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The Impact of increasing Mental Toughness on sports performance

PHD THESIS SUMMARY

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Contents of Phd thesis

Introduction

The science of sports is a vast and interdisciplinary field, which, with the help of related fields, analyzes how the healthy human body responds to physical exercise and how physical activity and sports performance affect physical, mental and social health. For a clearer and more realistic vision, sports science incorporates several sciences and academic fields such as physiology, psychology, sociology, engineering, chemistry and anatomy.

This doctoral thesis presents the benefits of psychological training on sports performance, and highlights the role that psychological training plays in the process of optimizing sports performance.

The main objective of the thesis was to highlight the importance of psychological training as a means of optimizing sports performance. Although this aspect acts indirectly on sports performance, it has a significant contribution in optimizing and raising the level of performance, regardless of the sport branch practiced. This paper aims to help athletes and sports specialists by presenting the psychological constructs of Mental Toughness (MT) which in recent years has aroused the interest of several experts and researchers in this field.

This concept (MT) is commonly used by athletes, coaches, sports press members, sports commentators, and sports psychologists to describe why certain athletes may become, or are currently, the best in the world in their sport (Connaughton et al., 2008).

The concept of MT is associated by some authors as a fundamental feature for success in life (Gucciardi et al., 2014). Performance, regardless of the field of manifestation, sports (both recreational and competitive), academic, organizational or any other form, is based on MT (Crust, 2010). Mental toughness is used in the sports world to describe athletes who manage to perform under high pressure circumstances (Thom et al., 2020) or as a person's superior mental quality, having a major impact on the career of an elite athlete (Gucciardi , Gordon & Dimmock, 2008). As a result, the vast majority of successful studies address MT in the context of performance sports.

MT is a universal concept, as there is no generally accepted translation of the term in Romanian. Several researchers and experts in the field claim that the construct incorporates several psychological attributes, first of all no representative translation of the construct in Romanian was found that would represent the construct in its entirety. Moreover, for a more representative translation, the methodology suggests that the term be translated into Romanian, and then again into English to check if the translation was indeed correct, but we did not succeed in a translation

that complied with this requirement. The paper will present the construct and its evolution over time.

The first part of the paper presents the theoretical foundation of the paper. It is divided into four chapters that first reflect the place of psychological training in the training of athletes, and then clarifies the construction of MT and how it is described in the international literature. Specifically, we can find out the opinions of several experts and researchers on what this concept represents both in sports and in other fields, as it has been conceptualized by various specialists over time, the content of MT and what underlies it. Towards the end, being presented the methods of measuring the construct, the most used instruments and the means of developing and influencing the construct.

At the same time, the paper comes with a very practical part which is presented in part II and III. In the second part is presented the adaptation of an instrument for measuring MT in Romanian and a pilot study that verified the feasibility of the intervention program proposed by us.

The last part of the paper presents 3 studies: the first study presents the relationship between MT, stress, anxiety and depression both among amateur athletes and in the case of performance athletes. Study 2 shows the relationship between MT and competitive anxiety, more precisely a latent regression analysis, and the 3rd study presents the implementation of the intervention program in order to develop the level of MT among performance athletes, with the aim of influencing the results and the level of performance of athletes.

Chapter 1 – Sports performance – conceptual definition and delimitation

Performance is the value of an individual or collective action that can be expressed in numbers, numbers or ratings. In the sports system, performance represents the search for excellence and its evaluation with the help of quantitatively measurable indices with the help of units of measurement: meter / kilometer and second / minute / hour, number of repetitions, score, points, artistic impression, etc. Popescu-Neveanu (1978) defines sports performance as a "valuable individual or collective result, obtained in a sports competition and expressed in absolute numbers according to the system of official scales or by the place occupied by the ranking".

The main objective of an athlete in the activities of training and participation in competitions is to obtain sports performance. At the basis of achieving sports performance are complex acts that involve somatic, functional, social psychological factors. In the vision of M. Epuran (2002) at the base of sports performance are the "four A's".

1.1 Spotrs training

In Terminology of Physical Education and Sport (2002), sports training is described as: "the instructive-educational process carried out systematically and continuously gradually adapting the human body to intense physical and mental effort, in order to obtain high results in one of the forms of competitive exercise ".

Sports training has ancient origins, since ancient times people have been systematically trained for military or competition purposes. Nowadays, athletes use training to achieve or achieve different goals.

The main purpose of training and sports preparation is to increase the effort and performance capacity of athletes and to develop a strong mental capacity, with more resources, which will allow the athlete to overcome difficult moments and adversity to perform at standards as high as possible.

1.1.4 Sports training components

The components of sports training are the fundamental elements of the process of training athletes. Considering the general components of the instructive-educational process specific to the field of physical education and sports (specialized knowledge, morphological and functional indices, movement skills and abilities, motor qualities, habits and habits of moral conduct), we can highlight the content link with these, as well as their merging according to the content of the sports

training. For these reasons, the following main components have been established in sports training: physical training, technical training, tactical training, psychological training and theoretical training. Each of them has a well-defined role and their common goal is to increase the level of performance.

1.1.4.1 Physical preparation

Represents the development of morphological and functional indices of the body. This component of training aims at both the development of effort capacity and the development of motor skills. In sports, the capacity for effort is the main goal of the whole training process, and in the training process we can talk about several types of motor activity.

1.1.4.2 Technical preparation

MOVEMENT TECHNIQUE - "Predetermined movement structures, materialized in elements and in technical procedures with great efficiency. The technique represents the totality of actions and procedures of movement, which by their specific form and content ensure the possibility of practicing a sport in accordance with the provisions of the regulations in force (boxing technique, sports game technique, jumping technique, gymnastics technique, etc.) " (Nicu et al., 2002, p.372).

