

## 4.6 Changes in the status characteristics determining the psychic performance of soldiers in an environment with an extreme climate (István Hullám)

### 4.6.1 Introduction

During the planning of military operations (missions) and their implementation in operating areas with extreme climates, the personnel is often exposed to increased or extreme physical or psychic loads. The proper handling of environmental factors is of utmost importance in the preservation of their health and in their survival in war situations, and therefore it is crucial for military leaders to understand (especially in operation planning) to what extent and through what mechanisms environments with extremely high or extremely low temperatures influence the cognitive, behavioural, movement-related (movement coordination, fine manipulation) and subjective reactions of soldiers. A large number of studies have confirmed that heat and cold stress significantly decrease the physical and psychic performance of soldiers, and that changes in psychical functions forecast critical physiological changes, so their analysis and detection have a predictive power. According to historical data, more soldiers have lost their lives as a consequence of extreme weather conditions than during actual fighting. Over the past few decades, heat has been a decisive climatic factor, since, from a strategic point of view, the majority of the key operating areas are located in environments with a very hot climate. Based on the findings of relevant studies published in international literature, the study chapter presents those cognitive, mental, psycho-physiological and group psychological elements of psychic performance that typically show changes as a consequence of extreme temperatures.

#### APPROACHES TO THE PSYCHIC FACTORS OF HUMAN PERFORMANCE WITH RELEVANCE FOR THE BORDERLINE AREAS OF PSYCHOLOGY, PHYSIOLOGY AND NEURO-PHYSIOLOGY

The psychological aspect of human (including military) performance manifesting itself in the form of behavioural responses (psychic performance) is divided into the following main constituents by R.F. Johnson and J.L. Kobrick (2002), two internationally recognised researchers of this field. These key elements are: mental (in the case of tasks mainly requiring skills related to cognitive processes, functions, arrangements); psycho-motor-based (primarily in manual tasks requiring coordination between sense organs, cognitive

functions and the movement system); and subjective (related to emotions, moods and attitudes). All three main aspects of psychic performance actually emerge as a result of very complex processes. The various parameters of perceived performance, resulting from individual sub-processes, can be measured using a variety of methods. In one of the measurement methods used in applied psychological research, simple and quick reactions required by the given task are measured in the function of changes in certain environmental factors. These include:

1. Skills in completing **sensoric tasks** (mainly visual and acoustic).
2. **Perception-based tasks** (perception => interpretation of basic changes in the environment, e.g. the accuracy of distinction between useful and dangerous targets)
3. Effectiveness in solving **complex mental tasks** usually requiring a complex way of thinking (analysing, decision-making, operational, mathematical, design). The simultaneous completion of two or more tasks is a frequent requirement. This is called dual or simultaneous task performance.

#### CONTENT AND STRUCTURE OF THE STUDY

The information base presenting the impacts of extreme ambient temperature on psychic performance, relying on databases of international analyses, was processed according to the following aspects. Psychic performance cannot only be interpreted from the perspective of the science of psychology. Therefore, in the first sub-chapter, the introduction is followed by a description of the topicality of and multidisciplinary approach to the issue, as well as a content-based and structural outline of the study. The second sub-chapter contains a model illustrating the mutual dependence and correlation between the psychological, physiological and behavioural (psychic) adaptation processes providing a basis for the interpretation of psychic performance, as well as another model explaining mechanisms of reactions triggered by environmental climatic effects in psychic-physiological systems. The third and fourth sub-chapters present changes in certain characteristics of psychic functions in cold and hot environments. The performance elements were grouped based on the systematisation principles preferred in psychological literature (Atkinson et al., 2001), making efforts to structure the description in a way that it starts out from simpler aspects (those representing less complex processes) and then goes on to more complex ones. I use the following classification for the introduction of



the cognitive-mental, psycho-physiological, physiological and social aspects of psychic performance:

1. Performance based on psycho-physiological and neuro-physiological mechanisms:
2. Response time, Perception, Alertness, Changes in the sleep-wake cycle
3. Performance based on psycho-motor skills (i.e. on the coordination of cognitive, neuro-physiological and movement-based mechanisms): Dexterity, Targeting, Target tracking, Endurance
4. Psychic functions organised under the dominance of the cognitive sphere: Mental performance, Complex mental performance, Simultaneous tasks
5. Psychic functions related to emotional mechanisms: Discomfort, Evaluation of emotional readiness and emotions, Subjective reactions
6. Complex physiological and psychic phenomena: Detectable symptoms
7. Complex impacts affecting community relationships and performance

The fifth sub-chapter includes an overall summary of those practical skills that are of primary importance from a military point of view, while the sixth sub-chapter contains recommendations for commanders and those working in certain military fields of expertise.

