

**MIKLÓS ZRÍNYI**  
**NATIONAL DEFENSE UNIVERSITY**  
János Bolyai Faculty of Military Technology  
PhD Institute in Military Technology

Theses of the DOCTORAL (PhD) DISSERTATION entitled

**MULTIFACTORIAL STUDY AND ANALYSIS OF THE  
MENTAL CONSEQUENCES OF EXTREME OVERBURDEN:  
APPLICABILITY OF RESULTS IN IMPROVING EXPERT  
SYSTEMS TESTING SUITABILITY AND FULFILMENT**

Written by  
Dr István Hullám

**BUDAPEST**  
**2005**

**Doctorand:** dr István Hullám

**Tutor:** Professor József Fűrész col. MD, CSc  
privat-docent

### **Stating the academic problem**

The army of the future is an ability-based force built on certain specified principles, procedures and doctrines, satisfying both national and federative requirements as well as the challenges of the informational society. The duties, organic structure, ammunition and armament of the army as well as its personnel and its training constitute a coherent system. The obligations deriving from NATO membership and the factors threatening international safety both motivate the creation of such military forces being able to carry out fast and effective operations, applicable both in crisis management, protection and in the frames of federations. The academic analysis of all these new challenges and the long-lasting, increased, extreme physical and mental stress (also their different combinations) is a significant condition of achieving the above aim. The improvement of the expert system of personnel selection (suitability and fulfillment tests) according to the changing system of requirements, and the ability-developing and state-preserving training of the personnel with special tasks all need the scientific results of stress research to be applied in practice, too.

The increased physical and psychic overburden affect human performance in a rather complex way. This effect can be registered in the change of both the quality and quantity of performance. The physical and psychic abilities of a soldier vary according to increased and extreme burdening. Consequently, the individuals and certain physical and psychic features of the group go through changing processes that can cause a decrease in individual or group performance, and an increase of insecurity.

Regarding the military activity, it ranges from simple, general, routine-like operations to performing tasks that require complex, specialized knowledge, physical and mental abilities and skills. With respect to the different psychic and physical functions, soldiers need to be capable of standing a burden greater than average in order to achieve the performance deriving from carrying out tasks (burdening) that require physical or mental effort of extremely varied period of time and complexity. It is of fundamental importance which functions get into the foreground considering military performance. In the course of the decades of medical experience as a therapist (both at the military armed forces and the armed forces of the Ministry of Interior), I have experienced amortization in different degrees of

psychical, psychomotor, and physiological functions of persons enduring long-lasting burden. Prevailing alterations in mood and emotions were many times accompanied by the deterioration of the simple and more complex memory, and also the senso-motor functions, which can be proven with subjective and clinical examination. For effectively prevent long-lasting deterioration of performance, more and more knowledge is needed about changes in psychic performance as a result of chronic, cumulated or extreme burden. Most international studies published in military medical science, concentrate on physiological changes. Those publications, which present psychic alterations and performance, have data gathered by tests, which have not been standardized on Hungarian population; therefore, these cannot be easily adapted. On the basis of the above, I have decided to examine the effect of acute psychic-, and subchronic complex (physical and psychical) stress on factors influencing military performance, such as cognitive (memory, information analysis, decision making, special orientation), simple and complex senso-motor functions, mood - emotional state and physical fitness.

## **Hypotheses**

1. As a result of acute and extreme stress, the storage of fresh engrams is damaged, as well as spatial orientation.
2. As a result of sub-chronic physical and psychic stress certain mental factors change that are relevant regarding task accomplishment and performance, for example mood, emotional stability, memory, complex somato-sensor operations.
3. Physical fitness plays a role in protecting emotional-mood factors and other mental functions that are relevant regarding task accomplishment, based on the principle that the same burdening requires relatively lower energy from a person with a fitter body than from one with a less fit organism.
4. The P.I.S.I. test it differentiates between personality characters representing mental abilities that are relevant regarding suitability tests.
5. From the PISI and Hobfoll Coping tests those parameters can be selected which determine the quality of coping functions. On the basis of these parameters groups

with good and poor coping functions can be formed of the military college students. These groups also differ on the basis of alteration in their mental function as a result of stress.

6. A model can be made which unites the coping processes, the effect mechanisms of acute and chronic stress, and the aspects of task accomplishment factors.

