel management, which translates into work results (efficiency) and increases the efficiency of the team. The research methodology was enriched with eye-tracking diagnostics and research on the type of stress affecting the examined person.

Eye-tracking as a qualitative test is based on a biometric method and deals with the measurement and analysis of eye movement parameters. The analysis of the activities related to the eye movement abruptly and the focus of attention allows to determine the parameters of saccades and fixations. On the basis of these data, it is possible to observe the correlation between the saccadic intensity and the individual phases of the decision-maker's thought process and his decision-making efficiency. The use of questionnaire methods does not allow for full objectivity in the assessment and interpretation of the impact of various situational factors on the efficiency of decision-making processes carried out by the decision-maker.

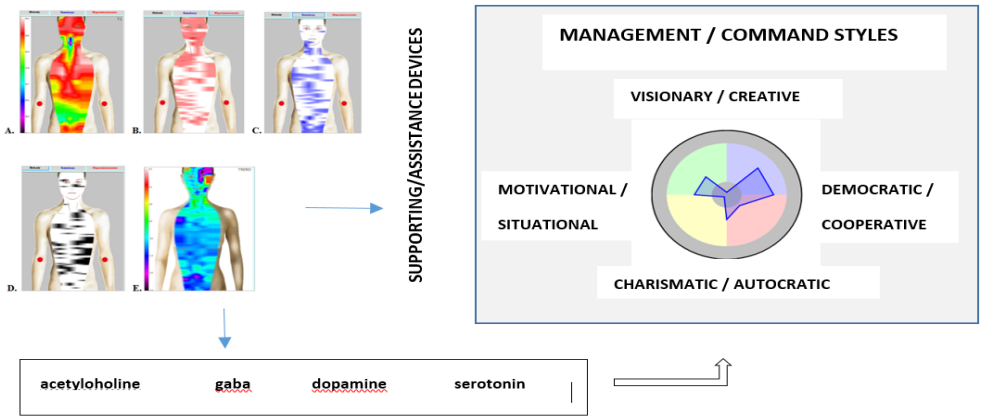
Scanning Thermoregulatory Diagnostics STRD is an examination that uses the variability of infrared radiation. It is standardized and can be an indicator of the overall activity of the nervous system. It is an excellent tool for determining the stress response and attitudes of the examined person. It allows us to look at the team as one organism, while diagnosing the "bottlenecks" of the organization. Recent versions of the software are "intelligent in nature" and allow you to direct conclusions in the field of management (command) style based on several trials at appropriate intervals relating to the trend.

3.1 The Essence of the Method of Subcutaneous Micro-Radiation Scanning

The method consists in a non-contact measurement, with an infrared sensor, of the human body, which is subjected to a stress stimulus, which in this case is the cooling of the body, which is achieved by undressing the subject. The method of examination can be compared to an ultrasound examination, where a probe, in this case an infrared analyzer, is moved along the human body according to a specific procedure, collecting data, i.e. specific temperature values in the infrared range.

Unlike ultrasound and TRD, the probe does not come into contact with the body in this method. Three consecutive measurements are made in a fixed order and time. After the organism reaches the state of homeostatic equilibrium (according to W. Cannon's theory), the fourth measurement is performed, which determines the biological "trend" of the organism, which is a fixed result vector of the basic group of neurotransmitters. A series of values are then obtained, which are subjected to mathematical analysis in order to find a correlation between all measurements. In the STRD study, not only the value of the infrared temperature itself is important, but also the trend and its fluctuations in a specific time unit. We call these changes the regulatory value or plasticity. All measurements can be presented as images or graphs. Figure 1 shows different variants of the STRD images.

Figure 1. *Different variants of STRD images and management / command styles caused by the domination of neurotransmitters*



Notes: *A. Picture of classical thermography; B. Image with increased energy, the so-called hyperregulation (in psychology it is a fight reaction); C. Picture with reduced energy, the so-called hyporegulation (in psychology it is an escape reaction); D. Picture of regulation inhibition (in psychology it is a stop reaction, eg anxiety); E. Picture of temperature difference between core and bark temperature.*
Source: *Own study.*

Each measurement point on the subject's body has a specific value. As a result of stimuli (stressors - in this case they are cooling the body down by undressing the patient and acting in contact with blood), there is a reaction in the form of a change in the value of a given point.

3.2 Regulatory Stiffness and Limitations of Human Plasticity

From the point of view of physics, each stimulus (stressor) causes an energetic reaction of the system, in this case the human body. Each point on the skin subjected to the stimulus can react in three ways. The value, that is, the temperature, may increase, which means that the point is warming up; the temperature may drop, i.e.,

the point cools down and the last possibility the temperature does not change. If all the tested points are sorted by value, from the lowest to the highest, and each of them is given a specific number, and then how they behave in time (i.e., during the next two measurements), then information will be obtained, which is called regulation. Regulation is the most important parameter of energy changes.

If the points with the highest values in subsequent measurements, i.e. the second and third, will have a lower value, we call it positive hyperegulation, if the same points heat up, we will call it negative hyperegulation. This is due to the known fundamental laws of physics - no correct value can increase because such a situation becomes incorrect and suggests a pathology of a given function. Similarly, if the points with the lowest value in subsequent measurements, i.e., the second and third, will have a higher value, we will call it positive hyporegulation, and if the same points decrease their value, we will call it negative hyporegulation. The same situation occurs in the case of hot spots, but it is a reverse reaction, i.e., a continuous drop in temperature is an incorrect reaction and also suggests a pathology of the function. There is still a third possibility, i.e., there is no change in the point temperature value as a result of the stimulus (stressor). Such a situation is called regulatory stiffness, the lack or a significant limitation of the plasticity of the tested system.