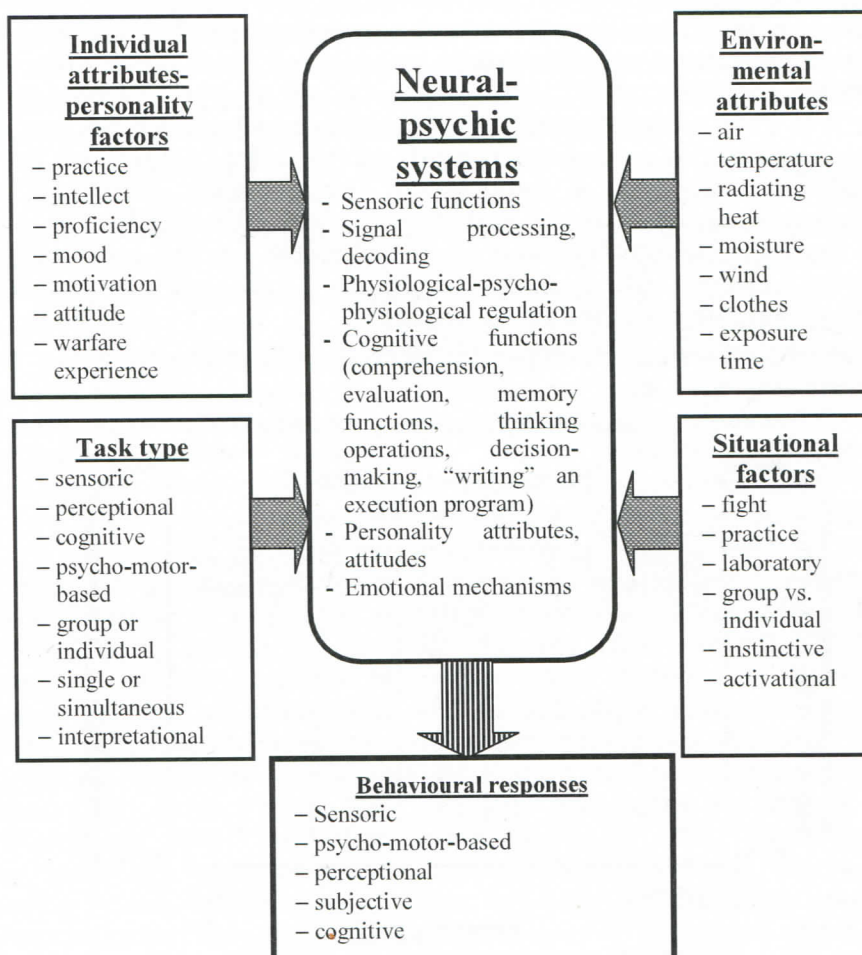
#### *4.6.2 Models providing a framework for the interpretation of psychic performance and helping the understanding of (physiological, neuro- and psycho-physiological) background processes*

PSYCHOLOGICALLY-ORIENTED MODEL PROVIDING AN  
INTERPRETATION FRAMEWORK FOR CAPTURING PSYCHIC  
PERFORMANCE:

Behavioural responses (dependent variable) are generated as a result of interactions between the environment, the individual, the task and the situation (independent variables). Behavioural responses are modulated (modified) by individual reactions based on personal experience, psychic resistance (stress tolerance) and its current status, intellectual capabilities and developed skills, proficiency in tasks that are important or decisive for the activity in question (e.g. military), the stability of personality, good coping skills, a well-

balanced control and the current status of emotions and moods, motivation and attitudes.