1.1.4.3 Tactical preparation

Tactical training encompasses the set of measures, means and methods used in order to master the tactics specific to a particular branch of sport. Tactics refers to a system of principles, ideas and rules for approaching the competition by the athlete or the sports team, with the help of which they capitalize on all technical, physical and mental abilities in order to put the opponent in difficulty and gain the advantage to win the competition. Tactics is an activity in which the most varied means are rationally used, depending on the opponents, game situations, in order to obtain victory. According to Dragnea he al. (2006) when it comes to sports tactics it can be divided into 4 components: tactical design, tactical plan, tactical actions and game system*c.*

1.1.4.4 Teoretical preparation

The concept that athletes have to train and compete, and the coach to take care of the rest is no longer fashionable.

The acquisition and application of theoretical knowledge are important aspects in terms of improving the development of skills and motor skills of athletes in a shorter time. Simultaneously with the development of motor skills and abilities, athletes should gradually become familiar with the theory of sports training (Bompa, 2014). Good theoretical training helps to understand the training plan and the training period and stimulates to a greater extent the conscious and active participation of athletes.

1.1.4.5 Psychological preparation

The increase in the number of official competitions held nationally and internationally has led to the consolidation of the importance of this component of training. In these conditions, it starts from the fact that the athlete is engaged in competitive activity with his entire biological, mental and social sphere, thus, it is necessary to fully address these spheres in the training process.

Among the most well-known psychological variables that influence sports performance are motivation, confidence, anxiety, etc. The concept of mental toughness appeared in the psychological sphere of sports training in the early 2000s. This construct symbolizes for people in the sports field, the mental capacity of a person to reach the world top in the field and the sports branch in which he works. Mental toughness (MT) is seen as an "umbrella" concept that encompasses important psychological aspects in order to achieve athletic performance.

Chapter 2 - Defining Mental Toughness

Concern and interest in MT began in the 1950s, when researchers cited and attempted to explain this concept in a variety of ways that included MT as a personality trait (Cattell et al., 1955; Werner & Gottheil, 1966), a mechanism against adversity (Alderman, 1974; Favret & Benzel, 1997), a critical advantage for athletes who lose long hours of intense training in order to achieve superior performance (Bull et al., 1996; Goldberg, 1998) and a decisive factor in differentiating success and unsuccessful performance (Luszki, 1982; Pankey, 1993). In the present MT is usually defined as a psychological characteristic that allows athletes to maintain or improve their performance in difficult situations (Beattie et al., 2020).

Even so, the conceptual foundations of mental toughness proposed before 2002 were questionable, as they were not based on scientific evidence but rather on anecdotal evidence based on the opinions of coaches or various sports people (Gucciardi & Gordon, 2011). The lack of empirical research has created even more confusion about understanding the construct. In 2001 Fourie and Potgeiter developed an interest in the concept of MT, but until 2002 no one tried to develop research programs to facilitate a deeper understanding of mental toughness: *What is it? How can it be measured? How can it be developed / influenced or maintained?*

Since the attempt to define the concept, many models have emerged that conceptualize and discuss the importance of this feature in the context of sports performance. In the chapter on conceptual substantiation, these models are to be presented and analyzed in chronological order. This analysis allows a better understanding of the conceptual shortcomings / disputes related to each in the model, as well as the solutions that appeared in order to resolve these conflicts. In order to illustrate the diversity of the way of conceptualizing MT, the most frequently circulated definitions of the specialized literature are to be reviewed:

Clough, Earle, & Sewell (2002, p.38) define people with a high level of MT as: "*sociable and open; they are calm and relaxed, have a competitive personality and have a lower level of anxiety than others. a strong self-confidence and are convinced that they control their destiny, they are not affected by competition or adversity* ".

"Mental toughness is the function that makes you able to cope more easily with challenges (competition, training, lifestyle) compared to your opponents; are skills

that sport transmits to a person; specifically, to be more consistent and better than his opponents, remaining determined, focused and convincing under the pressure of competition (Jones, Hanton, & Connaughton, 2002, p. 209)

"Mental toughness is the presence of some or all of the developed collection of values, attitudes, emotions, cognitions, and behaviors that influence how an individual approaches, responds and evaluates pressures, challenges, and adversities, both negative and positive to achieve their goals consistently"(Coulter, Mallett, & Gucciardi 2010, p. 715).

Even a cursory analysis of the definitions provided reveals that conceptual accuracy is an unresolved issue, there is no consensus on what is exactly or what is not MT (Gucciardi et al., 2014). Some conceptualizations of MT have associated this concept with the sports performance in which participants have defeated their opponents, which shows that athletes who have not defeated their opponents or have not reached a certain level of success can not have a high level of MT- (Gucciardi et al., 2009). What can be wrong, for example, is that the goal of a sprinter in a race may be to run a "personal best" and qualify for the final. Suppose this happens, but in the final it takes last place. From the perspective of some people who do not know the competitive objectives of the athlete, the performance can be appreciated (cataloged) as a failure. However, from the athlete's own perspective (and most likely the coach's, with whom they set the competition goals together), the same performance will be interpreted as a success, which will improve his approach and self-assessment in the context of a future competition. (Jones et al., 2002).

Therefore, this attempt to exemplify MT shows that it should be treated as a phenomenon involving both interpersonal and intrapersonal interactions and the style of constructing individual meanings, rather than as a stable personality attribute, or an post-hoc explanation of sports performance. Specifically, MT should be conceptualized as a result of internal processes (mental imagery or internal dialogue) or external (past factual events) that influence the interpretation of the current situation, implicitly performance (Jones et al., 2007; Gucciardi et al., 2008).

MT is not a homogeneous concept, it is an “umbrella” concept, a term used to refer to a large number of traits, interconnected mental processes (Bacharach, 1989). Therefore, in this paper we will start from a broader definition of the concept, and we will analyze the attempts to model the phenomenon, which models include a description of the structure, dimensions and how to combine them. Thus, as a working definition, MT can be described as "*the ability of a person to perform*

consistently at high levels, both subjectively (setting challenging goals) and objective (running time, lifting heavy weights) despite the challenges and stressors present in everyday life, as well as in the presence of significant adversities" (Gucciardi, Peeling, Ducker & Dawson, 2014, p.3).

