

NATIONAL UNIVERSITY OF PUBLIC SERVICE

Doctoral School of Military Sciences

MAJ. Beatrix HORNYÁK

**Possibility of measuring and developing Mental Toughness among
the professional and contracted personnel of the Hungarian
Defence Forces**

author's description of a doctorate thesis (PhD)

PhD supervisor: Prof. em. Dr. Judit Bolgár Ret. Colonel

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1. RESEARCH PROBLEM

Today, the persistent and increased physical and psychological stresses arising from the military obligations, the management of the crisis caused by mass immigration and the COVID-19 pandemic are significant, which require serious military, physical and psychological preparedness of soldiers. It is necessary to be able to prepare the military personnel to survive potential crises, to tolerate difficulties and to cope with them. One of the preventive and constructive way is to develop resilience to stress. Resilience research has come to the fore in recent decades as indicated by the fact that Google's search gives 3.65 billion hits for "resilience" today, compared to the number of hits in 2010 - when I first started to study the subject - barely reached 10 million. Despite the vast amount of literature on the subject, a number of theoretical and practical issues arise in defining, measuring, and developing resilience.

A fundamental problem is that there is a lack of an officially accepted definition of resilience itself, and the content of the concept is unclear. There is currently no consensus among researchers on how to interpret resilience as a trait, a process, or an output. There are currently three main research directions in the literature: the trait theory, the capability-based approach, and the system-level approach. The question is what does the concept cover: the set of character traits (trait theory approach), or the construct of abilities acquired during learning and experience processes (capability-based approach), or the perfect fit between individual characteristics and social supportive environmental factors (system-level approach)? Is it an inherited feature or something that can be improved?

Different approaches have led to the development of different measurement tools, but currently the measurement does not have a so-called gold standard. Current resilience measures have achieved relatively low scores in quality assessment based on a set of psychometric characteristics criteria. In the Hungarian Defence Forces (hereinafter: HDF), investigations have been carried out since 2006 to assess the resilience or mental toughness of the personnel. In recent years, the Mental Toughness Test (hereinafter: MÁQ test) developed for the personnel of the HDF has been completed, which has been part of the annual health screenings since 2008. Research on the test has been based on a capability-based approach to the concept, meaning that resilience is seen as the result of learning and experience processes that can be examined and assessed on the manifestation of cognitive scheme and behavioral patterns in emotionally saturated situations. In connection with the MÁQ, the data collection

phase and the basic research have been carried out in recent years, but the psychometric verification of the test has not yet taken place. Internationally, the fourth, and according to many, the fifth wave of resilience studies are taking place nowadays. Researchers have also begun to study resilience from a biological, genetic perspective and have developed models that integrate the interactions between individual behavior, environmental effects, and genetic, nervous system status to determine the factors required for resilience. The possibility of “reprogramming, re-wiring” has also arisen, for which the science of epigenetics can provide a good theoretical framework. No theoretical summary has yet been published in Hungary that would reflect the international trend of resilience studies.

In summary, I see the scientific problem in:

1. There are already several definitions of resilience, but there is no consensus-based definition along which the phenomenon could be studied.
2. Recently fundamental changes are taking place in our understanding of the context of human behavior, we can say that biology, especially brain research and molecular genetics, is trying to “penetrate” the field of social sciences. However, no summary has yet been published in Hungarian on the extremely complex neural mechanisms underlying resilience, which include the interaction of neurochemical, genetic, and epigenetic factors with each other and with the environment.
3. The psychometric verification of the MÁQ test, ie the examination of the reliability and validity, the standardization and the empirical examination of the theoretically assumed 4-factor structure, has not yet been performed.
4. The possibility of developing MÁQ through learning and experience processes has not yet been empirically proven.

In my dissertation, I mainly sought the answers to these scientific problems, and I tried to fill in the gaps.

2. RESEARCH AIMS AND HYPOTHESES

I have formulated my research aims related to my scientific work and the research hypotheses of my empirical research in the light of the scientific problems already described.

I. Based on the collection, analysis and evaluation of relevant literature:

1. My aim is to create a definition of resilience that can be used to examine mental toughness among the military personnel.
2. My aim is to compile a consistent theoretical background in line with international research trends by presenting the molecular genetic, neurobiological and epigenetic background processes of resilience as a psychological construct.
3. My aim is to make a proposal on the topic of targeted developmental trainings that can adequately strengthen coping and mental toughness.