Figure 4.4. shows the psychologically-oriented model:



**Figure 4.4.:** Psychologically-oriented relationship model of factors forming behavioural responses

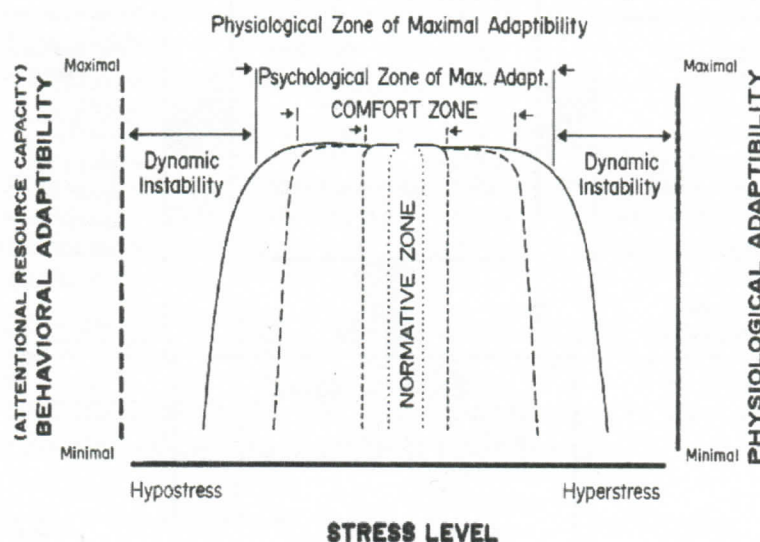
THE SO-CALLED "EXTENDED U" MODEL OF HANCOCK ET AL. (1989) DESCRIBING THE RELATIONSHIPS BETWEEN THERMAL STRESS (BOTH EXTREMES), PERFORMANCE AND ADAPTATION MECHANISMS

I regard the explanation of this model as mandatory as the authors (Hancock and Warm, 1989) explain interactions between extreme thermal stressors and physiological and behavioural (psychic) adaptation processes, as well as the relevant correlations between



them. They illustrate it very graphically that the two main adaptation processes are capable of maintaining psychic and physiological performance in spite of the increasing load. However, after a specific level, the capacities of both are falling dramatically, leading to a significant performance reduction. Based on analyses by the authors and other researchers, two important parameters can be regarded as important predictors of performance reduction: 1) in hot weather, the threshold is  $ET_{65} > 85^{\circ}\text{F}$  ( $29.4^{\circ}\text{C}$ ), while in the low temperature range it is  $ET < 52^{\circ}\text{F}$  ( $11.1^{\circ}\text{C}$ ). 2) According to Hancock's findings, a dynamic rise in the core temperature<sup>66</sup> of the body ( $0.22^{\circ}\text{C} - 0.88^{\circ}\text{C} - 1.33^{\circ}\text{C}$ ) leads to a progressive performance reduction in simultaneous, target-tracking and simpler mental tasks alike. He also notes that all phenomena need to be evaluated on the basis of the combined effects of climatic conditions (temperature, relative humidity, wind velocity and other factors).

Figure 4.5. shows correlations between the above processes:



**Figure 4.5.:** Hancock's extended "U" model (1989) for the interpretation of interactions between thermal stressors and psychic/physiological adaptation. [4.46.]

<sup>65</sup> ET (Effective Temperature) is an index calculated from DB (dry bulb) and RH (relative humidity). In other words, it is an index describing the temperature environment: a subjective mixture of dry temperature, relative humidity and air flow rate (as one perceives their own comfort).

<sup>66</sup> Temperature in the inner environment of the human body (most commonly in the rectum or in the oral cavity), the constant value of which is maintained by important physiological mechanisms.

## INTERPRETATION OF THE IMPACT MECHANISM OF ENVIRONMENTAL FACTORS USING A PROCESS MODEL WITH RESPECT TO PSYCHIC PERFORMANCE

In addition to the psychological model showing the most important structural elements of the generation of behavioural responses, for the better clarity of processes, another model explaining the effects of physiological reactions triggered by extreme ambient temperatures on psychic-mental functions should also be presented.