### **Aims**

- a) To choose the psychological tests and other methods of examination to be applied in the course of performing the tasks.
- b) To describe the impact of increased physical and psychological stress, on psychic components, which are relevant to military performance.
- c) To study the role of physical fitness in preserving the integrity of psychic operations, which are relevant to military performance.
- d) To study the role of coping functions in preserving the integrity of certain psychic operations, on military population. To study the possible role of coping functions, at evaluating aptitude and aptness for armed forces personnel, and also its place in selecting the persons.
- e) To create a model system for general and military adaptation of performance, task accomplishment, coping functions and mechanisms.
- g) To study the effect of acute stress on cognitive and other mental functions that are relevant regarding the success of task accomplishment.

### **In order to reach the above aims the following methods have been used:**

- a) I have created a measure system to detect the psychic and physiological processes that are relevant to the success of task accomplishment.
- b) I have studied the impact of increased physical and psychic stress on psychic components that are relevant to military performance.
- c) I have studied the role of physical fitness in preserving the integrity of psychic operations that are relevant to military performance.
- d) I have made a survey of the theories describing coping functions, on the basis of relevant publications of national and international literature, with special attention to the role of coping in preserving the integrity of mental operations that are

necessary for the success of task accomplishment. I have studied the role of coping functions in preserving the integrity of certain psychic operations that are relevant to military performance, on a chosen military population.

- e) I have created a model system for general and military adaptation of the interrelationship among performance, task accomplishment, coping functions and mechanisms.
- f) I have studied the effect of acute stress on cognitive and other mental functions that are relevant to the success of task accomplishment of security specialized secondary school and civil college population.

## **Summary of research and summarized conclusions**

To achieve the research aims described above, I studied the effects of acute and sub-chronic stress on some psychic operations that play a role in the success of task accomplishment in two model situations.

I studied the impact of acute stress on calling back data memorized shortly before the task accomplishment with civil college and security specialized secondary school groups, using a situational house model. I proved that as a result of acute stress the number of false routes significantly increased, the application of fresh information in spatial orientation deteriorated.

In sub-chronic (4-day-long) physical and psychic stress situations, examining the values of the homogeneous military college group before and after the task I managed to prove that the culminating stresses experienced during the survivor training significantly influence the operation of some psychic components that are relevant regarding task accomplishment. Having analyzed the data obtained from delayed memory and complex situational memory tests statistically, I could prove that the storage and reproduction of information that is important for a soldier significantly gets worse as a result of stress, similarly to the performances during the complex senso-motor operations (decomposing and assembling arms) practiced to an automatic level. At the same time, the improvement of simpler senso-motor functions such as reaction time and security of fire could be demonstrated in the course of measuring concentration capacity.

Among the factors influencing the failure of some psychic functions that are relevant regarding task accomplishment I studied the effect of physical fitness with the hypothesis that the given physical burden can lead to less stress in the case of groups that are in a better physical state. Although the results of the Kis-Lüscher test, gained by qualitative evaluation method showed that, the positive mood in the group with better fitness parameters gives higher %-rate, as a result of stress mood got worse in the same % rate in both groups, this was not proven by the correlation analysis.

The proportion of good performances was considerably greater in the group with fitness parameters higher than average than in the other group with respect to starting values in the case of complex cognitive, micromanipulation and spatial orientation abilities (mosaic test). as a result of the survivor training, similarly to the results mentioned above, the performance improved in the group with less fitness, while it decreased in the group previously with better values.

Examining reaction time and security of fire by the concentration capacity test, I could state that the less fit group and the one fitter than average did not significantly differ from each other in the beginning considering the simple senso-motor functions, still the performance of the less fit group considerably improved as a result of stress.

At the same time, in the course of studying the complex senso-motor functions of the trained and the untrained groups by the arm decomposing and assembling test, it could be seen that for the untrained the accomplishment time increased in a much higher percent as a result of stress as opposed to the trained, and the proportion of those increased whose delay in time turned out to be of high risk.

Among the registered results, the result of studying memory performance by the delayed and complex situational tests is of great importance, where I proved that in the case of the fit group the decrease in memory performance measured by the delayed method was significantly lower as a result of stress than in the less fit group. The decrease in complex situational memory performance was also lower in the fitter group.

In the dissertation I studied the suitability test values of coping functions. Using the PISI test I proved that within the police force, which can be qualified as successful on the basis of their many years of experience and operation, among factors representing coping functions Mobilizing, Creating Subsystem shows a value above the Hungarian average. At the same time, in the case of personnel who got into hospital due to situational psychic illness, the value of this parameter was under average.