II. Regarding my empirical studies:

4. My research aim is: I want to prove the existence of the assumed four-factor structure of the MÁQ test developed especially for the personnel of the Hungarian Armed Forces. My related hypothesis:

H1: *I hypothesize that the MÁQ test has a four-factor structure, ie the questions that make up the test are organized into four distinct groups of questions and are suitable for measuring the following four dimensions: durability over time, realistic range, active responsibility and control.*

5. My research aim is: I want to prove that the MÁQ test is a reliable and valid measuring tool for measuring resilience among the personnel of the Hungarian Defense Forces. My related hypothesis:

H2: *I hypothesize that the reliability of the MÁQ test is adequate, ie the internal consistency of the test (Cronbach's alpha) is stable and its size is adequate.*

H3: *I hypothesize that the MÁQ test shows a convergent validity in the right direction and degree (i.e., a positive relationship) with the Psychological Immunocompetence Questionnaire (PIK), the WHO General Well-Being Questionnaire (WBQ-5), and the Brief Stress and Coping Inventory's Life Meaning Subscale (BSCI-LM).*

H4: *I hypothesize that the MÁQ test shows a divergent validity in the right direction and degree (i.e., a negative relationship) with the Patient Health Questionnaire*

(PHQ-15), the Perceived Stress Scale (PSS-10), the shortened Beck Depression Inventory (BDI-R) and the Spielberger Trait Anxiety Inventory (STAI-T).

6. My research aim is: I want to prove that the degree and level of mental toughness can be increased with the help of targeted learning and experience interventions. My related hypothesis:

H5: *I hypothesize that the MÁQ value of the participants in the WLS training will be higher at the end of the training than the value measured at the beginning.*

3. RESEARCH METHODS

In the initial phase of my scientific work, I prepared a research plan that included the interdependent steps that served as a guideline in the preparation of my dissertation. To formulate my aims and hypotheses, I studied the relevant literature. In the absence of an accepted definition of resilience, the next step was to conceptualize the phenomenon, that is, to define the meaning of the concept to be examined precisely. Subsequently, I systematized the previous research results and then prepared a statistical analysis plan for the empirical examination of my dissertation. In order to achieve my research aims, I performed several empirical studies based on different statistical methods and performed on different test samples, which are summarized in the table below.

Aim of the study	Measure(s)	Used statistics	Sample
examination of reliability	MÁQ test	Cronbach alfa	screening database
examination of the structure	MÁQ test	Hierarchical clustering confirmatory factor analysis	screening database
standardization	MÁQ test	Normality check, stanine	screening database
examination of validity	PIK vs. MÁQ	correlation	HDF Body Composition Programme (HDF BCP)
	PSS-10 vs. MÁQ test	correlation	HDF BCP+WLS
	PHQ-15 vs. MÁQ test	correlation	WLS
	STAI-T vs. MÁQ test	correlation	WLS
	WBQ-5 vs. MÁQ test	correlation	WLS
	BSCI-LM vs. MÁQ test	correlation	WLS
examination of developmentability	MÁQ test of the WLS Pre-post-follow-up inventory	two-sample t-test	WLS

Table 1: Summary table of performed empirical studies (own editing)

The professional and contract personnel of the HDF took part in the investigations, the data collection was closed on 31 December 2018.

4. A CONCISE DESCRIPTION OF THE RESEARCH CARRIED OUT

In the *introductory* chapter of the dissertation, I justified my choice of topic based on its actuality and timeliness, described the scientific problem related to my empirical research, formulated my research aims and hypotheses, and outlined the methodology of my research..

In order to maintain the balance of the dissertation, I discussed the theoretical foundations related to the topic in five shorter chapters. At the beginning of the *first chapter*, I briefly summarized the physiological and neurobiological background of the stress response. I presented the operation of the two main systems - the SAM axis and the HPA axis - a complex cascade of neurochemical events in the central nervous system, aimed at restoring the internal balance of the body. In the second part of the chapter, I presented biological (Selye's General Adaptive Syndrome, Allostasis Model) and psychological (Lazarus' Transactional Stress Model, Cognitive Activation Stress Theory) theoretical models related to the stress response.