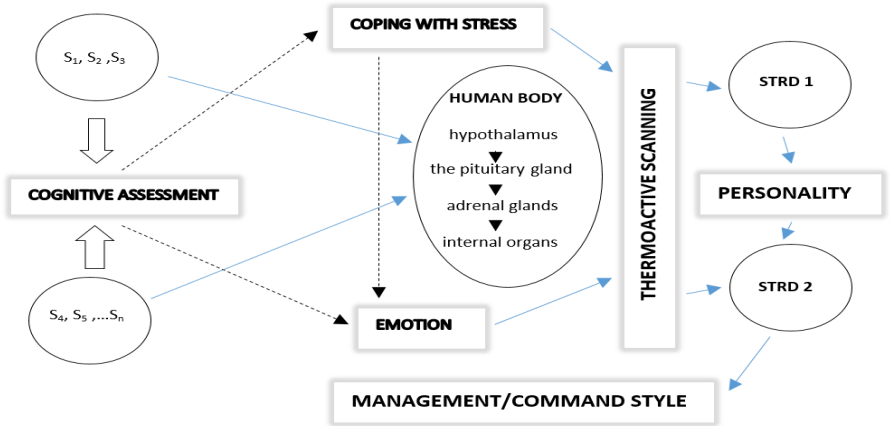
Regulatory rigidity is the most disadvantageous regulatory situation. Failure to respond to the stimulus indicates information chaos. This state of affairs cannot last long. Therefore, there is always an attempt to explain this kind of reaction. It should be remembered that stiffness, in common understanding, is associated with something dead. In fact, this is what happens - if the system does not respond to a stimulus, it is dead from the point of view of energy processes, i.e., it does not react with the environment.

The study of the plasticity of the manager (decision maker) is based on the STRD method on the variability of body temperature regulation as a response to external stimuli (including stress stimuli). The skin plays a decisive role in regulating body temperature. Therefore, it should be mentioned that it consists of several layers, i.e. epidermis, corium and subkutis. The corium is the place in the skin responsible for the creation and expulsion of skin heat, i.e. it is a layer that, by giving off heat, largely affects the recording, reading and subsequent analyzes (in each case, the mesenchymal basic substance plays an essential role in the regulation of heat through the skin. which is functionally located between the vascular system of veins and arteries). Based on the segmental division of the body by the spinal nerve, the temperature and the skin's ability to react to stimuli become indicators of deeper localized disturbances in the functioning of the whole organism or its individual organs. Certain areas of the skin correspond to specific organs and we call them Head zones. Lazarus' transactional stress theory in the cognitive assessment of the studied individual.

Stress as a type of mental tension is defined in psychology as dynamic, adaptive relations between the possibilities of an individual and the requirements of the situation (stressor, aversive stimulus), characterized by mental and physical imbalance. In medical terminology, stress is a disorder of homeostasis caused by physical or mental factors. Stress factors can be mental, physiological, anatomical or physical. The concept of stress was introduced to the use by H.H. Selye, who was the first to put forward the hypothesis that a number of somatic diseases are the result of man's inability to cope with stress. This phenomenon is called the so-called general adaptation failure syndrome. There are three types of stress in the typology (Heszen and Sęk, 2007):

- Stress as a stimulus - situations in our environment that have the natural ability to cause tension and strong emotions. Theories related to such definitions include: the theory of G.R. Elliott and C. Eisdorfer, concept of I.L. Janis and the concept of life changes by T. Holmes and R. Rahe.
- Stress as a reaction - both physiological and mental, being a response to the effects of stressors (stressful situations). Theories related to such definitions are: W. Cannon's homeostatic theory or Seley's concept (Pervin, 2002).

Figure 2. *Diagram of the influence of stressors (marked S1, S2, ..., Sn) on the cognitive assessment of the subject and the stage of thermoactive scanning to assess the management / leadership style*



Source: *Own study based on research.*

Psychological stress (according to the concept of R. Lazarus and S. Folkman) is a specific relationship between a person and the environment that is assessed by the person as overburdening or exceeding their resources and threatening its well-being. This relationship between the individual and the environment depends on two processes: cognitive assessment of the situation and coping with it. R. Lazarus emphasizes the importance of mutual interactions in this system - the so-called

transaction. The reciprocity of relationships means that not only the environment affects the person (as in the stimulus-response relationship), but also the person affects the environment. The individual together with the current situational context constitute a whole which is not a simple sum of its parts.

The transaction with the environment is subject to the cognitive assessment of the individual; the relationship can be judged to be irrelevant, favorable-positive, or stressful. This is a primary assessment. If, as a result of the primary assessment, the relationship is considered to be stressful, a secondary assessment is performed in which the entity assesses what can be done to overcome the threat (i.e. assesses the ability to cope with the situation).

The basic process of adaptation is triggered - coping with stress, i.e. "constantly changing (dynamic) cognitive and behavioral efforts to master certain external and internal requirements, judging by the person as overburdening or exceeding his resources". In this approach, coping is a series of deliberate efforts made as a result of the assessment of a situation perceived as stressful, and not an automatic adaptive behavior. Figure 2 shows a diagram of the influence of stressors (marked S1, S2, ..., Sn) on the cognitive assessment of the subject, their influence on coping with stress and, subsequently, on the assessment of personality through thermoactive scanning with the use of the STRD device.

The goal is to analyze the emotional state (including the level of stress) on management / leadership styles. The process of coping with stress has two functions: an instrumental (task) function, oriented at solving the problem that was the source of stress - by changing one's own actions or changing the threatening environment) and the function of regulating emotions, oriented at reducing unpleasant tension and other emotional states and stimulating emotions in order to mobilize to action.