Mental Toughness in physical education and sport field

According to the physiological and psychological structure of people, it is known that in addition to physiological characteristics, psychological and mental characteristics have a significant influence on performance, so it is recommended to address both characteristics in order to improve athletic performance (Oruc, 2021). Although lately the construct has appeared and has been recognized as an important factor in various fields, it has been and still is most often associated and studied in the field of sports. Therefore, MT is considered to be the superior mental quality of an athlete (Gucciardi, Gordon & Dimmock, 2009), therefore it appears as an essential aspect that underlies success and excellence in sports (Loehr, 1986; Clough, Earle, & Sewell, 2002; Crust, 2007; Jones, Hanton, & Connaughton, 2007).

As early as the 20th century, Alderman (1974) argued that a successful athlete is not only physically strong but also mentally strong; Watts (1978) stated that MT is one of the most important psychological qualities a coach seeks in athletes; Luszki (1982) and Tunney (1987) argued that success in athletic performance is based on four principles, and MT is necessary to achieve the other three; but most of the time these suggestions were based on the experience of the coaches and their personal opinions rather than on empirical evidence (Connaughton et al., 2008).

Over time, the number of athletes and coaches who attribute sports results to MT, or lack of it, has increased (Gould et al., 1987; Clough, Earle, & Sewell, 2002), and the need for procedures to development MT has increased (Clough et al, 2002; Crust, 2007), making MT one of the most studied concepts in sports psychology, enjoying the attention of several researchers in the field.

In an attempt to explain how MT influences athletic performance, Thom et al. (2020) uses the GES (Goal - Expectancy - Self-control) framework. With the help of the GES framework (Figure 2) the author explains how MT influences the performance of athletes in difficult situations.

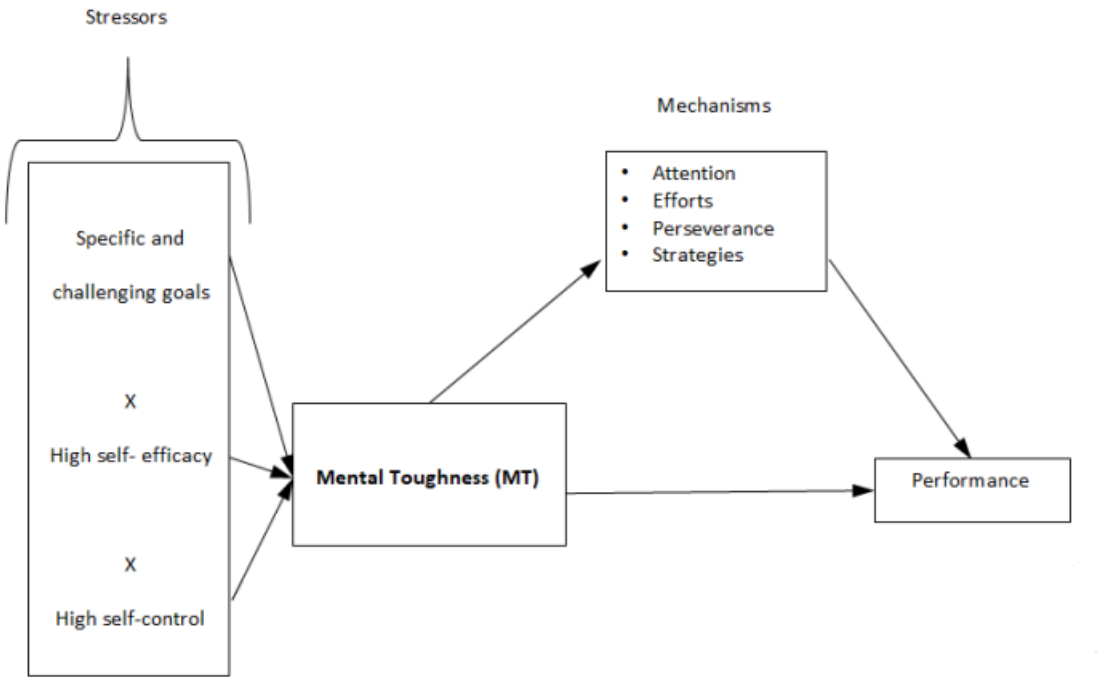

Figure 2. The way in which the GES framework influences sports performance (Thom et al., 2020).

Figure 2 shows the framework in which MT results from three resources in a difficult situation (eg stress factor): specific and challenging objectives, high self-efficacy towards activity and the degree of self-control of individuals (Thom et al., 2020). GES defines MT as a limited resource that runs on its own when an individual feels efficient for an activity. This psychological resource allows the regulation of cognitive, emotional, and behavioral efforts to achieve challenging and specific goals when faced with a stressor that threatens them not to achieve their goals (Thom et al., 2020).

Chapter 3 - Measuring Mental Toughness

The pressure and emotions that occur due to certain reasons (media, sponsors, public exposure) on modern athletes have a major impact, which has led to a greater interest in how to use mental resources to achieve superior sports performance. . In an attempt to reach true athletic potential, athletes complement physical training with psychological training tools, such as goal setting, coping skills training, or visualization and relaxation (Vealey, 2007: Gucciardi & Gordon, 2011).

Over the past two decades, researchers have become increasingly interested in how psychological factors, such as personality, group dynamics, and individual cognition, affect athletic performance (Tenenbaum & Eklund, 2007). An early area of research is the role of MT in human performance. Researchers, coaches, sports commentators, athletes and people in the field of physical activity recognize the importance of MT in sports performance.

The predominant methodological approach for measuring MT was through the use of questionnaires. There are a variety of instruments that have been developed to measure the construction of MT in sports or other fields. Throughout its short history, many instruments have been developed to measure this construct. Some of the most used tools are: Mental Toughness Questionnaire 48 (Clough, Earle, & Sewell, 2002), Psychological Performance Inventory (Loehr, 1986), Sports Mental Toughness Questionnaire (Sheard et al., 2009) and Mental Toughness Inventory (Gucciardi et al., 2015). However, the tools have been criticized for being too narrow, with a lack of theoretical and methodological rigor, and for their factorial structure (Middleton et al., 2004; Crust & Swann 2011; Gucciardi et al. 2012; Cowden & Meyer-Weitz, 2016).