In the *second chapter*, I dealt with stress at work. I presented the psychosocial risks and risk factors underlying workplace stress and the negative consequences of work-related stress at the individual and societal levels. Several theoretical models have been developed to identify the sources of stress in the workplace and to estimate the degree of stress at work. I presented the Person-Environment Fit Model, the Karasek's Demand-Control Model, and the Siegrist's Effort-Reward Imbalance Model.

In the *third chapter* of my dissertation I dealt with the stress related to combat activities and the sources of stress in military organizations. In the first part of the chapter, I review of the historical roots of psychotrauma which is affecting soldiers (combat and battlefield stress, PTSD), and the change in its perception from antiquity to the 21st century. In the second part of the chapter, I introduced the stressors that present a challenge to soldiers today. Then, I followed a theoretical division: discussed the stressors related to special military tasks, the stress loads of the military organization as a workplace, and the stressors arising from the military way of life in three subsections. In the first subchapter I presented the symptoms of combat stress, the process of its development, and the psychosocial stressors of different types of military operations. In the second subchapter - in the presentation of the stress loads of the military organization as a workplace - I discussed the pros and cons of the bureaucratic mode of operation. In the third subchapter I dealt with the stresses arising from the military way of life, mainly with the place and perception of the HDF in society.

In the *fourth chapter* I dealt with the conceptual definition of resilience and the description of the theoretical models behind the definitions, as well as the presentation of individual and environmental factors influencing the degree of resilience. In the first subchapter, I described more than a hundred definitions of resilience, illustrating the fact that the term is “overused” and can mean almost everything or anything, and I created my own definition of resilience. The individual and environmental factors determining the degree of resilience were described in the second and third subsections. Regarding individual factors, I undertook to present the neurobiological and psychological profile of the person. In Hungary very few people deal with the study of the neurobiological background of resilience, a summary in Hungarian has not been published yet, so I considered it important to present the neurochemical, genetic and epigenetic components that may play a role in resilience. These neural mechanisms are extremely complex, involving the interaction of neurochemical, genetic and epigenetic factors with each other and with the environment as well. At the end of the chapter, I have provided a very comprehensive overview of the personality traits of a resilient person.

I devoted the *fifth chapter* of my dissertation to psychometry. In this chapter, I have presented the two most basic criteria (ie, reliability and validity) that are key to the psychometric testing of psychological measuring instruments. Regarding the reliability test, I presented the test of internal consistency (Cronbach's alpha) and test-retest reliability. With regard to the examination of validity, I described the concept of criterion validity and construct validity, as well as the possibility of examining convergent and divergent validity. In the second part of the chapter, I presented the most important measuring tools that can be used to estimate the degree of stress and resilience. Among the measurement tools for estimating the degree of stress, I presented the questionnaires (ie: PSS-10, STAI-T, BDI-R, WBQ-5, BSCI-LM, PHQ-15) that I used in my empirical research to perform validity tests. Among the resilience measures, I described the most commonly used questionnaires among adults (ie RSA, CD-RISC, BRS, RS, DRS, ER-89, Psychological Resilience Scale). At the end of the chapter, I presented the summary psychometric quality assessment of the most commonly used resilience measuring devices, which can be of significant help to researchers in the selection of measuring devices and in the development of new one.

The empirical research presented in *chapter six* has provided insight into the resilience of the military population both nationally and internationally. I have reviewed the presentation of the empirical studies carried out in the HDF in two subchapters, considering that these

researches are based on two completely different research aims and research approaches. The research described in the first subsection examined the extent of resilience and its relationship to PTSD and other protective psychological factors among service members. Based on the results, the resilient persons were mainly characterized by a rational assessment of stressful situations and problem-focused coping, ie the emphasis was on changing the situation. In the second subchapter, I present the research results related to mental toughness. These health psychological researches have examined mainly the role of mental toughness in health status through the study of health behavior and other psychological parameters that determine health. The international research among soldiers presented in the third subsection has sought to identify protective factors that are thought to be related to resilience. Such factors include emotional and behavioral control, toughness, calm under stress, social support, positive thinking, cohesion and teamwork within the unit, and a positive command climate. Resilience is particularly important for maintaining the fitness of soldiers, recognizing that the U.S. Department of Defense has required all branches of service to develop a Combat and Operational Stress Control (COSC) doctrine since the turn of the millennium, resulting in significant heterogeneity in programs. In the fourth subchapter, I have given a brief overview of ten resilience programs that focus primarily on the development of individual and unit level resilience factors, and secondly on the development of family-level factors.