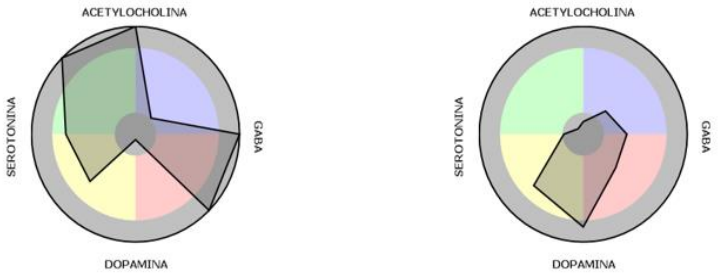
3.3 The First Reaction to Stress

Figure 3 shows how the function of the basic neurotransmitters will change in an uncomfortable situation. The ideal diagram should form a symmetrical star and fall between the outer and inner gray areas of the circle. The functions of the neurotransmitters are then normal. Then it can be concluded that the participant is able to find himself easily in every possible situation, and his reactions to stress will be the best possible. However, remember that this is the first unconscious attitude.

This does not yet reflect the management / leadership style, and does not even indicate a trend. Depending on the life situation and the level of development, the reactions of the examined person may change, so it is worth doing the tests regularly, monitoring the results and following the recommendations. This assessment does not show the concentration of a given neurotransmitter in the body, but its action, i.e. the impact on the behavior of the subject. It should be remembered that appropriate responses to stress can greatly support personal and professional

development. Figure 3 shows the first reaction of the body (after scanning the STRD three times). The deviation towards acetylcholine represents a type of blockage in the body, suggesting looking for new perspectives. A blockage in this area may mean that the subject cannot open up to other possibilities at the moment. One of the solutions in this situation is breathing training as well as team brainstorming (team heuristics). Perhaps this will also be followed by creativity, which may lead, for example, to a quick and effective solution to the problem. For verification, it is worth repeating the test to be sure whether the blockage is permanent or temporary.

Figure 3. *Study of changes in subcutaneous microlayers and the influence of neurotransmitters on the style of management*



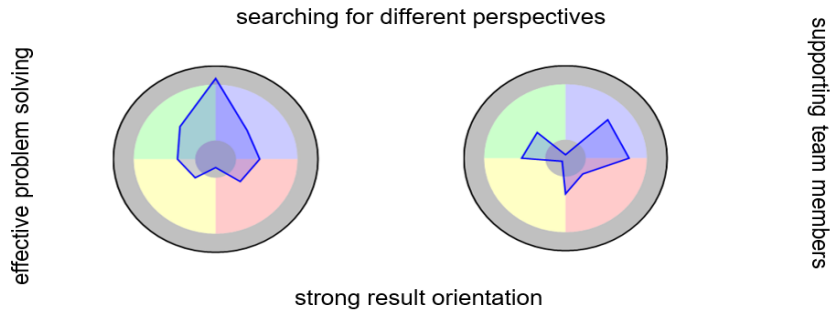
Source: *Own study based on research in the pilot group.*

Deviation towards GABA (gamma-butyric acid) suggests optimal team support. The high concentration of this neurotransmitter is characteristic of pregnant women and remains high after childbirth. People with a high concentration of this neurotransmitter are very protective and can optimally support the members of the team in which they work. As a result, they can maintain balance and proper resistance to stress. But also take care of others (e.g., your clients or team members). In return, they gain their support and loyalty. Leaders who support others understand how other people are feeling (empathy). By showing authenticity and sincere interest in those around them, they build trust, inspire and help colleagues overcome challenges. They engage in group work to promote organizational efficiency, alleviating unjustified fears of external threats and preventing employees from dissipating energy in internal conflicts.

Figure 4 shows the results of the examination after 240 sec, when the body is striving for homeostasis, i.e. internal balance. Homeostasis (*gr. homoíos - similar, equal; stásis - duration*) is the body's ability to maintain a relative internal balance despite changes in the external environment. Homeostasis is one of the basic concepts in physiology. The homeostasis of the human body is a fundamental condition of human health. It is maintained thanks to the mechanisms that coordinate and regulate life processes, operating on the basis of feedback. Apart from biological and physiological homeostasis, there is also psychological homeostasis. Both types of homeostasis are closely related to each other. A good physical condition affects

the mental balance, and a good mental condition affects the biological and physiological balance. When interpreting the results (Figure 4 on the right), it follows from the study that the person under study is looking for other people to cooperate with. This attitude combines ambition with cool calculation. Thanks to this, it allows you to achieve the goal in an easier way, because it uses not only one person, but a whole team of colleagues and even many companies or institutions to carry out the task. This is indicated by the permanent deviation with the predominance of the concentration of the neurotransmitter gamma-butyric acid.

Figure 4. *Examination of changes in subcutaneous microlayers and the influence of neurotransmitters on the style of management / command after 240 sec from the last (triple STRD scanning)*



Source: *Own study based on research in the pilot group.*

The serotonin deviation suggests, however, that the subject tries to choose what is most important. Such an attitude shows to what extent the subject gives the appropriate rank to important things and separates them from less important ones. This style can be improved by organizing your projects properly, and by encouraging colleagues to come up with ideas that could improve work performance. Serotonin is related to the coordination of the cerebral hemispheres. It is therefore essential for problem solving when information is collected, analyzed and considered. This is deceptively difficult to resolve, but it is a key input to decision making for major problems (such as mergers and acquisitions) as well as everyday problems (such as team dispute resolution).

Dopamine deviation, as a rule, concerns decision-makers characterized by effectiveness in action. This attitude indicates determination, consistency and patience of the examined person. It determines how much the subject is result-oriented and whether he is able to complete the tasks he begins. This attitude can be improved by training patience and proper time management. It is an attitude necessary to work in difficult market conditions. Outcome orientation is closely related to the effects of dopamine. Leadership is not only about developing and communicating your vision and setting goals, but also about achieving results. Strong results-driven leaders tend to emphasize the importance of efficiency and productivity, and prioritize work of the highest value.

