

Original empirical article

THE DIFFERENCES BETWEEN TOP SENIOR BASKETBALL PLAYERS FROM DIFFERENTLY RANKED TEAMS IN TERMS OF SITUATION EFFICACY PARAMETERS

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Abstract. *The assessment of differences in situation efficacy of basketball players from more successful and less successful teams may contribute to a better understanding of the overall situation efficacy of the players. Our research was aimed at ascertaining the differential factors between players playing in more successful and less successful top Croatian senior teams, with respect to standard and derived situation efficacy parameters. The final sample of participants (74 basketball players) was selected from an initial sample of 107 participants, basketball players from nine male senior teams from the A-1 Croatian Men's Basketball League during the 2006/2007 championship. It has been ascertained that discriminant functions for the derived situation efficacy parameters indicated a statistically significant difference between players from less and more successful teams, in particular with respect to the efficacy of two-point shots. However, a statistically significant difference has not been found for standard situation efficacy parameters, which has been explained hypothetically.*

Key words: *Parameters, standard, derived, differential, efficacy.*

INTRODUCTION

The game of basketball is divided into three main stages: defense, attack and transition. One of the major problems in the research into basketball was the definition of situation statuses during play, the relations between situation efficacy indicators and results in basketball competitions (games, championships, and tournaments). The latent structure of the basketball game situation space was analyzed, and the anthropological

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characteristics and situation efficacy indicators of individual player types were determined (Jukić, 1998).

In order to monitor the events during basketball games, FIBA (Federation International Basketball Association) standardized thirteen indicators of situation efficacy that are followed in each official game. On the basis of these indicators it is possible to calculate various derived parameters. Numerous scientific studies have been carried out on the problems of measuring the actual quality of basketball players (Elbel & Allen, 1941; Dežman, 1996; Erčulj, 1997; Swalgin, 1994, 1998; Dizdar, 2002). Such studies have mostly focused on the development of expert systems for the evaluation of the actual quality of basketball players (Swalgin, 1994; Trninić, Perica, & Dizdar, 1999). For this purpose the differences in the actual quality of players, obtained by various evaluation methods, have been compared to the evaluations of seasoned basketball experts in terms of the quality of the game of the evaluated players (Swalgin, 1998; Dizdar, 2002; Jakovljević, Karalejić & Radovanović, 2007). For example, Jakovljević, Karalejić & Radovanović (2007) used one expert evaluation system, obtained on the basis of the assessment of five basketball experts (whose marks were checked for objectivity and reliability) and the quality index, obtained from the official statistics based on the data for the situational efficacy of basketball players. They have found that the correlation between the two ways of estimating the quality of basketball players is medium ($r = .643$; $p < .001$). Dizdar (2002) classified two main methods for the evaluation of the total efficacy or real quality of the players. The first method comprises procedures for the objective evaluation of the players' situation efficacy, among which are: the simple linear combination, the simple linear combination of the z-value, partially pondered linear combinations, the player's absolute and relative efficacy index, the MVP-evaluation of the player's efficiency, the Swalgin basketball evaluation system (BES 1), the pondered Swalgin basketball evaluation system (BES 2), and the PC player's efficacy evaluation system. The second group of methods is comprised of procedures for the subjective evaluation of a player's situation efficacy, the main characteristic of which is the subjective evaluation of a group of independent basketball experts evaluating a group of basketball players according to one or more criteria. The results showed that as much as 67% of the common variance with the variable of the overall quality of players, and thus the largest percentage of all the methods (Dizdar, 2002), is obtained by the method for the evaluation of the overall players' quality «*PC players' efficacy evaluation system*». However, more understandable for coaching practice, and equally efficient, is also the method of the *partially pondered linear combination* (Dizdar, 2002), which uses the coefficients of shooting efficacy instead of mere statistical data on the number of points achieved and the number of shots missed.

Milanović, Jukić and Bračić (2001, from Nakić, 2004) ascertained the extent of the influence of shot variables on the results of basketball games during the European Championship in Barcelona in 1997, and arrived at the conclusion that out of seven variables, only three appear as significant predictors of the final result of the game, and the most important of them is the number of successful free throws. The other two most important variables are missed two-point or three-point shots. Nakić (2004) identified the differences in standard and derived situation efficacy parameters between men's and women's basketball teams during the senior European basketball championships in 2003. The obtained canonical discriminant functions significantly distinguish the men's from women's teams, men's winning teams from men's defeated teams, as well as women's winning

teams from women's defeated teams, in the area of standard and derived situation efficacy parameters.

The main aim of this research was to determine the differences in situation efficacy parameters between players playing for more successful and less successful top Croatian senior basketball teams. Namely, identification of such differences in situation efficacy could contribute to the better understanding of the total situation efficacy of top Croatian senior players. On the other hand, it could contribute to higher quality coaching so that the coaches could use the information to make improvements in their own work, both during practice and during basketball games.