In the *seventh chapter* of my dissertation I described my empirical studies. After analyzing and evaluating the relevant literature, I determined the working definition of resilience, which I used in my study. After the conceptualizing, I defined two main research aims: (1) the psychometric examination of the MÁQ test, (2) and the verification that mental toughness can be increased and developed through learning and experience processes. At first I examined the density and distribution functions of the MÁQ values, performed the normality tests to verify that the MÁQ scores follow a normal distribution, and then determined the standardized points to help interpret the results of the measurement tool. Next, I examined my hypotheses related to the research aims: the factor structure, reliability and validity of the MÁQ test, and the possibility of developing the degree of mental toughness.

In the *last chapter* of my dissertation I dealt with the analysis and interpretation of the results, presented my new scientific results and their practical applicability, as well as formulated recommendations and designated further research directions.

5. SUMMARISED CONCLUSIONS

The basic assumption of my dissertation is that psychological **resilience is** a very **significant human factor** for the military organizations. But measuring and developing it is a serious challenge for professionals both nationally and internationally. It is particularly important for the defense sector to preserve, maintain and improve the health, well-being and capability of soldiers, given that this is the only way in which the armed forces will be able to fully perform the tasks arising from their basic mission. However, due to its nature, the **performance of military tasks is very stressful**, which threatens the health, well-being and fitness for duty and which in many cases cannot be eliminated.

In addition to the identification of risk factors and the research of individual pathological lesions, I consider it particularly important to **explore the protective factors** that may play a role in the development and improvement of the resilience of soldiers to stress. Resilience is one such protective factor. After 9/11, the **U.S. military**, which traditionally focused on technical equipment and weapons, **recognized and acknowledged the fundamental importance of the human factor** in the success and effectiveness of military operations in the 21st century and **provided huge financial support** (eg CSF program: \$ 125 million) **for resilience development programs**. Research and development in resilience has been a priority for the United States Department of Defense (DoD), the Defence Centers of Excellence for Psychological Health and Traumatic Brain Injury, since 2007. In recent years, a number of trainings have been developed and applied in the U.S. military that show significant heterogeneity, but one thing they have in common is that all programs focus on developing individual and unit level of resilience factors. Based on all this, **I am convinced that the measurement and development of resilience should be given high priority in the human resources policy of the HDF.**

The “quantifiability” of psychic phenomenon, including the measurement of **resilience**, is a serious challenge, as most of the psychological phenomenon **cannot be measured directly**, so in practice we usually try to draw conclusions about the phenomenon with the help of directly observable characteristics. Thus, in order to assess the phenomenon, we need a scientific definition that defines the examined psychic phenomenon along the tangible (ie directly observable) characteristics, this is called conceptualization. In the case of **resilience**, **there is no consensus** among researchers on the **conceptualization and operationalization**

of the conceptual construct, so a number of definitions and measurement tools can be found in the literature.

As the first step of my empirical research, I created a definition that, together with the MÁQ test validated during my study, provides an unified theoretical framework for the examination and development of resilience among the soldiers of HDF. According to the interpretation used in my research, **resilience is the ability to adapt flexibly; it is based on inherited factors and those skills acquired during learning and experience processes and it can be observed in the responses of individual thinking and behaviour patterns in emotionally saturated situations, resulting in the soldier:**

(1) can better control the outcome of stressful situations;

(2) feel responsible for dealing with a stressful situation;

(3) is able to realistically perceive the situation and does not allow stress to spread to other areas of his life because

(4) knows that this is a temporary problem that is existing but will disappear over time.

Subsequently, in my empirical research, **I verified the four-factor structure of the MÁQ test** using hierarchical clustering and confirmatory factor analysis, based on which the 4 dimensions of the test are: **durability over time, realistic range, active responsibility and control** (which I named hungarian: IRAK model). With the four-factor validation, it will be possible to **define different Adversity Tolerance Profiles**, which will allow the development of targeted interventions for neuralgic points, adequately developing the level of mental toughness at both the individual and organizational levels.