Psychic functions and reactions are ensured by the smooth operation of the key areas of the central nervous system (hereinafter CNS) (according to our present knowledge, in the form of a distributed network). External environmental impacts basically reach our body via two routes, and both transmit the information to the control centres of the regulatory systems responsible for physiological and psychic processes through the receptors of our nervous system. For the better understanding of processes, type 1 of the receptors includes sense organs, type 2 includes the "sensing devices" for basic perception qualities (heat, pain, touch, position of joints and movement), while type 3 incorporates so-called interoceptors<sup>67</sup>. All our receptors serve to inform the control centres of our organism about our current physical and psychic status and to warn us in case of any changes in the external and internal environment relevant for the functioning of our body. Although there are undoubtedly external (burns, frost burns or physical injuries) and internal (bleeding, vascular disorder, rupture of vessel walls, muscles or ligaments) events causing or threatening with direct physical injuries, most of them reach the physiological and neural regulatory systems via the peripheral receptors of the nervous system and through the network connecting them with the sensing and control centres and transmitting the "execution programs" for the corresponding reactions. We are primarily informed about extreme temperature events in our environment by the resulting physiological reactions, which raise our awareness. This is true even if our sense organs also convey a lot of information about the climate surrounding us. As another factor promoting psychic mechanisms, we can "see and hear" different environmental phenomena indicating heat or frost, which help us to prepare our coping tools. One of the key elements of physical and psychic preparation (and the strengthening of motivation) is the "mental program", which adjusts the mental

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<sup>67</sup> So-called interoceptors provide information about the internal status of our inner environment and changes therein. These include receptors situated in the walls of our internal organs and blood vessels.



apparatus as follows: "physical and psychic resistance and the extensive skill-level practice of tasks will help me to cope with the challenges of extreme ambient temperature without a significant drop in my performance". However, excessive determination (motivation) may generate the risk that our consciousness disregards the physiological and psychic indications that warn us of the extreme temperature conditions, and therefore bodily damage and injuries may occur. Therefore, it is crucial to timely detect any changes in psychic performance caused by temperature extremities to ensure that the missions are completed successfully and the soldiers remain healthy and deployable.

Figure 4.7. shows a model depicting the environmental impacts, the key elements of the network of systems regulating their physiological and psychic operation, and the interconnection routes of mutual modulation effects:

#### *4.6.3 Summary of the impacts of high environmental temperature load on the operation of the nervous system (sense organs) and on psychic processes from the perspective of military activities*

There is no consensus in literature regarding the definition of *psychic performance*. English-language literature mostly uses the term "psychological performance", but what is meant is actually the wide range of traditional psychic functions described in course books. I do not think the use of the adjective "psychological" is appropriate here as it has a much broader meaning than psychic functions. Accordingly, in our context, the adjective "psychic" covers the coordinated operation of sensing, comprehension, attention, cognitive processes and actions (thinking: analysis, evaluation, decision-making), memory functions, and intellectual capabilities (including the ability to make use of learnt skills). The term "performance" refers to measurable qualitative and quantitative parameters.

Heat decreases human performance significantly and in various ways. During World War II, researchers studying thermal stress attempted to determine a kind of "break point", but they were unable to conduct their tests in a controlled manner under natural conditions (a combination of temperature, humidity, wind velocity and exposure time) so the findings could not be evaluated accurately. Even though subjective complaints are indirect indicators, they characteristically describe the physical and psychic condition generated by the heat:

- the performance of work became more difficult due to the lack of concentration;
- fatigue appears sooner;

- general well-being worsens;
- general mood shows a negative trend, lethargy develops.

A combination of the factors listed above generates a mental status in which mental performance (the completion of tasks) can only be recovered by providing colder (cooled) and drier (low humidity) air, depending on the given environment /e.g.: Adhesion and perspiration can be better avoided in drier and colder environments. which is beneficial for the completion of tasks requiring dexterity./

#### AFFECTED NERVOUS SYSTEM AND SENSE ORGAN FUNCTIONS:

1. The speed of simple reactions (response time) was also quite low in heat. The intensity of the heat impact is more important than its duration. Task situations requiring complex action or choice decisions prolong the response time, which difference is even more pronounced if the ambient temperature rises. (Johnson and Kobrick, 2002).
2. Visual distortion caused by heat (e.g. lacrimation, dazzle, optical illusions, glare) reduce accuracy in the performance of visual tasks such as the estimation of distance or weapon hit accuracy. (Nunneley et al., 1982).
3. Heat disorganises standard sleep patterns, which exacerbates the effects of sleep deprivation resulting from the typical disruption of sleep cycles under military conditions. Consequences: lack of concentration, slower thinking and longer response times. (Libert et al., 1988).
4. Antidotes (counter agents) affecting the nervous system used under military conditions (such as atropin) lead to longer response times and photophobia. In very hot weather, these result in a further decline in endurance and deployability. This is especially critical in situations where the stability of motor skills, quick reactions and smooth vision are required: observation, use of guns, driving vehicles, operating equipment. (Kobrick et al., 1990).

