



PSYCHOMETRIC PROPERTIES OF ONLINE VERSIONS OF MENTAL TOUGHNESS QUESTIONNAIRES IN BASKETBALL PLAYERS

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Abstract:

The aim of this study was to examine the psychometric properties of using the online version of the questionnaires for assessing mental toughness to gather and analyse the data in scientific research. It was assumed that, with the right introduction, written explanation, and usage of available IT solutions the results will have good psychometric properties.

The sample of 79 male athletes that played basketball in a 2022/2023 season, filed online version of the Sports Mental Toughness Questionnaire (SMTQ), the Psychological Performance Inventory - A (PPI-A), and Mental Toughness Inventory (MTI).

Results of descriptive analyses showed that good metric characteristics and discriminativeness of all three instruments. Reliability was also confirmed with obtained Cronbach's alpha coefficient scores. Obtained low to high significant positive correlations among all scales and subscales confirmed construct validity of online versions of all three questionnaires for assessing MT.

It was concluded that further research of this way of using of measuring instruments is needed but also justify.

Keywords:

Online platforms, Online questionnaires, SMTQ, PPI-A, MTI.

INTRODUCTION

In competitive or stressful professions like police work, military, medicine, sports, business etc. often the difference between successes and failure is a split-second decision taken under a certain amount of psychological pressure [1, 2]. How a person behaves in those tense situations and in a prolonged challenging environment is determined by individual characteristics that are often attributed to the concept of Mental Toughness (MT) [3]. The term itself, mental relating to the mind, or involving the process of thinking [4], and toughness as a noun describing something strong, not easily broken or made weaker or defeated [5], represents a concept that a certain set of personality characteristics define how a person reacts and deals with stress and challenges. MT is defined as a personal capacity to produce consistently high levels of subjective (e.g., personal goals or strivings) or objective performance (e.g., sales, race time, GPA) despite everyday challenges, stressors and significant adversities [6].

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In sports, especially at the professional level where people's jobs and careers are at stake, stress is an important and ever-present factor that can affect not only one performance, but the whole season or career [7]. Psychological burdens are present daily as a continuity in a quality performance, both in a practice and in a competition, is expected and needed. Some athletes fare better, cope better with stress, have more stable performances and have better results in general, so the connection between Mental Toughness and performance in sports was made [8]. It is easy to see why that is so. While playing basketball, players constantly have to make decisions, in less than a second, while running full speed, and while engaged in physical contact with the opponent, that can affect the course of the game and the final result. Plus, the training process is long and stressful and many people can't handle the pressure. Over the last couple of decades many studies were conducted to measure the importance and the link between sport results and MT. For example, the results of recent studies suggest that MT of young female basketball players played a significant role in performance index rating [8]. The benefits of discovering and defining a personal characteristic that can predict success would be enormous in terms of recruiting and selecting the candidates and that is why most studies regarding MT was done within sports context and even when it was examined in non-sport contexts, scholars have applied sport models with little explanation of the substantive or empirical evidence for doing so. Besides that, MT is still a controversial topic regarding the fact that, even with all the research done there is still a problem with its conceptual clarity, dimensionality (is it a multi or unidimensional concept) and traitness, (unresolved yet substantively important issue is whether MT is best conceptualised as a dispositional, trait-like or situational, state-like construct) [6]. Reflecting this range of different definitions, insufficient effort has been devoted to the development of a reliable and valid measure of mental toughness in sport [9]. Most of the studies were conducted by a questionnaire designed for a self-valuation process that would use the results and place them on a scale measuring the construct [7]. The scales mostly used are usually the Likert 5- or 7-point scales, in which 1 is false 100% and the biggest number (5 or 7) represents the opposite and 100% true, while the numbers in between represent the claims slowly graduating from one statement to another. The construction of the Likert (or Likert type) scale is rooted in the aim of the research. Sometimes the purpose of the research is to understand the opinions/perceptions of participants related with single 'latent' variable phenom-

enon of interest). This 'latent' variable is expressed by several 'manifested' items in the questionnaire [10]. For example, by agreeing or disagreeing with the statements like "I laugh a lot" regarding humour, and "I am always committed and involved" regarding sense of purpose, the person is actually answering the question of happiness and subjective well-being. [11]