Mental Toughness Inventory (MTI)

Mental Toughness Inventory (MTI) was created by Gucciardi el al. (2015), this being a one-dimensional tool, with 8 items (based on the conceptual model of the authors) that show strong loads of factors and producing a reliable internal score on three independent samples of participants.

The first version of the questionnaire included 70 items, grouped into 7 factors, according to the author's conceptualization model. The content analysis performed by the experts resulted in the reduction of the number of items of the questionnaire to 61. As a result, the 61-item questionnaire was applied to 418 subjects (athletes, students and corporate). Following the

application of the questionnaire, 19 items were removed for empirical and conceptual reasons, and another 21 items were removed based on the results of the confirmatory factor analysis. The result was a tool with 21 items loading 7 factors, however, this model was not validated due to factor inconsistency (Gucciardi et al., 2015). In response, the authors chose a direct approach, measuring the basic concept only at its key dimensions, the end result being a one-dimensional model with 8 items. Items were selected from 21 according to a combination of empirical criteria (e.g., standardized load size, minimum cross-loads) and conceptual (e.g., multi-expert assessments, appropriately capturing the scope of each facet).). Each facet of the original model was replaced by a single item, and an item was added to measure one's ability to cope with adversity, capturing both daily challenges and major suffering.

Given that the instrument proposed by Gucciardi et al. (2015) is the newest method of measuring MT, it has enjoyed the attention of several researchers in the field in recent years. The aim was to validate the instrument on both sports and non-sports subjects, in different languages (English, Chinese, Malay, Greek, Portuguese and Spanish) and different cultures such as: Australian (Hannan et al. 2015), Malaysian (Gucciardi et al., 2016), Chinese (C. Li, CQ Zhang, & L. Zhang, 2017), African (Cowden, 2018), Portuguese (moreira et al., 2021), Greek (Stamatis et al., 2019)) Spanish (Stamatis et al., 2021). Some recent studies have found psychometric support for MTI, while others provide only partial support.

Based on results Hannan et al. (2015) suggested to release the covariance between two error terms (items 5 and 6 and items 7 and 8) increasing the framing of the model. Regarding the structure of MTI (Gucciardi et al., 2015), item 5 measures optimism: "*the tendency to expect positive events in the future and to attribute positive causes and results to different events in one's life*", while item 6 assesses emotion regulation: "*awareness and the ability to use emotionally relevant processes to facilitate optimal performance and goal achievement*." Therefore, this path was allowed to be freely estimated, as both items generated thoughts focused on emotion. Item 7 of the MTI is a measure of buoyancy: "*the ability to effectively perform the skills and processes needed in response to the challenges and pressures of everyday life*" (Gucciardi et al., 2015, p. 29), while item 8 assesses contextual knowledge: "*the use of knowledge acquired in the context of performance, to achieve the desired objectives*". With the intention of increasing the degree of local matching, correlations were used and the modification of the model was accepted regarding

the 2 items, because both items determine the performance and the thoughts focused on achievement (Gucciardi et al., 2015; Hannan et al. , 2015).

Basically, correlations between errors are accepted if a method factor is invoked. According to Hannan (2015), the arguments of the changes have a conceptual character, invoking the presence of other factors than the MT factor, which is also loaded on certain elements, one-dimensional, but rather, which is called bifactor structure. Another methodological issue is the modification of the model to obtain acceptable indicators (model fit index). This change is an accepted practice if it is applied to a model whose change rate crosses the threshold, and the model is standing and is not revived by changes.

The psychometric qualities of the Mental Toughness Inventory have been supported in several studies. Li et al. (2017) in the first study that examined the concomitant validity of MTI (Chinese version) reported good reliability. The test-retest coefficient of the instrument maintained a moderate to high consistency (r = .61) over the 10-week interval - test interval, consistent with previous studies (Gucciardi, 2015; Li et al., 2017) . The psychometric properties of MTI were also supported by Cowden (2018). The CFA results support the one-dimensional structure of the MTI factor, with evidence of measurement invariance among white and non-white athletes.

The construct validity of the MTI has been supported by several studies. MT showed significant correlations with dispositional flow (Cowden, 2018) and intentions for regular physical activity (Hannan et al. 2015).

Based on the results from the literature, the Mental Toughness Inventory was used as a tool to assess the level of MT in this paper. This choice is based on criticisms of other instruments based on their lack of theoretical and methodological rigor and their factorial structure (Middleton et al., 2004; Crust & Swann 2011; Gucciardi et al. 2012; Cowden & Meyer-Weitz, 2016).). MTI was developed in response to the need for MT measurement, enjoying the popularity and interest of many researchers, so it was validated and translated into several languages.

Chapter 4 - Ways of intervention and modification of Mental Toughness in order to optimize sports performance

As a result of the sports results attributed to MT by a multitude of athletes, coaches and the large number of researchers in the field of sports psychology, more and more questions have arisen about how this quality (MT) can be acquired or developed. If MT is a genetically inherited trait, a personality trait, if the environment has influences on its development or if it can be developed and trained through various programs.

Even since the construction of this construct, some researchers have argued that it is a personality trait (Cattell, 1957; Kroll, 1967), but more sports psychologists (Loehr, 1995; Bull et al, 1996; Gibson, 1998; Goldberg , 1998) suggests that in part, an individual's MT level may be changed and influenced. Some papers aimed at the development of MT, proposed certain mental skills in training programs aimed at influencing performance and categorized these programs as means of developing mental toughness (Watts, 1978; Loehr, 1986; Goldberg, 1998). Hodge (1994) argues that athletes can gain MT by resisting competitive pressure, while remaining focused on the goals of mastery, hard work, determination, and commitment. Gordon (2005) suggested that much of MT is related to social experiences and that at least some aspects of MT can be learned.

Connaughton & Hanton (2009) argue that in the first phase, the vast majority of claims were based on anecdotal evidence and the experience of several coaches, rather than on scientific research; more emphasis was placed on the development of general mental skills training programs, rather than on the specific development of MT. This statement refers in particular to development issues and the subsequent ambiguity created in the literature before 2002 (Gucciardi & Gordon, 2011).