The two populations, in comparison of their factors differed significantly (t-test). According to further statistic analysis of the data on the basis of averages, deviation, frequency and correlations, *Feeling of Advancement*, *Synchronous Ability*, *Emotional Control* and *Self-control* the two populations can be separated. And the factors mentioned show positive correlation to each other, too. Studying military college students, values within the average range could be detected with respect to coping functions. Comparing the test results of military college students and the police officers trained to carry out special duties, the police officers have significance greater than  $p < 0,001$ , with the exception of one factor the Emotional Control. According to these results, one interpretation is that the group of police officers was a selected group compared to the other.

I have shown on the basis of psychometric analysis of tests detecting coping functions (Hobfoll Coping Test), mood-emotional state (Kis-Lüscher test), and certain characteristics of fitness (VO<sub>2</sub> max, body fat %) which are necessary for successful task accomplishment, that 1) high value of Lüscher conflict<sup>2</sup> index, expressing strong stress experience correlates with

the Instinctive and Antisocial coping strategies; 2) lower body fat% expressing more fit state, has negative correlation with Antisocial coping strategy; 3) fit persons are more significantly characterized by the Avoiding coping strategy representing stronger self-control ; 4) there is significant correlation among Instinctive, Antisocial and Aggressive coping strategies; 5) the ratio of conflict stress correlates with Indirect, Antisocial and Aggressive coping strategies, and the total coping value in the examined group.

I analyzed the coping function mechanism using interrelated models /figures 30-31-32./ regarding its potential role in task accomplishment. Based on the previous empirical experience and the research results, I extended coping function to the concept of professional coping, moreover I demonstrated the effect mechanism of acute and sub-chronic psychic and physical stress in a model /figures 30-31-32./. Based on my experiments I assume that as a result of the stressor the interpretation of phenomena built on existing experience binds the data processing mechanism to such an extent that the line of decision mechanisms needed for task accomplishment is blocked /figure 32./.

## **New academic results**

1. With the application of the P.I.S.I. test, I have proved through comparative analysis of data obtained from technically qualified police force population and armed force officers treated with psychic illnesses, that the test differentiates between abilities that are relevant to suitability tests.
2. I have proved that as a result of acute stress the storage of fresh engrams is damaged.
3. I have proved that as a result of sub-chronic physical and psychic stress certain mental factors change that are relevant regarding task accomplishment and performance, for example mood, emotional stability, memory, complex somato-sensor operations. As a result of physical burdening, state indicators of simple functions like reaction time, or security of fire change in positive direction.
4. I have proved that physical fitness might play a role in protecting emotional factors that are relevant regarding task accomplishment, based on the principle that the same burdening requires relatively lower energy from a person with a fitter body than from one with a less fit organism.
5. I have created a model with the adaptation of certain elements of existing coping and other cognitive models for coping functions taking the task accomplishment factors



into consideration. I also built in the effect mechanism of acute and chronic stress, and I completed the model with an operation model borrowed from information technology in which the analogy was provided by the co-operation of storage memory capacities and processor capacities. Both acute and chronic stress, push the processing of future-oriented impulses targeting task accomplishment into background, influencing the processor focusing on processing the existing experiences.

### **Applicability of the results of the dissertation, suggestions**

- a) My research incorporating psychological tests, which detect personality dimensions of coping ability and stress management (P.I.S.I and Coping tests), proved that these tests contain such factors, which differentiate among persons who are successful in coping and those who are treated with psychic illnesses. Therefore, I suggest the application of these tests within the special suitability examining system aiming at gaining further experience, and for extending the principles of the qualifying expert system in the future.
- b) I suggest that mental factors that are relevant regarding task accomplishment and performance, such as coping ability, mood, emotional stability, memory, complex cognitive and somato-sensor operations should be studied further, using the situational method, in populations selected according to different respects.
- c) On the basis of my experiments carried out so far with my research group, as well as based on the published sub-results a new, original research area is outlined nationally and probably internationally, too, which analyses the effect of acute and extreme stress on various psychic performances. The planned experiments and tests together with the ones that have been carried out so far will provide valuable data for academic research, furthermore for training and preparation systems applied in armaments and military forces.
- d) Understanding ability deterioration, as a result of acute and subchronic, physical and psychic stress, and taking it into consideration in the course of decision making is extremely important while in commanding position.
- e) My results provide data for improving modern sensor systems.

- f) My results emphasize the importance of physical endurance with regard to persons exposed to special requisitioning.