#### CHANGES IN PSYCHIC-MENTAL PERFORMANCE:

1. In case of tasks calling for long-term concentration (security duty, observation, operation and monitoring of control equipment), heat exposure shortens the period of efficient performance to 30 minutes. This can be improved by taking permitted stimulants (caffeine intake in various forms, although not without limits) or by consciously reducing monotony. (Taylor, Orlansky, 1993).



2. Performance in complex mental tasks (complex cognitive-mathematical operations, e.g. deciphering messages) declines in temperatures above 32.2°C after 3 hours. Acclimatisation to and training under heat exposure mitigates this decline in performance. (Kobrick és Fine, 1983).
3. Long-term heat load leads to instable motor functions and decreased endurance. There is a performance loss in activities requiring the stability of motor skills (e.g. shooting accuracy). (Johnson and Kobrick, 2002).
4. The efficiency of target tracking declines (the controller has to evaluate differences in the continuous sequence of targets). (Pepler, 1959).
5. Performance is affected by heat more if simultaneous tasks are being carried out (doing two or more tasks at the same time); therefore, it is recommended to divide them into individual tasks. (Mackie and O'Hanlon, 1977).

SECONDARY FUNCTIONAL DISORDERS TRIGGERED BY  
PHYSIOLOGICAL REACTIONS IN HOT WEATHER:

Neural-psychic functions	Function	Temperature threshold (in °C)
Sensoric	coordination of the eyes, perception of contrasts, visual acuity,	35
		38
		32
Attention	vision, hearing,	37
		35
Psycho-motor-based Cognitive capabilities	successful targeting, calculation, problem solving tasks, receipt of Morse codes,	32
		35
		32
		48

**Table 4.2.:** *Temperature thresholds of performance drop in psychic functions (Gal and Mangelsdorff, 1991) [4.45.]*

Literature does not specify a generally accepted temperature threshold confirmed by practical examples above or below which functions determining performance start to deteriorate inevitably, clearly and rapidly (apart from temperature ranges that are evidently detrimental in theory). Individual heat tolerance depends on the following: individual characteristics and load capacity of the physiological and psychic regulatory systems of the body, efficiency of

physical and psychic preparation, the current status, as well as the load potential of other stressors, various parameters of the air in the given environment (humidity, wind velocity), and the decisive parameters of the official and protective clothing worn. At the same time, there are some published observations, which can be used in practice as base threshold values.

Zoltán Detre (2010) quotes data collected by Gal R. and Mangelsdorff AD. (1991, 2001) in his publication on correlations between extreme heat load and psychic performance ([http://portal.zmne.hu/download/bjkmk/bsz/bszemle2010/1/14\\_detre\\_zoltan.pdf](http://portal.zmne.hu/download/bjkmk/bsz/bszemle2010/1/14_detre_zoltan.pdf)). According to research conducted by the authors quoted, the following temperature thresholds can be determined with respect to the expected deterioration of the functions of the psychic nervous system and other psychic functions under tropical conditions, with high humidity (Table 4.2.).

1. The symptoms characterising heat disease triggered by intense heat stress already significantly reduce military performance in themselves (the intensity of symptoms varies widely depending on the individual). In addition to general physical condition, it is a factor considerably influencing the psychic-mental performance of soldiers, so it needs to be considered carefully before taking soldiers back to service. (Kobrick and Johnson, 1990).
2. Secondary phenomena occurring in hot weather, such as perspiration flowing into the eyes or glasses, contact lenses obscured by moisture, worsen visual functions. (Nunneley et al., 1982).
3. Moisture resulting from perspiration may cause the instability of headphones, head microphones or eyeglasses, leading to a performance loss in tasks requiring undisturbed hearing and vision. (Nunneley et al., 1982).
4. When protective gloves are worn in hot weather, they increase perspiration and the hands may become wet. This makes the gloves slippery and creased, and, as a consequence, dexterity and tactile abilities worsen. (Stoll et al., 1982).
5. When designing the operating units of military equipment, factors preventing their optimum operation under extreme climatic conditions must be taken into account (e.g. control buttons, unwanted warming of surfaces) as they may impede manual operation or cause burns. (Stoll et al., 1982).