Researching the development of psychological characteristics among elite athletes, Gould et al. (2002) found that a wide range of people (coaches, parents, teachers) have influences on these characteristics, and that they develop over a long period of time; it states that psychological characteristics can be developed in both formal and informal settings. We find these statements later in the work of Thelwell et al. (2005), in which footballers stated that MT developed from varied experiences and backgrounds during their formative years.

Bull et al. (2005) argue that the influence of the environment is the basis for the development of a strong character (eg competitiveness), perseverance and tenacity (eg thinking beyond limits,

self-confidence) in elite cricketers. They stated that coping with early failures and exposure to certain risks had a positive effect on their MT level. The same idea was supported by elite athletes in the study by Connaughton et al. (2008) mentioned a variety of events that influenced and developed MT: critical life events, failures in sports performance, fraternal rivalry, and parental support.

In an attempt to determine the nature of this construct and to see to what extent genetics and the environment make their mark on MT, this concept has been studied in twins, both identical and non-identical. After applying the MT measurement questionnaires, Horsburgh et al. (2009) found that, like most personality traits, MT had a strong genetic component, but it is also strongly influenced by environmental factors. Clough et al. (2010) reported significant correlations between high levels of MT and a higher volume of gray matter material of the right frontal lobe, this part of the brain being responsible for reality assessment, monitoring and strategic thinking. These differences in brain structure are based on the genetic component, so it is clear that it plays a significant role in the development of MT, but it is equally clear that other developmental processes have influences on this construct (Clough et al., 2010; Crust & Clough, 2011).

Existing research (e.g. Connaughton et al., 2008; Gucciardi et al., 2009; Weinberg et al., 2011) indicates that MT can be influenced both through the environment in which the person is active and through learning / training. Which of these two methods is more effective has not yet been established, but the stake is not to establish a superiority of one or the other, but to identify how the two types of influence can be combined to have the greatest possible effect on MT development (Crust, 2008).

Chapter 6 - Pilot study: Verification of the sports performance optimization program through Mental Toughness

Introduction

Mental toughness is one of the most important and well-known psychological constructs in sports and beyond. Several authors in the field of sports psychology (Loehr, 1986; Clough et al., 2002; Crust, 2007; Jones et al., 2007; Cowden & Meyer-Weitz, 2016) have stated that MT is a psychological construct that supports success. excellence and performance in sports.

Because innovation, competitive advantage, and success are at the core of performance, there are few constructs that resonate with people as strongly as mental toughness. The MT concept has attracted the attention of both researchers and coaches and practitioners through the volume of research on the construct and its conceptualization. It is not surprising that MT has become one of the most widespread concepts in the broad field of psychological training (Gucciardi, 2017).

Sports psychologists (Loehr, 1995; Bull et al, 1996; Gibson, 1998; Goldberg, 1998) state that a person's MT level can be influenced. The development of MT through the prism of certain mental skills in programs aimed at influencing sports performance have been proposed by some authors (Watts, 1978; Loehr, 1986; Goldberg, 1998) as a means of developing MT. Although it has been found that much of MT is related to social experiences, there are also aspects of MT that can be learned (Gordon, 2005).

Researchers in the field (Connaughton et al., 2008; Gucciardi et al., 2009; Weinberg et al., 2011) argue that the development of MT is based on both the influences of the environment in which the person works and the learning and training processes which it went through. It has not been established which of these two variables is more beneficial, but it cannot be a question of establishing a ranking, but rather of a combination of them for a maximum yield (Crust, 2008).

Regarding the effectiveness of intervention programs, several authors (Bhambri et al., 2005; Gucciardi et al., 2009; Bell et al., 2013) support their effectiveness in the development of MT. Although both the implementation period of the programs differed from one study to another (2 weeks (Bhambri et al., 2005) to 2 years (Bell et al., 2013)) and their content (multidisciplinary programs, focused programs on different key attributes of MT or programs that include the development of different psychological skills), these have had a positive impact on the MT level of athletes (tennis players, footballers or cricketers) .Bell et al. (2013) was approximately the same

at the initial measurement in the case of the MT analysis on 2 groups (control and intervention), after the intervention the MT level of the control group remained the same, and in the case of the intervention group there were significant differences. Bhambri et al. (2005) in their study of 4 groups reported differences in the level of MT, three of the groups showed differences in the level of MT compared to the control group. Moreover, Gucciardi at. (2009) argue that both intervention programs aimed at the development of MT and programs aimed at developing psychological skills have seen positive changes in the level of MT and resilience compared to the control group.

Over time, several experts in the field have proposed various intervention programs in order to develop MT. The intervention program chosen for this study is to be presented below.

The Gold Medal - Mental training

It is a MT development program created by Dariusz Nowicki, who is a psychologist and coach of the Polish Judo team, with numerous international medals. Starting from the idea that any method that contributes to sports performance must be used and that most of the time when 2 opponents are of the same level in terms of physical training the one who will win will be the one who will be stronger mentally. He states that there is a possibility that a well-trained athlete will lose to another less physically fit but with a strong mind (Dariusz Nowicki, 1997). The “Gold Medal - Metal Training” program is based on the work of several psychologists and coaches from Eastern Europe and Scandinavia and includes a user manual that offers implementation suggestions and 12 audio materials that have different themes (for example: breath control, relaxation muscle, mental relaxation, fitness, recovery).

Aim and objectives

According to Thabane et al. (2010) The objectives of a pilot study focus on 4 key aspects: the implementation process, the resources needed for implementation, the management of the implementation of the intervention and the scientific nature of the implemented program. Therefore, this study aimed to verify the 4 essential aspects of the intervention program.

Methods

In the present study the research methods used were the experiment, the statistical analysis and the survey method using questionnaires. Data collection was done using two questionnaires. In terms of data analysis, this was done using IBM SPSS Statistics 23.

Participants

The sample of this study consisted of N = 16 participants (31.8% male and 68.8% female), from a diverse range of sports (Judo, Hockey, Basketball, Triathlon, Dance, Athletics). Of these, 8 were performance athletes and 8 were amateur athletes. Their age ranged from 19 to 44 years with a mean of M = 25.81 (SD = 7.70).