Before the COVID-19 pandemic these types of questionnaires were done in person and were written on paper [12], with the advantage of the person doing the research, being present to explain and guide the process. Online environment and transdisciplinary attitude were needed to develop scientific research, given the complex societal challenges we faced during pandemic [13]. Sample collection via online platforms, which during the pandemic was practically the only safe way to conduct large-scale research, turned out to be very practical and simple in practice. Major strengths of the online survey are: global reach, business-to-business (B-to-B) and business-to-consumer (B-to-C) appeal, flexibility, speed and timeliness, technological innovations, convenience, ease of data entry and analysis, question diversity, low administration cost, ease of follow up, controlled sampling, large sample easy to obtain, control of answer order, required completion of answers, go to capabilities, knowledge of respondent vs. nonrespondent characteristics, while the major potential weaknesses are: perception as junk mail, skewed attributes of internet population: upscale, male, etc., questions about sample selection (representativeness) and implementation, respondent lack of online experience/expertise, technological variations, unclear answering instructions, impersonal, privacy and security issues, low response rate [14].

In sport particularly, having in mind busy competition calendar, time needed for training as well as for rest, traveling all around the world for matches and training camps, it is difficult to gather representative samples for the research. Online solutions may be the answer, but the question arises as to how valid this method of conducting research can be, given that majority of the questionnaires of Mental Toughness (as well as majority of other similar psychological instruments) are intended to be filled in with the physical presence of the examiner (psychologist). On the other hand, companies dealing with psychological assessment, such as AQR International, are developing online solutions for the application of their instruments, which is why, the online version of their mental toughness assessment questionnaire MTQ was available for online assessment even before the pandemic.



The aim of this study is to examine the psychometric properties of using the online version of self-report instruments for assessing MT to gather and analyse the data in scientific research. We assumed that with the right introduction, written explanation, and usage of available IT solutions the results will have good psychometric properties, which is first condition for thinking of implementation of such solutions in research practice. It is important to note, that this approach doesn't mean that the role of psychologist in conducting psychometric assessment should be changed. We just want to examine possibilities of implementation of online IT solutions in this process, as it happened in numerous other fields during and after pandemic.

1.1. PARTICIPANTS

The sample for this research was 79 male athletes that played basketball in the 2022/2023 season, divided in two basic categories, Serbian speaking and non-Serbian speaking. Non-Serbian speaking participants did an English version of the questionnaire, while the Serbian language speakers did the Serbian translation. Serbian language form was filled by 54 participants (age = 21.6 ± 4.9) from 9 different clubs, in three different divisions (14 participants played 1 division in the season 22/23, 14 second, and 28 third division). 14 of the 54 still had a junior status while 40 of them were seniors, with sports experience (number of years playing the sport) on average of 11.7 ± 5.5 years. 21 of them are elite athletes while 33 of them never had any national team experience. By playing position in the team, 14 of them were point guards (1), 12 shooting guards (2), 11 small forwards (3), 11 power forwards (4), and 5 of them were playing centre (5) position. English form was filled by 25 participants (age 18.6 ± 5.0) from 3 different clubs, 11 cadets, 6 juniors, 8 seniors with an average sports experience of 9.3 ± 4.8 . 3 of them played first division, 9 of them played second division and 13 of them played third division during the 22/23 season, while 8 of them were elite athletes and 17 had no national team experience. By position in the team, 4 of them were point guards (1), 7 shooting guards (2), 4 small forwards (3), 6 power forwards (4), and 4 of them were playing center (5) position.