#### PSYCHIC FUNCTIONS RELATED TO EMOTIONAL MECHANISMS:

1. Individual reactions related to the feeling of discomfort vary widely. The level of heat acclimatisation and individual



dispositions influence the intensity of perceived discomfort to a large extent. It is typically high temperature and humidity that cause discomfort and a lower level of motivation for people doing military tasks. (Baron, 1977; Bell et al., 1976, 1978, 1982).

2. Crowded conditions and the impacts of heat exposure, combined with a higher frequency of aggressive behaviour patterns and increased irritability, exacerbate controversies between individuals and groups, conflicts of interest and other controversial situations (a major role is played here by the limitation of the personal sphere). (Baron, 1977; Bell et al., 1976, 1978, 1982).

#### OTHER PECULIARITIES IN A MILITARY SETTING:

1. The chemical protective clothing protecting the body constitutes a micro-environment preventing heat and humidity to escape. This increased heat exposure also needs to be taken into consideration when performing special tasks. (Kobrick and Sleeper, 1986).
2. When chemical protective clothes are worn in hot weather, the performance of the soldier is expected to drop almost immediately to a moderate extent. However, observations show that there is no more significant reduction in the following 6 hours. This drop in performance is primarily caused by the physical burden of wearing the special clothing, but the effect of heat is of almost the same importance. (Kobrick and Sleeper, 1986).

#### *4.6.4 Impacts of low ambient temperature on the major elements of psychic performance*

The target areas of today's peacemaking and peacekeeping military operations have a variety of distinctive features in terms of their climate. Although these areas are mostly situated in zones with a very hot climate, many of them also have a cold season or are characterised by extremely large ambient temperature fluctuations (deserts), so very low temperatures also need to be taken into account. Military actions performed in cold weather (typically below the freezing point) and under very cold conditions pose a dual challenge as the soldier must be protected from the injuries and physiological consequences caused by cold, at the same time, optimum conditions must be established for the free and accurate movement of the body and the limbs and the smooth operation of the sense organs (primarily regarding vision, hearing and the sensing of

heat) in order to successfully carry out the tasks of the mission. The most important consequence of low ambient temperature with a negative effect on humans is hypothermia.

A distinction must be made between hypothermia caused by cold water and cold air. Cold water exercises its effect on the basis of conduction, and therefore, hypothermia occurs 25 times faster than through air, and there is also a higher load on the mechanisms and capacities of the body responsible for thermoregulation. The biggest load factor for the human organism is cold and humid air.

#### IMPORTANCE OF RESEARCH EXPERIENCE AND FINDINGS FOR MILITARY PRACTICE:

1. From the physiological impacts of cold climate, the detection of phenomena and status attributes referring to hypothermia is the most important from a practical point of view. From a physiological perspective, the detection of core temperature is the most meaningful as it is a major point of reference for our thermoregulatory system. Looking at the psychic side, behaviour patterns provide us information on the current status (slower speech and psychic speed).
2. As far as the impacts of hypothermia on psycho-physiological mechanisms are concerned, the deterioration of response time and sleep quality must be emphasised. A reduction in the speed and accuracy of reactions given to various environmental stimuli and signals directly affects the effective implementation of certain military activities (e.g. delayed reaction to military communication signals or the misinterpretation thereof may be very dangerous). Long-term sleep disorganisation in sleep (sleep deprivation for several days) may undermine the global physical and psychic condition. (Ellis, 1982; Angus et al., 1979).
3. Cold climate most robustly affects functions related to motor activities (fine manipulation mechanisms: operation of devices, equipment and weapons; carrying out coordinated movements: i.e. the continuous mobility of the soldier). This is a highly important factor as it is a physiological, physical guarantee for the successful implementation of military activities. A negative change in the performance of delicate, coordinated movements can be observed already above the freezing point (below 12°C) (e.g. the error rate increases threefold). The speed of movement may decrease by 13 to 20% due to falling ambient temperatures. Wet environment (e.g. soaked clothes) may lead to further functional disorders



as a result of increased heat conduction. (Clark et al., 1960, 1961, 1962).