METHOD

Participants

The population from which the sample of participants was drawn was represented by successful top senior basketball players. The players had actively competed at the top levels in national championships i.e. played on nine men's senior teams from the A-1 Croatian Men's Basketball League in 2006/2007: «Cedevita», «Svjetlost», «Borik», «Kvarner», «Dubrava», «Dubrovnik», «Alkar», «Šibenik» and «Osijek». The average chronological age of 23.5 years reveals that the participants belong to the younger population. The final sample of participants (74 basketball players) was selected from the initial sample of 107 participants. The criteria for the selection of a player for the final sample of participants was the number of minutes in play (a minimum of ten minutes per game), i.e. the number of games played (a minimum of eight games played in championship).

Measures

The derived situation efficacy coefficients for the evaluation of situation-related efficacy were calculated on the basis of the *partially pondered linear combination* method for the evaluation of the total quality of the players (Dizdar, 2002). Among many important activities (mostly in terms of the defensive roles of the player) that cannot easily be measured in statistical form, there are twelve standard situation efficacy parameters, which include data about the efficacy of one, two and three point shots, offensive and defensive rebounds, stolen and lost balls, assistances, and personal fouls. On the basis of the standard situation efficacy parameters, seven derived situation efficacy coefficients of the basketball players were derived: utilization of two-point shots, utilization of three-point shots, utilization of free throws, efficacy of the two-point shots, efficacy of the three-point shots, efficacy of the free throws and total situation efficacy (Dizdar, 2002). Derived coefficients:

$XK1IS = XP1 / (XP1 + XN1)$ free throw utilization coefficient; $XK2IS = XP2 / (XP2 + XN2)$ two-point utilization coefficient; $XK3IS = XP3 / (XP3 + XN3)$ three-point utilization coefficient; $XK1UC = XP1 \times XK1IS$ free throw efficacy coefficient; $XK2UC = 2 \times XP2 \times XK2IS$ two-point shot efficacy coefficient; $XK3UC = 3 \times XP3 \times XK3IS$ three-point shot efficacy coefficient; $XDLK = XP1 + 2 \times XP2 + 3 \times XP3 + XSO + XSN + XA + XOL - 0,5 XN1 - XN2 - XN3 - XIL - XOP$ total efficacy index.

The dependent variable in this research was whether a player played for one of the more successful or less successful teams in the senior A-1 basketball league championship (four teams, ranked from first to fourth place in the championship, that played in the "Champion League" were classified as more successful teams, and the other teams were classified as less successful teams. The total sample of the games played, from which the data on the players' and teams' situation efficacy was collected, consisted of sixteen games per team (the «dual meet» system of competition).

Procedure

All of the data regarding the standard situational parameters were collected from the official web-site of the Croatian Basketball Association, the Portal Kosarka.hr (2007), after the competitive season of the A-1 league championship in 2006/2007. In the data analysis, we used the discriminant analysis to calculate the factors of the differences in standard and derived situation efficacy parameters.

RESULTS

In addition to the usual parameters for descriptive statistics, a detailed analysis of the differences in the players' situation efficacy parameters between the players performing for more or less successful teams, the discriminant analysis was used. The possibility of grouping participants from more and less successful teams in comparison to the standard and derived parameters of situation efficacy was investigated. Having taken into account the overall sample of basketball players, the highest arithmetic average values were obtained for the following standard situation efficacy parameters: the number of successful two-point shots (XP2), the number of personal fouls (XOP), the number of rebounds in defense (XSO). The rarest situations in basketball games, i.e. the lowest arithmetic average values, were found for the following standard situation efficacy parameters: the number of unrealized one-point shots (XN1), the number of successful three-point shots (XP3), the number of attack rebounds, the number of balls stolen (XOL). The lowest arithmetic values were obtained for the following derived situation efficacy parameters: of all the shot utilization coefficients, the three-point shot utilization coefficient (XK3IS) is the lowest and reads 0.31, while the three-point shot efficacy coefficient was the highest, i.e. XK3UC (8.84).

Differences in the players' standard situation efficacy parameters

As it can be observed from Table 1, the value of Wilks's λ (0.749) indicates that the discriminant function does not indicate a statistically significant difference among the players of the four most successful and 5 less successful teams, based on all the standard situation efficacy parameters in basketball. The group centroid values are -0.556 for the most successful and 0.587 for the less successful teams. The structure of the coefficients indicates that there is a link between the individual discriminant variables with a discriminant function. In this case they vary from between -0.062 and 0.360 . The results of the univariate analysis of variance (in relation to the discriminant function) for individual standard situation efficacy parameters, between the most successful and less successful

teams, indicate only two statistically significant differences. Successful two-point shots and unrealized two-point shots show a statistically significant difference between the players of more successful and less successful teams, in a theoretically predictable direction: more successful two point shots for players of more successful teams, and less successful two point shots for players of less successful teams.