1.2. MEASUREMENTS AND PROCEDURES

For this study we used the Google Forms to collect and analyse the data. Google Forms allows us to compose questions, collect answers from respondents, and present data in spreadsheet format so that participants can track and analyse the data using Google Sheets. [15] In this study the participants were filling the form at the time of their choosing, in the privacy and comfort they chose, mostly using their phones, just by clicking on the link sent to them by their coach. This is not a standard environment for a study like this which raises the question of validity of the results. But Google Forms is a 100% free to use web-based survey tool that offers unlimited surveys with unlimited respondents where survey answers and data are automatically collected in Google Spreadsheets, has the option to embed a survey into emails or websites, gives lots of theme options, add your custom logo, photo or video option, and add collaborators option, with only limitation in data privacy, [16] and as such has a great potential for this type of studies, thus the attempt to validate the results. Moreover, as web-based surveying offers researchers many advantages over more conventional survey modes, these findings suggest that non-market valuation practitioners should consider using this survey administration mode in the future. [17] For our study we chose Google Forms because the Google Forms provides various options for capturing the data from multiple answers. For example, one can have multiple choice options, check boxes, scale, grid, text, etc. [16].

Absence of personal presence of the examiner (psychologist) is the biggest problem in this kind of research. It can be potentially overcome with usage of filmed explanations posted on video sharing platforms and a linked to an online questionnaire, or his/her live online presence during data gathering sessions with help of platforms such as Google Meet, Microsoft Teams or similar. Because of explorative nature of this study, we didn't apply this kind of procedure, wanting to know whether the application of the online questionnaire without built-in security mechanisms that would ensure greater validity affect metric characteristic of the instruments.

After data gathering, all the procedures of the data processing and interpretation were done by the psychologist as it would be done if the traditional paper and pen version was used.



1.3. STATISTICAL ANALYSES

The online questionnaire was set in a way that does not enable existence of missing values or multiple answers, which enabled the analysis to be carried out immediately after data collection. First, the data were subjected to descriptive statistical analysis. Minimum, maximum, mean, standard error of mean, standard deviation, coefficient of variation, skewness as well as kurtosis was calculated. The Kolmogorov-Smirnov non-parametric test was used to determine the normality of the data distribution. Reliability analysis was used to determine the reliability of the instruments. Cronbach's alpha score and Cronbach's alpha score based on standardised items was calculated. Construct and convergent validity were tested with Spearman's nonparametric correlation test. For discriminant validity assessments descriptive statistics, skewness and kurtosis as well as nonparametric Kolmogorov-Smirnov test were used.

Statistical significance was defined at the level of 95% probability, for the value of $p < 0.05$ and at the level of 99% probability, for the value of $p < 0.01$. All statistical analyses were performed using SPSS 20 (IBM Corp., Armonk, N.Y., USA) and Jamovi (version 1.2.27.0).

2. RESULTS

Descriptive statistical analysis was performed on the whole sample for the total scores as well as for the scores on subscales (Table 1) of the SMTQ, PPI-A and MTI. Standard error of mean ranging from 1.37% (SMTQ) to 2.37% (Control) of mean enables accurate and narrow

estimation of the population mean. The analysis shows that the sample was quite homogeneous on all of the variables and with an acceptable coefficient of variation. Descriptive statistics and the Kolmogorov-Smirnov nonparametric test showed there are no significant deviations from the normal distribution except Constancy, Determination, and MTI.

The analysis of the observed deviations of the distributions was done with the Q-Q plots (Figure 1). The presence of outliers at lower scores as well as accumulation in maximum values can be observed in all three distributions. The elimination of outliers, first of all, with the possible application of logarithmic transformation, which is unnecessary in this particular case, would lead to the elimination of observed deviations and enable the application of parametric statistics in further analyses. Considering the specific goals of this work, this will not be the case, but further analyses will be done on the original data and scores.

Reliability analysis (Table 2) was performed at the level of individual answers of respondents on all items of both total scores and subscales of the SMTQ, PPI-A and MTI, on the total sample. Obtained Cronbach's alpha scores prove to be excellent for MTI, good for PPI-A and Determination, acceptable for SMTQ, Self-belief, Positive Cognition as well as questionable for Confidence, Constancy, Control and Visualisation.

Table 1 - Descriptive statistics for the SMTQ, PPI-A and MTI scores.