4. Hypothermia reduces the level of alertness, the speed and efficiency of cognitive mechanisms (mathematical operations, interpretation and analysis of observations, decision-making etc.), as well as memory functions. Poorer cognitive performance is already measurable below an ambient temperature of 10 degrees Celsius, resulting in a change of 15 %. Long-term cold exposure (below 18.3°C) negatively influences logical argumentation, learning and memory functions. Due to memory disorders, it is recommended to give brief and succinct instructions and use direct online communication. Because of the expected fall in the level of alertness in permanently cold weather, it is recommended to change shifts more often when scheduling service times. (Mackworth, 1950; Davis, Baddeley and Hancock, 1975).
5. To ensure the effective implementation of tasks, it may be advisable to divide very complex tasks into sub-tasks. It may be more efficient to use smaller groups to complete special tasks that could be easily solved by a single person under normal temperature conditions. This, of course, necessitates personnel trained for a variety of tasks under extreme environmental conditions. (Pilcher et al., 2002).
6. In cold climates, clothing that is appropriate in every respect may be of utmost importance. In addition to good thermal insulation, key requirements include air permeability and moisture absorption capacity (e.g. in the case of protective gloves, because insufficient hand protection against hypothermia or excessive perspiration of the hands increases the risk of frostbite and, at the same time, impairs the implementation of fine movements), which are essential for adaptation to the environment. This is especially true of the hands, whose undisturbed use and protection must be ensured with all possible means (particularly against the combined impact of hypothermia and moisture). The fact that fine hand movements become more limited and clumsy may progressively aggravate the feeling of discomfort caused by hypothermia. The experiencing of discomfort and the decline in motor functions also decelerates psychic performance. (Enander, 1986).
7. Special attention must be paid to cold, moist and wet environments. Due to the good thermal conductivity of water, hypothermia, or even frostbite, may develop already above the freezing point. It is impossible to perform longer tasks in cold water without appropriate protective clothing and training.

Such tasks require due care and professionalism even if the above conditions are met. Several studies have conformed that the speed of movement and cognitive performance rapidly deteriorate, even in special clothes, already in water temperatures below 10°C (50-70 % of the information is lost). (Davis, Baddeley and Hancock, 1975).

8. Carefully organised physical and psychic training (including acclimatisation) influences subjective heat perception favourably and increases tolerance. (Clark and Jones, 1962).

#### *4.6.5 Partial summary*

IMPACTS OF EXTREME CLIMATIC CONDITIONS (TEMPERATURE, HUMIDITY, DROUGHT OR PERMANENT RAINFALL, AIR FLOW) ON THE PERFORMANCE FACTORS OF HUMAN PSYCHE, AND THE MILITARY IMPLICATIONS THEREOF:

1. Apart from extreme conditions, the decisive factors of the ambient climate do not influence our psychic functions through their direct physical impact but via our neural and physiological regulatory systems. The degree of detrimental or performance-reducing impacts is mainly determined by the duration and intensity of exposure or, where appropriate, the combined effect of several factors, mutually reinforcing one another. High-quality physical and psychic preparation (including, besides acclimatisation, the skill-level practicing of tasks under conditions that are similar to the regional climate of the planned mission) may significantly increase load capacity. Therefore, it is not possible to define precise temperature ranges that definitely cause harm. However, certain hints are given by a study published in 2007 by Hancock et al., presenting a meta-analysis of 291 publications on performance reactions (variations) triggered by thermal stressors (i.e. ones representing heat and cold). Based on the mathematical analysis of the research findings of different authors, they identified  $ET > 29.4^{\circ}\text{C}$  as a level above which a drop in performance must be expected, but this level and the progression thereof is highly influenced by other factors as well. With respect to low temperature, this threshold is at  $ET < 11.1^{\circ}\text{C}$ .
2. One of the most important conclusions of international studies is that failure to detect, or the underestimation of, "everyday" bodily symptoms and phenomena triggered by our physiological thermoregulatory systems may lead to a significant drop in performance (perspiration or wet clothes may cause severe problems both in extreme cold and in



extreme hot), so the detection of these is more than simply a health-related aspect.