3.4 Plasticity and Internal Blockages and the Impact of Stress on Management Style

Limited regulation is a reaction to too much stress. In the graphs they are marked with gray boxes - circles. The condition is often felt as sadness, sometimes regret, or as a depressed mood. It can also be felt as rage and sometimes disgust or depression. This situation requires a "fight or flight" response. For verification, it is worth repeating the test to be sure whether the blockage is permanent or temporary.

For example, too much dopamine results in impulsive behavior and too much risk-aversion. Such a manager (commander) may then over-control others or become extremely irresponsible for the fate of the company and the team. These are not the best qualities of a leader. The solution may be to reduce the risk and get to know your colleagues better and accept their differences.

A blockade in the sphere of looking for other perspectives may mean that the respondent is not able to open up to other possibilities at the moment. One solution in such a situation is, for example, breathing training as well as team brainstorming. Such action may trigger the creativity of the subject and the problem will resolve itself. For verification, it is worth repeating the test to be sure whether the blockage is permanent or temporary.

Figure 4 shows as well how the function of the basic neurotransmitters will change after a few minutes from the moment of stress induction. After homeostatic adjustment, it is a more conscious life attitude of the respondent and at the same time a certain style of management. As the result may fluctuate, it is worthwhile to monitor the long-term responses of test takers. The respondents have the opportunity to raise or use their competences that have not been used so far, reduce the abused ones and expose competences that are in the norm. The most harmonious managers use all four attitudes to a similar degree. Depending on the life situation and the level of development, the reactions of the respondents and the management style may change, so it is worth doing the tests regularly, monitoring the results and following the recommendations. Keep in mind that nominally this assessment does not show the concentration of a given neurotransmitter in the body, but its action, i.e. its influence on your behavior. It should also be remembered that appropriate responses to stress can greatly support personal and professional development.

3.5 Eye-Tracking as a Tool to Analyze the Attitudes of Decision Makers

The looking process consists of saccades, i.e., rapid eye movements, and fixations, i.e., periods of vision stabilization. Fixations are very short - 200-300 milliseconds - and frequent: an average of three fixations per second. During fixation, visual information goes to the brain, where it is further processed. When nothing limits the direction of the gaze, eye movements reflect the shifts in the focus of attention. When looking at scenes or images, the eyesight falls more often on areas containing

important information and focuses on them for longer. One of the categories that particularly attract the observer's attention is emotional content - both positive and negative. Over the last few years, eye tracking studies have shown that key objects, i.e., those that determine the importance of the scene viewed, strongly attract attention. The Emotional Objects Databases presented by scientists allow for a precise determination of whether a given eye fixation hit a key object or the background of an image, making it a good tool in the study of processes related to directing attention to important information.

The latest eyetrackers are photoelectric eye trackers that allow you to register the movement of the eyeballs by changing the reflection of light (electromagnetic waves) on the cornea of the eye. These types of eyetrackers allow for non-invasive and contactless observation, which does not interfere with the natural behavior of the subjects. By following the path of sight, they show what the subject is looking at and allow for the identification of areas on which he focuses his attention. They make it possible to register the reflection of light or other electromagnetic waves that are directed to the eyes (eyeballs) of the subjects (Duchowski, 2004).

The quality of research carried out with the use of an eye tracker is measured by the accuracy, precision and repeatability of the measurement. Accuracy is the average angular difference between the reference viewing direction and the eye track direction. Precision is the ability to register the same viewing direction when observing a given reference point. In turn, the repeatability of the measurement refers to the correct operation (measurement) of the device for different people (resulting from differences in the structure of the eyes and individual psychophysical predispositions) (Manituk and Bazylik, 2014). The factors that affect the quality of the measurement are: the characteristics and technical parameters of the eye tracker camera (including resolution), the calibration (calibration) of the eye tracker and the use of simplified models for determining fixation (Manituk and Tomaszewska, 2012).

Decision-making skills have a significant impact on the team building process. The ability to make effective decisions determines the trust of the subordinates in the leader, so important for the proper functioning of the team. Relationships based on trust in the context of leader decision-making are built in a continuous process of gathering experience through the interaction between decision-making situations, the leader making decisions, and subordinates carrying out tasks in accordance with the leader's decision and the end result of their cooperation.

There are three states (situations) in which a decision is made: certainty, uncertainty and risk. Taking decisions under conditions of certainty should, as a rule, not pose difficulties. The main problem in situations of certainty, however, may be the lack of knowledge and experience in the area of activity to which the leader (manager / commander) is appointed. Therefore, most research focuses on the effectiveness of decision-making as a leader's competence, i.e. the area of interest is focused around

factors influencing the emergence of conditions that create uncertain and risky situations, i.e. those in which it is difficult to predict the consequences of a specific decision and those that able to predict with a certain probability. Among the many factors disturbing the certainty of making decisions, i.e. those that reduce the possessed decision-making potential, and thus disturb the effective use of the knowledge and experience of the decision-maker, there is a time deficit, information deficit and stress caused by the influence of the environment on the receptors (weather conditions, sound, light, hunger, thirst, psychophysical fatigue, excess stimuli, or fear).

As a result of the impact of these factors, changes in the course of basic cognitive processes such as concentration of attention, the scope of short-term memory and the ease of access to the accumulated experience, i.e., the so-called persistent memory, may occur. All of this can create cognitive limitations in the mind of the decision maker. The existence of many different neural rhythms causes most people to be unable to focus their attention on an object (phenomenon) for any length of time. Concentration disorders during decision-making generate mistakes. These are, for example, ADD (Attention Deficit Disorder), i.e., attention deficit disorder. It is difficult to predict when a significant spade will occur.