My research results **confirmed the reliability and validity** of the MÁQ test and the **developability of the mental toughness.**

6. NEW SCIENTIFIC RESULTS

1. I collected, analyzed and evaluated the national and international literature on the determination and measurement of psychological resilience, on the basis of which **I created a new definition of resilience**, which, in line with the research in the HDF, provides an opportunity to examine resilience among the soldiers..
2. **I was the first in Hungary to present a summary of the complex neurobiological** (including neurochemical, genetic and epigenetic) **processes underlying resilience**, thus creating a broad, consistent theoretical basis for further research.
3. **I developed standardized points for the interpretation of the results of the MÁQ test** with statistical methods, with the help of which it is possible to evaluate and monitor the degree of mental toughness in the military population in the future.
4. **I was the first to prove the theoretical four-factor structure of the MÁQ test empirically** (durability over time, realistic range, active responsibility and control). Taking into account the scores of the four identified factors, it will be possible to explore, define, and appropriately develop resilience patterns (Adversity Tolerance Profiles) among the HDF personnel.
5. **I verified the reliability and validity of the MÁQ test**, with which I established its introduction among the personnel of the HDF, so I expanded the psychological tools of the HDF with a proven reliable and valid measuring tool, which is suitable for objective and credible measurement of psychological resilience.
6. **I proved empirically that the level of mental toughness can be improved** through learning and experience processes, for which the WLS training proved to be an effective tool, so it can be a starting point for the development of the HDF's own resilience training.

7. PRACTICAL USE OF RESEARCH RESULTS, RECOMMENDATIONS

Based on the review of the US military programs aimed at improving resilience, as well as the results of my empirical research, I have made a number of recommendations.

1. **Resilience must play a significantly greater role in the human resources policy, force development and everyday life of the HDF.**
2. In order to increase the resilience of the soldiers, **it is recommended and justified to develop and implement skills development trainings and to integrate them into the organization of the HDF.** I consider it appropriate to develop a training that is:
 - leader oriented;
 - has a multidisciplinary and a holistic approach;
 - has a flexible theme;
 - emphasizes the training of internal trainers;
 - adapted to the military population and emphasizes the similarity between mental endurance and physical endurance (which is why I find the term mental toughness very useful);
 - has a separate budgetary framework and a pre-planned effectiveness assessment protocol;
3. I recommend the **inclusion of trainings in the topics of all military training.**
4. I recommend the **involvement of external experts** in the research and development of resilience.
5. I recommend **the development and making available of resilience programs for family members as well.**
6. It is recommended to **further develop the MÁQ test** validated on the basis of the present dissertation.

THE AUTHOR'S LIST OF PUBLICATIONS ON THE SUBJECT

Book chapter/section

1. Sótér Andrea, Hornyák Beatrix: *Az egészségmonitorozás gyakorlati haszna: a Magyar Honvédség rizikótérképe* [The practical benefits of health monitoring: the risk map of the HDF] - In. A rendvédelem és a honvédelem területén végzett orvosi és pszichológiai tevékenység kihívásai napjainkban Tudományos szakmai konferencia Tanulmánykötete [Challenges of Medical and Psychological Activities in the Field of Law Enforcement and National Defense Nowadays]. - Budapest, 2014. - p. 63-85.
2. Beatrix Hornyák: *Mentális állóképesség vizsgálatokkal kapcsolatos eredmények a Magyar Honvédség személyi állományának körében.* [Results related to mental toughness tests among the personnel of the HDF] - In. Orbók-Barkovics Veronika, Orbók Ákos (ed.): *A Hadtudomány és a XXI. század* [The Military Science and the 21st Century]. - Budapest: Doktoranduszok Országos Szövetsége, Hadtudományi Osztálya, 2017. - p. 47-61.
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4. Csaba Hegedűs, Beatrix Hornyák: *A sportolási gyakoriság hatása a mentális állóképességre (MÁQ) és a pszichoszociális egészségre.* [The effects of physical activity on psychological resilience and psychosocial health] - In. *Honvédorvos.*, 2012. 64. évf. 3-4. sz. - p. 153-160.
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1. Hornyák Beatrix, Szilágyi Zsuzsanna: A mentális állóképesség (MÁQ) és az egészségügyi-fizikai állapotfelmérés eredményeinek összevetése a Magyar Honvédség személyi állománya körében [Comparison of the results of the mental toughness (MÁQ) and the health-physical condition survey among the personnel of the HDF] (Magyar Pszichológiai Társaság XIX. Országos Tudományos Naggyűlése, 2010. május 27-29., Pécs)
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6. Hornyák Beatrix: Pszichoszociális kockázatok mérése, értékelése és kezelésének lehetőségei [Options for measuring, evaluating and managing psychosocial risks] (Magyar Katonai- Katasztrófaorvostani Társaság XVII. Tudományos Konferenciája, 2014. 11. 26., Budapest)