Participants were informed about the use of the data and were assured of the anonymity and confidentiality of the answers given. Each subject accepted to participate in the study and completed the participation agreement.

Instruments

Mental toughness inventory (MTI) (Gucciardi et al., 2015) was used to measure MT. Participants were asked to indicate how true each of the statements were (e.g., "*I strive for continued success*" and "*I am able to adjust my concentration when performing tasks*") as an indication of how they think, feel and behave as an athlete, using a 7-point response scale (ranging from 1 = false, 100% of the time, to 7 = true, 100% of the time).

A feasibility questionnaire was applied according to the objectives of the study. The questionnaire investigated the 4 essential aspects: process, resources, management and scientific. Participants were asked to answer some items on a scale from 1 to 5 (where 1 = total disagreement and 5 = total agreement). Among the items being "*it was easy for me to meet the requirements of the coordinator*", "*I think the program needs too much time*" and "*I need someone to remind me when I have to run the program*".

Procedure

Participants were informed about the purpose and objectives of the study. After their agreement, an initial MT level measurement was performed. Later, an online group was set up where they received instructions and materials to listen to. These materials were sent every 3 days,

and after each material the MT level was measured again. At the end of the program, the final value of MT was measured and a feasibility questionnaire was applied according to the research objectives.

Discussion and conclusions

According to the results, in the case of the gender analysis of the feasibility questionnaire, item 2 shows a significant difference t (14) = 6.36 (boys with higher score), this item measuring the time resources of the participants to go through the materials. This may be due to the higher training volume that the boys have or their busier schedule. Regarding item 3, it showed significant differences t (14) = 2.30 (girls with a higher score). Item 3 measures the management dimension of the study, more precisely, the extent to which they forgot to follow the instructions given by the coordinator, suggesting that in the main study the coordinator should be more careful and remind participants of the tasks to be done. Item 9 showed a significant difference t (14) = 1.28 (boys with higher score). Item 9 represents the desire of the subjects to be more frequent the sessions of implementation of the program, in the present study these being in number of 2 per week.

According to the results, the study is feasible with slight changes related to the implementation and organization of the process, so the coordinator needs to be more active in collaborating with the subjects and provide them with information and suggestions more often. In the main study, we propose that the subjects be part of groups in which they regularly receive messages with implementation instructions and messages that remind them of the tasks required by the program. From a scientific point of view, the effect of the intervention proved to be great, which supports the process of implementing the intervention.

Chapter 9 – Implementation of The Gold Medal – Mental training

Introduction

Mental training is considered a training method that consists in repeating "in mind" some elements or exercises that the athlete has performed in the past or is preparing to perform in the future (Nicu, 2002). It is a side of total training that has become a complementary and very valuable means of training athletes. It offers an "*efficient and intensive way of practicing motor acts in representation, as athletes sketch their mental plans for the execution of movements*" (Giurgiu, 2004). (Giurgiu, 2004).

Practicing mental training is beneficial from several points of view. Firstly, sporting performance is both overcoming their own limits and overrun limits of opponents, so any means that can make progress in training and performance must be taken into account and used. Furthermore, mental training comes as a filling of practical training that does not require physical effort. In addition, for difficult times such as injuries, long and exhausting, mental training comes to practical training, and even replace it, at the end the results can be satisfactory (Giurgiu, 2004; Holdevici & Crăciun, 2013).

The volume of repetitions in physical training can reduce their quality, but with mental training these repetitions can be reduced and the quality maintained. Repeating acts or motor actions in representation helps the athlete exceeding the monotone moments, it provides a rhythm change, reduces the level of physical fatigue and the possibility of exhaustion. From the moment the athlete has acquired the ability to correctly view the technical element or process, the act or motor action, it can be used by this skill for different purposes. Mental training can make a significant contribution to learning motor acts in correcting actions and drivers learned wrongly or in their improvement. The athlete can improve his activity with mental training because he has an impact on several directions for his preparation. Sensory excitement after average levels has an impact on the analyzer system, so these traces can be images that reproduce not only a single sensory stimulation, but a full perception. For example, I could have the image of an act or motor actions imprinted on the retina, so our brain has the ability to update the perceptual-motor experience gained in the physical training (Holdevici & Crăciun, 2013).

According to Giurgiu (2004), from a psychological point of view, the systematically practiced of mental training leads to:

- Better awareness;
- Discipline of thought;
- Increasing concentration capacity;
- Improving motor memory;
- Stimulating creativity;
- Developing self-control, self-control;
- Reducing emotions and stress;
- Diminishing competitive anxiety by desensitization;
- Forming positive, constructive attitudes.

The Gold Medal – Mental training

The Gold Medal – Mental training for Combat Disciplines was created and proposed by Dariusz Nowicki, this being a psychologist and coach of the Polish judo team, with numerous medals at international level. When 2 opponents are at the same level of physical and technical training, the one who can be the one who is mentally stronger. Thus, any method that can improve sports performance must be taken into account and exploited. Nowicki (1997) states that there is a possibility that a well-prepared athlete has lost in front of another physically prepared but with a strong mental. The Gold Medal – Mental training is based on the work of several psychologists and coaches in Eastern Europe and Scandinavia and includes a user manual that offers implementation suggestions and 12 audio materials that have different themes (eg breathing control, muscle relaxation, mental relaxation, sports peak, recovery).

The program was translated and registered in Romanian language. The content has been adapted to the speed trials practiced in athletics. For a clearer picture of the presented and adapted mental program the first three sessions of the program are presented in the Annexes section,. The entire program being available on request.