	Minimum	Maximum	Mean	SEM	Std. Deviation	COV	Skewness	Kurtosis	Kolmogorov-Smirnov Z
SMTQ	2.36	4.00	3.01	0.04	0.36	0.12	0.17	-0.51	0.79
Confidence	1.67	4.00	2.85	0.06	0.51	0.18	-0.33	-0.39	1.15
Constancy	2.00	4.00	3.40	0.05	0.48	0.14	-0.86	0.23	1.62*
Control	1.50	4.00	2.87	0.07	0.60	0.21	-0.24	-0.53	0.99
PPI-A	2.64	4.93	3.94	0.07	0.59	0.15	-0.32	-0.67	0.74
Determination	1.67	5.00	4.16	0.09	0.82	0.20	-1.04	0.40	1.88*
Self-belief	2.00	5.00	3.84	0.09	0.77	0.20	-0.18	-0.92	1.06
Positive Cognition	2.00	5.00	3.93	0.08	0.68	0.17	-0.44	-0.12	0.95
Visualization	2.00	5.00	3.87	0.09	0.76	0.20	-0.24	-0.75	1.11
MTI	2.25	7.00	5.59	0.13	1.15	0.21	-1.11	0.84	1.46*

* Significant at the 0.05 level

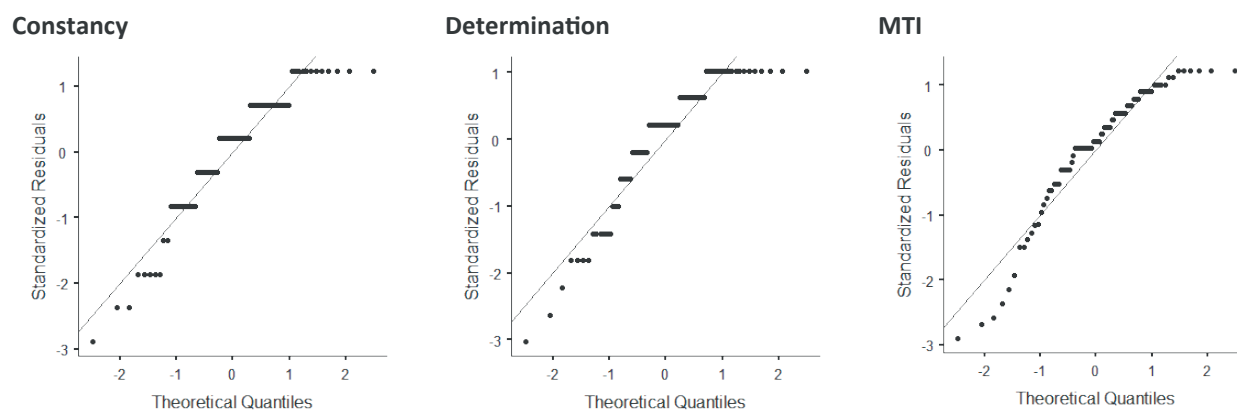


Figure 1 – Q-Q plots for Constancy, Determination and MTI scores.

Table 2 - Reliability statistics for the SMTQ, PPI-A and MTI scores.

	Cronbach's α	Cronbach's α Based on Standardised Items	N of Items
SMTQ	0.701	0.715	14
Confidence	0.684	0.693	6
Constancy	0.610	0.616	4
Control	0.637	0.652	4
PPI-A	0.862	0.869	14
Determination	0.805	0.805	3
Self-belief	0.716	0.733	4
Positive Cognition	0.731	0.731	4
Visualization	0.630	0.646	3
MTI	0.928	0.929	8

Table 3 - Correlation analyses for the SMTQ, PPI-A and MTI scores.

	Conf.	Const.	Cont.	PPI	Det.	Selfb.	Pos.Cog.	Visu.	MTI
SMTQ	.828**	.633**	.568**	.577**	.360**	.477**	.535**	.387**	.524**
Confidence		.350**	0.180	.420**	.296**	.279*	.424**	.282*	.433**
Constancy			0.177	.465**	.453**	.265*	.415**	.323**	.422**
Control				.339**	0.016	.483**	.285*	.256*	0.159
PPI-A					.732**	.773**	.849**	.776**	.795**
Determination						.333**	.531**	.556**	.709**
Self-belief							.599**	.400**	.551**
Positive Cognition								.560**	.683**
Visualization									.560**

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).



Spearman's nonparametric correlation analysis was performed on the whole sample for the total scores as well as for the scores on subscales (Table 3) of the SMTQ, PPI-A and MTI. Among all scales and subscales, low to high significant positive correlations were obtained. Confidence is which doesn't correlate significantly Confidence, Constancy, Determination and MTI is an exception.