**Publications being published or accepted for publication with regard to the dissertation:**

1. **dr. Hullám I.: Doktori (PhD) értekezés koncepció.** ZMNE Katonai Műszaki Doktori Iskola, Kard és Toll, 2003. , Budapest
2. **dr. Hullám I. – Györffy Á.: A szélsőséges környezeti hőmérséklet hatása a védelmi szférában dolgozók pszichikai teljesítményére.** ZMNE /Védelem-Egészségtudomány, Tananyag fejezet/, 2003, Budapest (Megjelenés alatt)
3. **dr. Hullám I.: A személykiválasztás rendszermodellje a terrorelhárító szolgálatnál.** Humán Szemle, 2003/IV., Budapest
4. **dr. Hullám I. – dr. Bilkei P.: A személykiválasztás elméleti alapjai és módszertani sajátosságai a BM rendvédelmi szerveinél.** Honvédorvos, LVII. Évf., 2004/2. szám ISSN 0133-879 pp.199-209.
5. **dr. Hullám I.: Az elektronikus szakirodalmi tájékozódás a kutatás szolgálatában.** Kard és Toll, 2003., Budapest
6. **dr. Hullám I. – Györffy Á. – Végh J.: Katonai tevékenységekkel kapcsolatos terhelések pszichológiai vonatkozásainak vizsgálata, Túlélő tábori kiképzés körülményi között.** Honvédorvos, 2004, Budapest LVII. évf. 2004/2. szám pp.165-191. ISSN 0133-879
7. **dr. Hullám I. – Györffy Á. – Végh J. : Pszichikai teljesítmény változások katonai túlélő kiképzés során.** Honvédorvos, 2004. (58) 3-4 szám 340-341. o., Budapest
8. **I. Hullám – Á. Györffy – J. Végh: „Psychological examination of burdening effects of military activities in survival camp circumstances.”** AARMS, 2005, Budapest (megjelenés alatt)

**Further publications:**

1. **dr. Hullám I. – dr. Barsi J.:** Multiprocesszoros adatfeldolgozás az idegrendszerben. Technika, 1980. , 8: p. 21.
2. **dr. Hullám I.:** „Mikroszámítógép – hálózat” az élő szervezetben. Finommechanika – Mikrotechnika, 1982. , 6:169-173.
3. **dr. Kovács G. – dr. Hullám I. – dr. Lukács H. – dr. Hilszmajer I.: Pszichiátriai megbetegedések manifesztációja a katonai szolgálat során.** Honvédorvos, 1990, 42. évf. , 3-4:177-185.

4. **dr. Hullám I.** – dr. Barsi J. : **Az informatika szerepe a neuropszichiátriai diagnosztikában.** Magyar Informatikusok I. Világtalálkozója, Budapest, 1996. , p. 417-424.
5. **dr. Hullám I.** – dr. Rihmer Z. – dr. Kovács L. – dr. Tahin Zs. – dr. Kovács G.: **A pánikbetegség előfordulása leszerelő sorkatonáknál.** Honvédervos, 1996, 4: 276-281.
6. **dr. Hullám I.** – dr. Barsi J.: **A kommunikációs jelenségek tartalmi elemzése.** Magyar Informatikusok II. Világtalálkozója, Budapest, 2000. , p. 519-524.
7. Dr. Bíró G. – **dr. Hullám I.** – Dr. Kovács M.: **A nemzetközi trendek hatása a Gábor Dénes Főiskola fejlődésére.** Informatika 7. évf. 1. szám 33-36. o., 2004, Budapest
8. **I. Hullám** – Á. Győrffy: **Psychological Training for a better self Management in the EU after enlargement.** Informatika 7. évf. 5. szám 48-52. o., 2004., Budapest
9. Ágoston Gy. – **dr. Hullám I.** – dr. Kovács M.: **A műszaki és a biológiai tudományos lehetőségek kombinálása.** Informatika 7. évf. 3. szám 59-63. o., 2004, Budapest
10. Dr. Szilágyi T.: **Felnőttképzési kézikönyv.** /**dr. Hullám I.** - szerkesztő/, LSI Informatikai Oktatóközpont, 2004, Budapest ISBN 963 577 347 1
11. Gy. Ágoston – **I. Hullám** – M. Kovács: **„The Combination of technological and scientific Potentials”** Informatika 7. évf. 2004/5. szám pp. 48-52. ISSN 1419-2527