3.6 Decision-Making Efficiency Test with the Use of the JAZZ NOVO Eye Tracker

As shown by many years of research, there is a close correlation between the factors characterizing difficult (stressful) situations and the effectiveness of the implementation of the decision-making process. Identification of the key elements affecting the mental performance of leaders in this area can be made using the method of eye tracking. Based on the analysis of the functioning of the oculomotor system, the symptoms of motor and cognitive disorders are identified in relation to factors disturbing the routine activities of the thought process. Based on the results of the research, it can be concluded that the delay of the saccadic reaction, i.e., the slowdown in the transfer of points of focus, fixation, to objects appearing in the field of view of the decision-maker, constituting an element of the objective state of reality, may indicate that the decision-maker cannot make a decision in the required time, which determines the dynamics of the situation. Thus, the registered parameters of saccadic and fixative activity may indicate in which phase of the decision-making process the decision-maker is (Walecki, Lasoń, and Gorzelańczyk, 2012).

The Jazz-novo Ober Consulting eye tracker is an effective tool for the above-mentioned examination of the level of decision-making ability in the conditions of limited rationality of the decision-maker. This device allows you to examine the parameters of the eye movement recorded by the photoelectric method by measuring the following parameters of saccadic activity:

- saccades intensity,
- saccades time to fixations ratio,
- mean fixation time,
- total saccades duration,
- scan path length,
- fixation duration share.

The use of the eye tracker also allows to determine the efficiency of the decision-making process in the context of the impact of variable factors of the physical and mental environment. Therefore, it seems important for the group of decision-makers subjected to such an impact to state the degree of influence of these factors on the effectiveness of thought processes and decisions made. Research has shown that the efficiency of the thought process depends on the psychophysical state of the decision-maker (Łaszczyńska, Jarosz, and Truszczyński, 2005).

Eye-tracking examination also allows to determine the time of the step reaction of the eye movement. The analysis of the duration of saccades and fixations determined by the oculograph allows to determine the ability to acquire visual information, which correlates with the saccade movement of the eyeballs. Extending the time of saccades and shortening the time of fixation under the influence of factors disturbing comfortable conditions indicate a decrease in the efficiency of thought processes based on obtaining and analyzing information. Therefore, it can be expected that in this situation the probability of errors also increases. Nevertheless, training in the execution of mental processes in various conditions of difficult situations may bring the effect of skill, thanks to which the decision-maker will be able to make decisions burdened with fewer errors (Łaszczyńska, Jarosz, and Truszczyński, 2005).

By distinguishing three types of saccades in the process of visual attention: express saccades, regular-fast saccades and regular-slow saccades, they can be assigned to a specific phase of the decision-making process. Express saccades can be combined with non-attention-consuming visual information processing and are automatic. The other two types of saccades (regular fast and slow) are associated with the mechanisms of conscious processing of visual information, because they require a decision-making phase and an intentional shift of attention to another fixation point. Thus, on the basis of the relationship between the types of eyeball jumps occurring in the process of visual attention and the phases of hunters' processes, it is possible to determine with a certain probability in which decision-making phase the decision-maker is currently in (Fisher, Gezeck, and Huber, 1995). This is important because when identifying cognitive and decision errors, it can be thus presumed whether these errors are related to a reduction in the efficiency of visual information acquisition, or rather result from the fact that the decision-maker has not completed the planning phase and moved to the control phase, in which he undertakes corrective decisions without taking into account the initial situation.

When carrying out research on decision-making effectiveness and its relationship with the style of management / command, a thesis should be made: The style of management is the result of many components of the human personality that can be examined and analyzed with the use of ICT tools such as an eye tracker and an infrared scanner. In the area of research with the use of an eye tracker, it is possible to examine the behavior of a decision-maker in situations where: he or she does not have a specific task and goal to be implemented, noticing decision-making components (objects) as soon as possible and assessing them, operating under conditions of increased stress, strong competition and pressure of senior management.

4. Methodology and Stages of Research

The activity profile of the laboratories of the Military Academy of Land Forces focuses on researching and monitoring stress among students, their ability to make decisions under conditions of certainty, uncertainty and risk. Changes and limitations in the research environment caused by COVID-19 resulted in limitations in the study population. The aim of the study was to evaluate the reaction of a candidate acting under the influence of external stimuli (determination of the type of stress) and to study the relationship between the radiation emission of selected neurotransmitters and decision making (tested with the use of an eye tracker). The research methodology assumed the study in conditions close to natural (battlefield) and in the final phase took into account management profiles (management styles).

The aim of the study was to assess the correctness of the task performance according to a given algorithm (help on the battlefield) in conditions of strong stress and to monitor the concentration of selected neurotransmitters under stress and after achieving homeostasis. The study was divided into several stages.

In the first stage, training was carried out for the entire pilot group, in which each respondent performed manual activities related to providing first aid on the battlefield under the supervision of an instructor. The first part has been completed with the exercise validation.

In the second stage, each participant covered a distance of 0.5 km with a weapon and ran into the room where the phantom was located and followed the exercise algorithm. The temperature in the room (previously unknown) was low (outside 32 ^{o}C, inside 9 ^{o}C), the sounds of the battlefield and the screams of the wounded were simulated. At this stage, the correctness of the actions leading to the tactical bandage on the bleeding limb (phantom) was assessed according to the algorithm adopted in the tactical phase.

In the next stage, the subject was examined by means of thermoactive scanning - STRD and the level of 4 basic neurotransmitters having a direct impact on personality was assessed. In the next stage (240 sec pause), the subject performed a

test assessing the type of stress he or she was subjected to (stimulating or instrumental). Table 1 shows the tendency to take risks in the tested pilot group.