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8. Tápai Balázs, Hornyák Beatrix, Sótér Andrea: Experiences of the Williams LifeSkills (WLS) Training Program in the Hungarian Defence Force (Mental Health and mTBI Workshop, 2015.02.24-25., Ramstein)
9. Hornyák Beatrix, Sótér Andrea: Health monitoring benefits for the HDF (társszerző: Sótér) (23rd Multinational Military Medical Engagement, 2015. 09. 14-16, Budapest-Tudományos poszter)
10. Hornyák Beatrix: Mentális állóképesség összefüggése az egészségmagatartással [Relationship between mental toughness and health behavior] (Lelki egészség Világnapja BM Tudományos konferencia, 2015. 10.08., Budapest)
11. Hornyák Beatrix, Sótér Andrea: A WÉK tréningek hatékonysága a Magyar Honvédség személyi állományának körében [The effectiveness of the WLS trainings among the personnel of the HDF] (Magyar Katonai- Katasztrófaorvostani Társaság XVIII. Tudományos Konferenciája, 2015. 11. 25., Budapest)
12. Hornyák Beatrix, Sótér Andrea: A katonák körében végzett Williams Életképesség tréningek hatékonyságvizsgálata [Evaluation of the effectiveness of Williams Life Skills trainings among soldiers] (X. Jubileumi Szakdolgozói Tudományos Nap, 2016. április 27-28., Balatonakarattya)

PROFESSIONAL-SCIENTIFIC CURRICULUM VITAE

Beatrix Hornyák was born in Tata in 1978. She graduated from the László Vas Medical High School, then obtained a Bachelor's degree in nursing at the Szombathely Department of the University of Pécs in 2000.

She continued her studies in Pécs, where she graduated in 2002 as a Master of Science in Nursing (MSc). After that, she worked for a short time in the Intensive Care Unit of the Szent Borbála Hospital in Tatabánya, then she worked at the Komárom City Institute of the ÁNTSZ as a senior nurse and health promoter. Her professional interest was in the prevention of chronic non-communicable diseases. In 2003 she started her studies as a scholarship student of the Faculty of Public Health of the Medical and Health Sciences Center of the University of Debrecen, where she obtained a postgraduate degree in Public Health in 2006.

The subjects of behavioral medicine studied at the University drew her attention to the importance of the psychological factors that play a role in the development of chronic diseases, so she continued her studies in the field of psychology. In 2006 she was admitted to the Department of Psychology of the University of Szeged, where in 2009 she obtained a degree in Behavioral Analysis (BA).

In 2007, she joined the Health Promotion and Recreation Department of the MH HEK as a civil servant, and after her basic military training as a subordinate officer, in the rank of a captain. She is the developer of several health promotion programs and professional guidelines within the HDF. In recognition of her professional work, her managers supported her in continuing her studies. From 2009 she continued her studies at the Department of Health Psychology of the Medical and Health Sciences Center of the University of Debrecen, where she obtained a Diploma in Health Psychology (MSc) in 2011. In her dissertation, she examined the relationship between Mental Toughness and Health Behavior.

She was appointed Head of the Department of Health Education and Authorities in 2011 and Deputy Head of the Department of Health Promotion in 2013. In 2013, she obtained a WLS facilitator qualification, and then, recognizing the effectiveness of the method, she took an active part in organizing the training of military facilitators. In 2014, she obtained the Skills Development Trainer qualification of the Hungarian Psychological Society at the Budapest University of Technology.

She started her doctoral studies at the NKE Doctoral School of Military Sciences in 2014, in the first academic year by winning an External Doctoral Student application, in a supported form, and from the second academic year as a HM scholarship holder.

She was promoted to Major in 2016, and in 2017 she completed her required study and research activities and obtained her absolutorium.

She has an intermediate language exam in English and Italian. The number of her scientific publications in the Hungarian Archives of Scientific Works: 35, of which 8 are in foreign language.