Hypothesis

This last study of the thesis aims to check 4 hypotheses:

- First hypothesis – asserts the growth of the MT level following the implementation of the gold medal intervention - mental training. The participants enrolled in the MT development program will have higher comparison scores with the participants who are in the control group. This increase after effect on performance levels.
- Second hypothesis – states the increase in sports performance after training and the form of sport that they must achieve with the start of the competition season. Thus, as we approach the end of the competition season and the most important competitions, the participants will reach the peak of the sports form in the objective competitions.
- Third hypothesis – states the optimization of sports performance through MT; The increase recorded at MT level during the intervention program will lead to an increase in sports performance. Mental training will have an indirect effect on your sports performance, this effect being mediated by MT.
- Fourth hypothesis – supports the importance of MT on increasing sports performance and highlights the mechanisms by which MT acts on the ability of athletes to perform at the highest possible levels.

Methods

The study aimed to implement the mental program presented above. This study was conducted over a period of 12 weeks (28.03.2021 -20.06.2021), being allocated one week for each of the 12 sessions that make up the mental training program. The main methods used in the present research were the experiment method, the survey method and the statistical analysis. The data were collected using several questionnaires. In terms of data analysis, it was performed using IBM SPSS Statistics 23 and IBM SPSS AMOS 23.

Participants

The participants in this study were 14 senior athletes from Romania with national and international performances. Their age ranged from 19 to 33 years (M = 24.14, SD = 1.08).

Participants were informed about the use of the data and were assured of the anonymity and confidentiality of the answers given. Each subject accepted to participate in the study and completed the participation agreement.

Then they were divided into two groups (control and experiment), 7 in each group. During the 12 weeks, the subjects from the experimental group integrated mental training into their preparation plan.

Instruments

Weekly training schedule questionnaire - participants were asked to indicate the number of workouts they performed in that week. Of this number, there were intensity, volume, technical and recovery workouts. They were then asked what percentage of their weekly training goals were achieved.

Nutrition information - was used to verify that participants are following a diet and paying attention to the calories consumed during sports training and the sources from which they procure macro and micro nutrients

Mental toughness inventory (Gucciardi et al., 2015) was used to measure MT. Participants were asked to indicate how true each of the 8 statements (e.g., "I strive for continued success" and "I am able to adjust my concentration when performing tasks") is an indication of how usually think, feel and behave like an athlete. MTI uses a 7-point response scale (ranging from 1 = false, 100% of the time, to 7 = true, 100% of the time). MTI has been validated in different languages (English, Chinese, Malay, Greek, Portuguese and Spanish) and different cultures, such as: Australian (Hannan et al. 2015), Malaysian (Gucciardi et al., 2016), Chinese (Li et al., 2017), African (Cowden, 2018).

Sports Anxiety Scale - 2 (Smith et al., 2006) is a questionnaire that assesses the characteristic competitive anxiety experienced by athletes before or during competition. The scale has 15 items and measures responses to three factors: somatic anxiety, anxiety, and interruption, based on a four-point Likert scale for answers, ranging from one (not at all) to four (very much).

Performance evaluation - during the subjects' experiment, their sports performance was recorded in 3 stages. Thus, the result of the first competition of the season, the result obtained at the national championships and the results obtained at the international competitions in which they participated were recorded (eg the International Championships of Romania "Iolanda Balaș Șoter",

European Team Athletics Championship - League 1). Due to the trails different in which the subjects competed, the results of each one were transformed into points based on the table proposed by the IAAF (International Amateur Athletic Federation) in order to be analyzed.

Data analysis

Following the measurements and the experimental design, the profile of the obtained data was longitudinal, which gave us the possibility to use Latent Growth Modeling ("LGM"). These refer to statistical methods that allow the estimation of inter-individual variability in intra-individual patterns of change over time (Bollen & Curran, 2006). This change is also known as evolution over time, growth curve or development or latent trajectory. This evolution / trajectory can take different forms in different individuals:

- zero trend, which indicates the absence of any change;
- show a systematic increase or decrease (linear, quadratic, etc.).

Thus, LGM presents two possibilities of analysis that summarize the trajectories both at individual and group level.

1. Fixed effect - is a unique variable that characterizes a particular population (eg population average). The parameters that define the characteristic trajectory for the entire population are the mean of the intercept and the mean of the slope (both obtained by summarizing the values of intercept and individual slope).
2. Random effect - represents a random distribution of values around the fixed effect (eg variance of scores). The parameters with random effect, which characterize the inter-individual fluctuation are the intercept variance and the slope variance. Smaller random effects, extremely zero, represent increased homogeneity of individual trajectories. High values reflect increased heterogeneity of trajectories (Curran et al., 2011).

Discussions and conclusions

Based on the data obtained, several LGM models were tested. The first presented the initial level of our variable (MT) and its trajectory over the 12 weeks. The results show that the proposed intervention program influences the MT level of the athletes, the level increasing significantly during the experiment. MT being one of the important psychological constructs underlying sports performance (Gucciardi et al., 2014).

The second model presented the evolution of MT having as covariate the Group of which the subjects are part. The data analysis model showed that the MT level showed a positive increase compared to the initial measurement, with an upward trend throughout the experiment group. The group showed influences on the evolution of MT, the subjects from the experiment group showing a constant evolution of the slope. The experimental group of the study showed a positive trend of MT, the trajectory of the envy being positive or constant while the trajectory of the subjects in the control group showed significant oscillations, with an uncertain variation over the 12 weeks. These results confirm the hypothesis with the number 1 - the increase of the MT level among athletes as a result of practicing The Gold Medal – Mental training.

Model 3 presented the evolution of sports performance in three stages and confirmed the hypothesis with number 3. Thus, the sports performance of the subjects gradually increased in accordance with the competitive season and the peak of sports form. This is due both to the training process of each athlete and to the maximum sports fitness point that was set towards the end of the season in accordance with the major national and international competitions.

Model 4 presented the relationship between the 2 main variables (mental toughness and athletic performance), in addition to these having the covariates Group, Training and Nutrition.

As it emerged from the first analysis model, the level of MT of the individuals in the experimental group increased significantly and showed influences on the trajectory of MT. MT intercept had a significant positive effect on sports performance intercept, suggesting that the initial MT level has an influence on the initial level of sports performance. Moreover, MT slope had significant positive influences on both the Intercept of Sports Performance and the Slope of Sports Performance. This suggests that increasing MT has an important role to play in increasing the level of athletic performance..