Table 1. *Propensity to take a risk (with advantage of neurotransmitters)*

Pilot group (test persons)	*Stimulating risk*	*Instrumental risk*
E_1	*X (ACE)*	-
E_2	-	*X (DOP)*
E_3	-	*X (GAB)*
E_4	-	-
E_5	*X (ACE)*	-
E_6	*X (DOP)*	-
E_7	-	*X (SER)*
E_8	*X (undetermined)*	--
E_9	-	*X (balance)*
E_{10}	-	*X (DOP)*
E_{11}	-	*X (GAB)*
E_{12}	-	*X (DOP)*

Source: *Own study.*

Research shows that 41,6% studied population is prone to taking risks known as stimulation risks. It is seen as a way to provide self stimulation by increasing physiological arousal. Profit, "win or lose" is not important here, because the activity is supposed to create a pleasant state of excitement, which is an end in itself. The rest of the respondents (58,4%) showed a tendency to take instrumental risk, which is perceived as an opportunity to achieve a positive result. It is the future win that makes people look for such instruments to increase the likelihood of success.

The next stage of the research was to measure the emission of neurotransmitters by a non-invasive thermoactive scanning method - STRD. Each cadet was tested three times at 10-second intervals, which is in line with the methodology of such a study. Then, after 240 seconds, another (fourth measurement) was made to determine the command style trend. The question was: is there a relationship between the intensity of certain neurotransmitters and the style of management / command? It was not possible to give an unambiguous answer after the study. Therefore, it remains the subject of further separate studies on a larger population. The study was concluded with an analysis of the ability to make decisions with the use of an eye tracker, where scenarios with objects are displayed on a large screen.

4.1 Methodology of the STRD Diagnostic Test

Human infrared radiation as an aspect of the surrounding thermal field is an excellent tool that serves to show the internal state of the human body. Changes in infrared radiation correspond to changes in microcirculation on the skin. The cutaneous microcirculation has been shown to be a potential representative of the entire vascular bed and reflects its structural and functional mechanisms, as well as general vascular disorders.

Cutaneous microcirculation is easily accessible, it is a useful translation of the general model of the vascular bed. The skin circulation is the main site of human thermoregulation and has a large capacity reserve, and thus the possibility of a clear vascular reaction in response to physiological, metabolic, thermal and pharmacological stimuli (Holowatz, 2007).

In classical thermography, only the image of thermal fields, i.e. "cold" or "hot", is obtained. This does not fully reflect the nature of the skin microcirculation changes. it is possible to show and calculate (apart from the image) the temperatures of changes in infrared radiation in the form of oscillations of temperature changes and to determine a statistical change of the trend, i.e. increase, decrease or inhibition of temperature.

The main difference between the TRD and STRD methods is that in the STRD method, we scan human skin with a thermal imaging microcamera and in the TRD method we measure individual points on the body. The STRD method provides much more data than the TRD method. In addition, the STRD method allows for the functional assessment of the state of the body, enabling:

- treating the examined person as a whole;
- grasping in time the functions of the various systems that make up this whole and, if possible, quantifying them;
- determining the internal dependencies of these systems.

Technically, the STRD method consists in measuring the temperature in selected places on the skin with a meter that uses infrared radiation. Since it is necessary to determine not only the values of the changes but also the functions, the whole system should be presented in the form of an amplitude. In medicine, "stress" is similar. That is: a specific stimulus is triggered and then the temperature values are checked before and after this load. Then, the obtained temperature measurement values and their interdependencies are presented in the form of a statistical analysis.

The method allows for a comprehensive and local presentation of the type of disorders in human microcirculation autoregulation. The basis of the volatility analysis is the comparison of the so-called core temperature represented on the forehead to the so-called cortical temperature, i.e., the rest of the body surface. The core temperature, i.e., the inside of the body, is represented by the center of the forehead (glabella), it has been proven that this place corresponds to core temperature.

After the scan, we obtain three or four (depending on the choice and purpose of the study) values of the electromagnetic field variability in the infrared range, including the so-called trend, i.e. the direction of temperature changes, the absolute value of temperature and the so-called regulations, i.e. differences between individual temperature measurements.

All these data are given by factor analysis. This allows you to find connections between the various subsystems of the body that can influence the formation of many diseases and emotional behavior. This is directly related to the emotional intelligence of commanders and managers and influences their style of command / management.

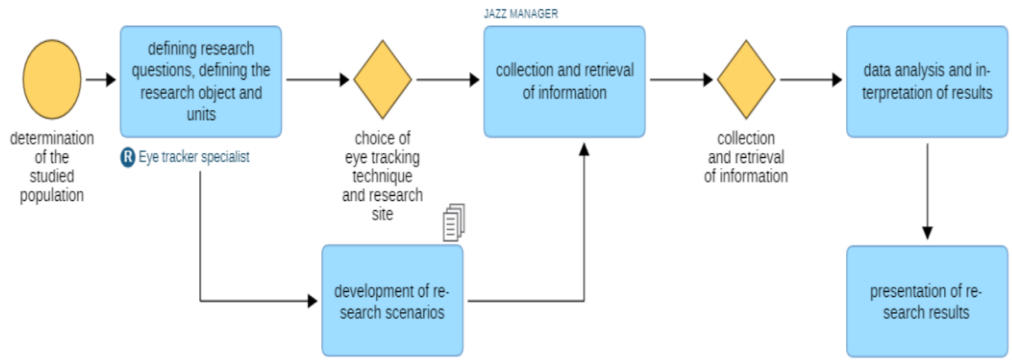
The advantage of the method is that the early detection of changes in self-regulation and the association of these disorders with diseases and the presence of specific emotional patterns allows the use of the STRD method to screen large groups of people without exposing them to the adverse effects of electromagnetic fields such as X-rays or magnetic radiation. Chronic stress, known in medicine as "distress", is considered to be one of the main factors in many diseases. It is known today that chronic stress corresponds well with disturbed thermoregulation. On this basis, we illustrate the so-called emotional patterns that describe the causes and symptoms of disorders of the entire human system.