3. In very hot weather, a performance drop first appears in the completion of military tasks requiring visual capabilities, fine motor coordination and long-term concentration. The degree of performance reduction depends on the amount and duration of heat exposure, the associated climatic conditions, individual capabilities, the current physical and psychic condition, and the characteristics of the clothes worn with respect to quality and the formation of a micro-environment in the given climate.
4. When carrying out activities in a cold climate for a longer period (more than 3 hours), it is a disorder in simpler and more complex (fine coordination and/or simultaneous) motor skills that appears the soonest. Special emphasis must be placed on the progressive physiological, and consequently performance-reducing, effects of moist and wet environments.
5. Both temperature extremes exert a robust effect on the performance of activities related to certain elements, and the coordinated functioning, of mechanisms regulating cognitive functions and stress management and behavioural responses. Based on the above, both temperature extremes primarily result in disorders regarding the speed and efficiency of alertness, response time, long-term focusing of attention, psycho-motor skills, and cognitive operations, as well as regarding memory functions.
6. Even in the most coordinated and most motivated military units, irritability is expected to rise temporarily, aggressive behaviour patterns may become more frequent, and individual and group conflicts may appear as a result of the permanent heat, the accommodation and living conditions that necessarily limit the private sphere, as well as the permanently stressogenous role of operating areas. The effects of cold climate mainly manifest themselves in lower psychic speed, indifference and apathy.
7. The quality and functional parameters of standard and special clothes, devices and equipment are important performance-relevant factors for any military action carried out at either end of the climate scale. Even though these impacts are realised indirectly, via physiological systems, they must be definitely taken into account for the preparation of military missions and during their successful implementation in the operating areas.

#### 4.6.6 Recommendations

##### RECOMMENDATIONS FOR MILITARY LEADERS (COMMANDERS):

1. Military leaders must be provided basic physiological and psychological training in connection with the effects of extreme climates on military performance to be able to perform the operational planning of missions and the preparation of the military personnel.
2. Military leaders have to take every opportunity to ensure the physical and psychic preparation of personnel intended for use in operations in environments with extreme (primarily hot) climates in order to avoid, mitigate or properly manage the psychic-mental performance-reducing effects of extreme temperatures in the area of operation.
3. Commanders working in mission areas must be provided relevant data regarding the local climate and the expected physiological and psychic effects thereof for the planning of each mission and the regular service activities.
4. During missions performed under extreme temperature conditions that are longer than 3-6 hours, psychic performance is expected to decrease. This impact can be mitigated by dividing complex tasks into sub-tasks and by simplifying communication.
5. The commanders controlling the operations must give special care to their staff in case of activities performed in extreme temperatures, in wet environments or in water, because long-term exposure may lead to more rapid and significant performance reductions and injuries.
6. It is recommended for commanders of missions to include in the practice activities in the territories with a given climate tasks providing information on the current status of psychological performance (with special regard to the use of special protective clothing and equipment).
7. They have to check whether the clothes and protective equipment worn and the equipment, devices meet the requirements of the given climate in order to protect and maintain the health of the personnel

##### RECOMMENDATIONS FOR CERTAIN SPECIAL MILITARY SERVICES:

1. When designing and producing military and protective clothes, extreme climatic factors, as well as scientific and practical experience gained from international research must be taken into account (along with the experience of soldiers who served in missions), with special emphasis on the characteristics of



the micro-environment forming between the body and the clothes worn and its role in thermoregulation.

2. As far as special protective clothing is concerned, the personnel must be provided with equipment that already incorporates state-of-the-art technological solutions managing the negative impacts of perspiration and humidity and providing proper thermal insulation.
3. The sanitary corps must be prepared to detect and treat the symptoms and phenomena of both thermal stress and hypothermia. In the mission areas, they have to maintain the basic knowledge of soldiers within the framework of self-help and companionship.
4. Under extreme temperature conditions, the manual skills of grasping and holding deteriorate, and it becomes more difficult to control certain devices and equipment manually due to the overheating or overcooling of controls. This justifies the redesign of some military devices and equipment in accordance with the peculiarities of the given climate, also taking into consideration ergonomic aspects.

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