Training process had a negative effect on the Intercept of sports performance. This can be attributed to the fact that many athletes at the beginning of the competition season are still in the volume period, only then begin the preparation for the peak form the most important competitions are usually at the end of the competition season. At the same time, the training had a significant positive effect on the slope of sports performance, claiming that the training process plays an important role in increasing sports performance.

Nutrition presented whether or not individuals follow a diet during training. It should be noted that if they followed a diet we did not monitor the particularities of that diet, so the covariate

nutrition did not have a significant effect on the intercept or the slope of sports performance. This can be attributed to the fact that the nutrition of the participants was not monitored in more detail, taking into account the particularities of the observed regime..

Model 5 is the final model of data analysis. It incorporated the previously presented model and verified the mechanism of action of MT on sports performance. The analysis confirms hypothesis number 4 and highlights how MT works on sports performance by reducing the level of sports anxiety. These results are consistent with other studies that associate high levels of MT with low levels of anxiety, this relationship being manifested on the level of performance (Schaefer et al., 2016; Hossein et al., 2016; Kalinin et al., 2019; Kalinin et al., 2021).

Chapter 10 - General conclisions

The present Phd thesis has studied the MT construct among athletes from several perspectives. Given that this contract has not been addressed in our country and that there have been no published scientific papers, the first step in this paper was to validate and adapt an instrument for measuring MT so that we can later contain the following studies. Thus, the present paper attempted to validate the MT measuring instrument proposed by Gucciardi et al. (2015). Following the analyzes, the CFA results support the factorial validity for the Romanian version of MTI. The results are also consistent with other studies that have attempted to validate this measurement tool (Gucciardi et al., 2015; Gucciardi et al., 2016; Li et al., 2017; Cowden, 2018; Stamatis et al. , 2019, Moreira et al., 2021, Stamatis et al., 2021). The study provides initial evidence of the group invariance of MTI by gender, thus indicating that it is safe to compare the mean scores of these subgroups (Brown 2015). The study also analyzes the group invariance of the measurement model by the type of sport practiced and the level of performance. Test-retest reliability was tested over a relatively long period (6 months), but even so the results were consistent with previous studies (Gucciardi et al., 2015; Gucciardi et al., 2016; Li et al., 2017). The results suggest that researchers and practitioners may use the Romanian version of MTI in future research, which seeks to provide insight into the theoretical characteristics of this concept.

An important factor that has influenced the evolution and results of athletes over time is competitive anxiety. In the literature, research on the relationship between MT and competitive anxiety is somewhat confusing (Hanton, Neil & Mellalieu, 2008). There is correlational and experimental research that provides empirical support for the relationship between anxiety and MT (Mahoney & Avener, 1977; Parfitt et al. 1990). At the same time, studies have failed to find any relationship between these two variables (Cowden, Fuller & Anshel, 2014). We considered it necessary to study the relationship between competitive anxiety and MT in this study. The results will be useful later in adapting the intervention program. Competitive anxiety is influenced by a lot of individual factors, such as the mechanism of psychological management, motivation, but more recently it has been found that it is also related to MT. Our study attempted to control some of these methodological factors using a latent regression analysis. Using a cross-sectional descriptive design, we tested a latent regression analysis model with the latent variable MT as the predictor and the criterion anxiety as the competitive anxiety. We found that the measurement model of both scales has an acceptable fit of the data. More importantly, we found a significant

regression coefficient between these two latent variables, athletes with high MT levels tend to be less anxious. This result is in line with the existing conceptual definition of MT. Formulated in terms of anxiety, individuals with higher levels of mental toughness are less tempted to interpret ambiguous information or high-pressure competitive situations as threatenin and respond with dysfunctional thoughts and maladaptive behavior (Hossein et al., 2016). MT mediates a negative association between motivation and competitive anxiety. Several studies have highlighted the negative relationship between MT and anxiety (Hossein et al. 2016; Algani et al., 2018; Miftakhul, 2018; Kalinin et al. 2019).

Moreover, in addition to the relationship between anxiety and MT, we considered it necessary to address MT in relation to the level of stress and depressive symptoms of other athletes. Stress and depressive symptoms are present in the life of athletes during difficult training periods or after a competition or unsuccessful competition periods. Thus, the analyzes performed suggest that athletes with a high level of MT tend to be less stressed, anxious or depressed. This result is in line with another definition of the concept of MT, which characterizes people with a high level of MT as "*having a high level of control, commitment and consistency, even in unfavorable circumstances and tend to interpret problems in terms of challenges*" (Gucciardi et al., 2014). Intervention studies have shown that high levels of MT reduce the level of competitive anxiety, stress and depressive symptoms (Kalinin et al., 2019).

At the end of the paper we presented a mental training program as a direct means of increasing the level of MT and an indirect means of increasing sports performance. The Gold Medal - Mental Training program showed a significant increase in the level of MT among the individuals in the intervention group. This result is consistent with the views of other authors in the field who argue that programs aimed at developing psychological skills have a significant contribution to the development of MT (Gucciardi et al., 2009; Connaughton et al., 2010; Thelwell et al., 2010). The level of MT together with the physical training process practiced by each athlete proved to have a significant influence on the level of sports performance of each subject. According to the results, mental training has shown indirect influences on sports performance through MT, which has a mediating role in the relationship Mental training - MT - Sports performance. This paper is in line with studies in the literature and supports MT as an important pillar of sports performance (Crust, 2010; Clough & Strycharczyk, 2012; Gucciardi & Gordon, 2011).

Future researche

The results show that the development of MT positively influences sports performance both directly and indirectly by reducing the level of anxiety. An important research perspective is to establish other mechanisms by which MT influences sports performance (eg improving coping strategies).

The mental training program was created with the goal of improving MT in combat disciplines (Dariusz Nowicki, 1997). In this thesis it was translated into Romanian and adapted to the trials practiced in athletics, all sports in which it was practiced being individual sports. Thus, a second research perspective is to verify whether the mental training proposed by us also has benefits for athletes who practice team sports. But before checking if the program is beneficial and on team games, certain episodes of the mental training program must be adapted according to the sports in which it is intended to be used.

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