4.2 Methodology and Purpose of Research with the Use of an Eye Tracker

Research questions are specific to each research, they result from its goals and subject scope. In eye tracking, questions may concern primarily:

- ergonomics of perception, ie what attracts attention and what goes unnoticed;
- in what order the elements are perceived; what elements attract attention but are not processed;
- reaction to the message (as a necessary component in the decision-making process);
- unusual and unexpected (non-standard) situations and behaviors in the environment of the examined person, which may cause stress and uncontrolled, involuntary reactions of the organism.

Figure 5. *A simplified scheme of research using the eye-tracking technique*

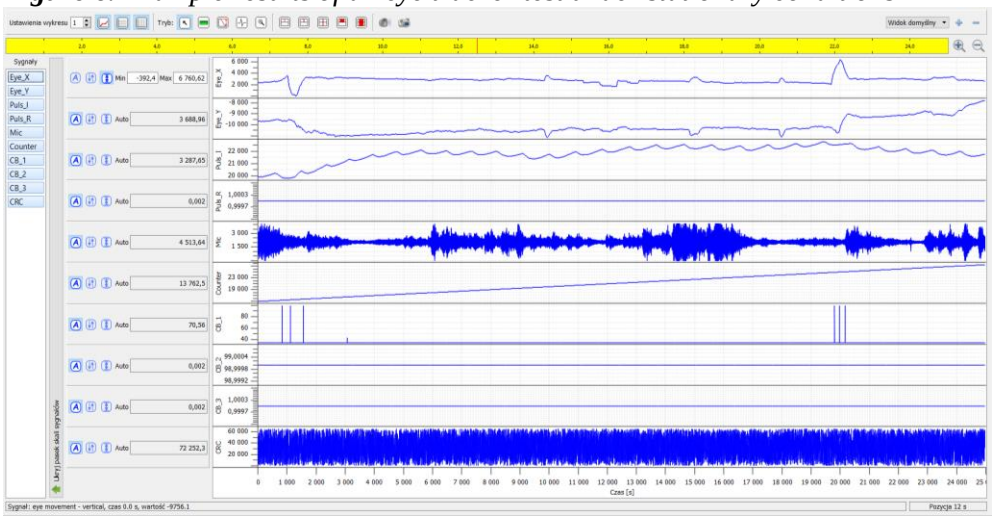


Source: *Own study.*

Figure 5 shows a diagram of the research using the eye-tracking technique. After specifying the research questions, the next step in the research algorithm is the selection of the research object and units. The subject of the study were prepared tactical scenarios and images on a large screen containing elements that threaten the life or health of the subject. The purpose of such scenarios was to cause additional stress stimuli. In one of the scenarios (for the purposes of the STRD study), objects reflecting real situations were placed. The next step in the procedure is the selection of the eye tracking technique and research sites. A stationary technique (tests in a closed room) and a mobile technique (field tests, e.g., a training yard, warehouse, production hall, etc.) can be used here. The choice of technique determines the type of eye tracker used for the examination. In the case of tests in a closed room, the test subjects should be provided with the best possible conditions and atmosphere - similar to those in which they are used to use, e.g. at home in front of a computer (variant 1) or by influencing the subject with additional external factors - stressors (variant 2). Collecting and collecting information also follows a strictly defined pattern. In stationary examinations, the subject is placed at the test stand (desk, screen, eye tracker). The survey is usually carried out in two stages: in the first, respondents are allowed to freely browse a given object, and in the second, they are asked to perform a specific task (e.g. to search for specific information). The eye tracker records two types of information:

- fixations - points where the respondent's eyesight was stopped (focused),
- saccades - eye movements between fixation points.

Figure 6. *Example results of an eye tracker test under stationary conditions*



Source: *Own study based on research.*

Fixations are understood as the state of relative rest of the eye, i.e. points where the eyesight stopped. They show the focus of eyesight on a specific object. The average immobility lasts from 0.2 to 0.3 seconds. Saccades are eye movements understood as

a quick, jump from one point to another. The saccade is performed on average 4-6 times per second and lasts generally from 0.03 to 0.06 seconds. Very often, registration of eye movement is accompanied by an interview with the respondent, in which additional information about the subject of the study can be obtained.

The next step in the procedure is data analysis and interpretation of the results. Fixations and saccades are analyzed. The length and number of fixations determine how the examined element focuses attention. The lower the time to the first fixation, the higher the ability of the examined element to focus attention. The number of fixations on a given element determines the efficiency of searching the examined object, its importance and noticeability in the perception process. The saccades allow to determine how often and quickly the subject shifts his eyesight to its various points (Jacob and Karn, 2003). The figure shows an example of the measurement results of a military academy cadet on the time axis (X). There are visible saccades and fixations for the left and right eyes, and the ratio of saccades to fixations (line 3 from the top in Figure 6).

5. Results and Discussion

Pilot studies indicated that in the studied population, four people did not make mistakes in operating according to the algorithm. Five out of twelve respondents (i.e., 41.6%) did not correctly complete the task according to the assumed algorithm after wearing a tactical band (they did not check the other limbs for massive hemorrhages). Three respondents made mistakes under the influence of a stress factor.