3. DISCUSSION

This study aimed to examine the psychometric properties of online version of the SMTQ, PPI-A and MTI in the population of basketball players. All the findings confirmed good psychometric properties of online versions of all three questionnaires in sport population, more precisely basketball players, making them candidates for further research of possibilities of implementation of IT solutions in domain of personality assessment, above all in scientific research.

According to descriptive indicators (Tables 1), the participants in the research have highly developed MT, which is in line with results of previous studies [8]. This well-known fact that athletes differ from the general population in terms of their more developed MT is illustrated by all 3 questionnaires. Due to the specificity of the population, the obtained scores are quite homogeneous and shifted towards the maximum values. This limited range of manifestations of various MT scores had an impact on the metric characteristics. Since this is a study with a clear applicative character, the results were not subjected to the procedure of removal of the outliers, which also had the impact on the metric characteristics. Never the less, almost all descriptive parameters speak about good metric characteristic of all MT scores. The exceptions are deviations from normal distribution in Constancy, Determination, and MTI. Considering mentioned characteristics of the subject's population and an absence of outlier detection procedure, this kind of deviation is expected, but more importantly easily repairable, and that is why it is acceptable. This is clearly illustrated with Q-Q plots (Figure 1). Also, since the MTI instrument is mainly intended for the general population, it showed quite good characteristics in the sports population as well. Taking everything into account, the obtained results speak in favour of the discriminativeness of the online versions of all three measuring instruments.

According to reliability parameters (Table 2) MTI showed the best properties, PPI-A was also very good, and SMTQ can be described as acceptable. Never the less, if taken into account the relationship between the size of Cronbach's alpha scores and the number of scales that make up one score, it can be clearly observed that all three instruments behave in a good way according to this parameter. Also, the obtained reliability of the online version of the questionnaire is quite similar to that obtained in the validation studies of the paper versions [18, 19, 9, 20, 21, 22].

The results of correlation analyses (Table 3) are also in line with the results of previous studies [6]. Considering the direction, intensity, and number of obtained correlations it can be easily claimed that the construct validity of online versions of all three instruments in a population of basketball players is confirmed.

In the end, this study for the subject of analysis had the psychometric properties of online versions of already validated instruments, which are in widely used in sports and research practice. Taking everything into account, the online tests showed at least the same psychometric characteristics as the paper versions [6, 9, 18, 22, 19, 21, 20].

Like any research, this one has its limitations. In addition to the already explained problems with the lack of live presence of the examiner, which was mainly justified considering the goals of the study, the biggest limitation concerns the sample. In order to reach a final conclusion on the subject that was researched, it is necessary to repeat the research on a larger and more diversified sample, both according to sport and according to other demographic characteristics, gender above all.

Finally, it should be emphasized that the researched use of online versions of questionnaires concerned primarily this method when collecting data for the purpose of scientific research, because nothing can and should not replace real face-to-face or even group psychological testing. Also, the change of media and the setting of questionnaire application does not mean that the psychologist's role in this process automatically changes, but on the contrary, psychologist's role must remain unchanged and irreplaceable in the process of ensuring ethical standards of research, processing and interpretation of data so that the research method of applying psychological questionnaires will be valid. In the end, if additional studies show similar results as this one, it would still be recommended that this method be used only in conditions where traditional psychometric testing is not possible.



4. CONCLUSION

Having in mind that good metric characteristics, discriminativeness, reliability and construct validity of online versions of SMTQ, PPI-A, and MTI questionnaires for assessing MT was clearly demonstrated by the obtained results, it can be concluded that this method of measuring instruments show good psychometric characteristics. Adding to this the efficiency of data collection with the help of online platforms, striving towards a valid implementation of online solutions in psychometric practice is quite justified. This study represents one small step in that direction. Therefore, it can be concluded that this study met its aims, although further research with larger and more diverse samples is still necessary before online versions of psychological questionnaires become part of standard research practice. Also, further improvement of data gathering process with more usage of online IT solutions, which will improve validity of this method is needed before it become common research practice.

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