Research has confirmed the thesis that pain / suffering is the body's response to a threat and appears when a stimulus is triggered, i.e., a stressor. Moreover, the research showed the influence of eustress on respondents as positive and mobilizing to action, and the influence of neustress as a stimulus for a given person who was neutral in action, which for others was an eustress or distress stimulus. Stress management as a cognitive and behavioral effort is aimed at coping with external or internal factors, reducing them or tolerating them, takes a stimulating or instrumental form. In the risk trend study, the population distribution was 40/60. Increased dopamine levels were observed in four students, and acetylcholine in two. This may indicate a lack of concentration and escape from making decisions under conditions of high stress. In one of the subjects, the concentration of gamma-butyric acid (GABA) was significantly above the mean for the studied population.

Summing up, many years of research on stress confirm its variable role depending on the intensity, number and type of stressors. This is consistent with the research conducted on the student population of the Military University of Land Forces. Working in near-natural conditions (battlefield) assisted by information technology devices for assessing stress correlated with the radiation of neurotransmitters (dopamine, acetylcholine, GABA and serotonin) indicates the need for further

studies in a larger population to assess and reduce stress in students by regularly scanning with STRD devices.Eye tracking tests allow to determine which elements of the perceived material are noticeable and which are omitted by the subject, after what time, in what order and how often individual elements attract the observer's gaze and attention, and to which elements the subjects return. When working on the research material, overinterpretation should be avoided, because eye-tracking research does not provide unambiguous information about whether the respondent understands the content of the research object. After data processing and interpretation, the study results are communicated. Most often the results are presented in a research report, which in the case of eye tracking tests may include (Pernice and Nielsen, 2009):

- fixation maps and gaze plot maps - paths of the sequence and time of viewing individual elements;
- heat maps - defining the concentration of attention on individual elements;
- survey videos - showing exactly what the respondent was looking at during the survey;
- statistics and ratings of individual key areas (including the time to the first fixation in the area of interest, the sum and time of fixation in a given area).

Heat maps are a graphical representation of the thermal distribution of the areas that the subject paid attention to. They illustrate both the noticed and unnoticed elements. The frequency and time of observation are used to determine the degree of the subject's concentration. Black and white and color heat maps are used to present the data. Black-and-white maps provide less information, show dark and light areas on the map, while the brighter ones mean that the subject stared at them for longer, i.e. paid more attention to a given element. Color maps provide additional information about the intensity of attention that the respondent directed to a given element of the text / image. The degree of attention of observers is indicated by colors. Red reflects the greatest concentration of eyesight, yellow slightly less, green - minimal. In addition, the degree of color intensity reflects the strength of the intensity, then the subject focuses more on this element.

Eye-tracking was (and still is) a precursor and foundation for broadly understood augmented reality. Augmented reality is a system that connects the real world with the computer-generated world. Currently, a camera image is used, overlaid with 3D graphics generated in real time. Augmented reality is increasingly used in many areas of science, economy and medicine, combining the real world and virtual reality with the use of an interactive image in real time.

Augmented reality technology uses the so-called markers, i.e. reference points on the basis of which AR applications define their position in relation to the real world. Markers are identified by AR device cameras, so initially they had the form of easy-to-detect symbols and patterns, such as the QR code (Grabowski, 2012). In 2017, the marker-free AR technology was introduced, the operation of which consists in

determining the actual plane by detecting color patterns and unique shapes present on the viewed surface.

6. Conclusion

In order to confirm the accuracy of the obtained data on determining the level of leadership competences in the area of decision-making, inferred on the basis of the level of the four basic groups of neurotransmitters, and to find a correlation between this level and one of the very important leadership competences for leaders, which is the ability to make decisions, research tools enabling tracking thought processes that include eye trackers.

Therefore, eye-tracking seems to be a good complementary method both for research based on thermoregulation as well as for other methods, such as neuropsychological tests, which enable the assessment of the efficiency of cognitive functions, and thus the identification of the correlation between the level of decision-making competences and situational factors.

Thus, the indicator of the appropriate level of decision-making competences in team leadership is the effectiveness of the actions taken, directly dependent on the decisions made by the leader. These, in turn, have their own possibilities and limitations depending on the conditions of decision making.

Based on the analysis of research to date, it can be concluded that the use of the eye tracking method can help in determining the individual efficiency in the field of visual information analysis and processing in the context of decision making. Eye-tracking techniques find an increasingly wide range of applications. These techniques, classified as qualitative methods, are also applicable in quantitative research (in situations where the research is carried out on large samples of respondents). In the study of cadets of the Military University of Land Forces, a study was carried out with the use of the JAZZ Novo eye tracker, and the results of the research confirmed the thesis as to the possibility of using the eye tracker to assess the attitudes of decision-makers and decision-making effectiveness.

Combining the research methodology and enriching it by selecting other analytical devices from the IT group, such as a thermo-active scanning device, mobile StresBreaker scanners and extensive IT applications make it possible to identify the attitudes of future commanders and managers in an increasingly better way, and also effectively help organize the process of personality education and at a later stage of further professional development.

Organizations that want to focus their efforts on priorities such as role modeling, quick decision making, vision definition or shaping leaders should increasingly use innovative methods of assessing the competences and predispositions of managerial (command) staff not only in the field of decision making. In connection with the

above, it is reasonable to strive to develop a holistic model of personality on the basis of which it will be possible to interpret changes in neuroplasticity, and the method of such an examination is the Thermoregulatory Scanning Diagnostics - STRD.

This article summarizes the research conducted at a military university as part of the leadership research program. The ICT tools used in the research have been enriched during their implementation with new elements from the IT group, such as the possibility of saving biometric data using electromagnetic wave in RFID and NFC systems and will in the future constitute a component of additional extended research on the essence of command and management styles and leadership that are increasingly and more widely entering the world of augmented reality.

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