Table 1 Discrimination analysis: players of 4 most successful and 5 less successful teams in relation to the variables of situation efficacy standard parameters

Discrimination function	Characteristic root		Wilks λ		Canonical correlation		χ^2 -test (degrees of freedom)		p
	0.335		0.749		0.501		19.080 (12)		p<.100
Variable	Wilks λ	Correlation with discrimination factor	F-test (1,61)	p	M Higher ranked	M Lower ranked	σ Higher ranked	σ Lower ranked	
XP2	0.862	-0.062	9.227	<.010	34.816	33.194	21.753	23.951	
XN2	0.846	0.334	7.932	<.010	24.105	30.028	15.071	16.004	
XP3	0.750	0.128	0.062	>.200	11.342	12.694	8.987	9.555	
XN3	0.756	0.329	0.539	>.200	20.132	26.278	14.898	17.737	
XP1	0.752	0.321	0.273	>.200	21.263	27.139	14.735	17.293	
XN1	0.761	0.301	0.977	>.200	8.158	12.389	6.305	16.382	
XA	0.749	0.072	0.024	>.200	21.737	23.333	19.880	18.842	
XSN	0.755	0.068	0.530	>.200	13.474	14.306	10.899	10.585	
XSO	0.749	0.131	0.029	>.200	29.790	29.790	19.431	19.521	
XOL	0.758	0.151	0.721	>.200	13.790	13.790	7.170	8.408	
XOP	0.757	0.360	0.618	>.200	30.842	30.842	11.103	12.740	
XIL	0.749	0.229	0.008	>.200	19.921	19.921	11.168	11.986	

Legend:

XP2=number of successful two point shots; XN2=number of unsuccessful two point shots;
 XP3=number of successful three point shots; XN3=number of unsuccessful three point shots;
 XP1=number of successful free throws; XN1= number of unsuccessful free throws;
 XA=number of assistances; XSN=number of offensive rebounds; XSO=number of defensive rebounds;
 XOL=number of stolen balls; XOP=number of personal fouls; XIL=number of lost balls

Differences in the players' derived situation efficacy parameters

Table 2 shows that the discriminant function indicates the differences between players of the 4 most successful and 5 less successful teams. Consequently, a statistically significant difference can be established between the players on the basis of derived situation efficacy parameters in basketball. The group centroid values are -0.571 for the most successful and 0.603 for the less successful teams. Structural coefficients indicating a connection between individual discriminant variables with a discriminant function in this case vary from 0.006 and 0.812 . In the univariate analysis of variance only one statistically significant difference was found, for the two-pointshot utilization coefficient (XK2IS), in a theoretically predictable direction: better two-point shot utilization for players of more successful teams. In addition to this one, there are two more differences

which tend to be important: total situation efficacy, i.e. XDLK (in the expected direction: better situation efficacy for the players from more successful teams) and efficacy coefficient for free throws, i.e. XK1UC (contrary to expectation: the players of less successful teams are more successful).

Table 2 Discrimination analysis between players of 4 most successful and 5 less successful teams in A-1 Croatian Men's Basketball League Championship in relation to the group of variables of derived situation efficacy parameters

Discrimination function	Characteristic root		Wilks λ		Canonical correlation		χ^2 -test (degrees of freedom)		p
	0.354		0.738		0.511		20.776 (7)		<.010
Variable	Wilks λ	Correlation with discrimination factor	F-test (1,61)	p	M Higher ranked	M Lower ranked	σ Higher ranked	σ Lower ranked	
XK2IS	0.899	0.812	14.390	<.010	0.583	0.494	0.086	0.100	
XK3IS	0.745	0.141	0.594	>.200	0.325	0.300	0.155	0.149	
XK1IS	0.744	-0.006	0.462	>.200	0.730	0.731	0.138	0.133	
XK2UC	0.741	0.178	0.254	>.200	41.858	35.731	28.306	30.306	
XK3UC	0.741	-0.014	0.269	>.200	8.773	8.902	8.000	7.426	
XK1UC	0.768	-0.258	2.666	>.100	15.745	19.396	11.811	12.315	
XDLK	0.741	0.114	0.192	<.100	104.775	96.004	58.991	71.251	

Legend:

XK1IS= $XP1 / (XP1 + XN1)$ free throw utilization coefficient; XK2IS= $XP2 / (XP2 + XN2)$ two-points utilization coefficient; XK3IS = $XP3 / (XP3 + XN3)$ three points utilization coefficient; XK1UC= $XP1 \times XK1IS$ free throw efficacy coefficient; XK2UC= $2 \times XP2 \times XK2IS$ two point shot efficacy coefficient; XK3UC= $3 \times XP3 \times XK3IS$ three point shot efficacy coefficient; XDLK= $XP1 + 2 \times XP2 + 3 \times XP3 + XSO + XSN + XA + XOL - 0,5 XN1 - XN2 - XN3 - XIL - XOP$ total efficiency index

DISCUSSION

The main conclusion resulting from this research is that the discriminant function does not make a statistically significant difference between the players from more successful and less successful teams on the basis of a group of standard situation efficacy parameters in basketball. However, successful and unsuccessful three-point shots are the differentiating factors that indicate a statistically significant difference between the players from more successfully and less successfully ranked teams in the A-1 championship league, in a theoretically predictable direction. The two-point shot, either successful or unsuccessful, is the best indicator of success pertaining to the teams' results.

The results of this research differ significantly from those obtained by Nakić (2004), where on the European Senior Championship level the discriminant function indicated a well defined difference between more successful and less successful teams, according to the standard situation efficacy parameters. The men's winning teams, in comparison to the defeated teams, showed the largest difference in successful free throws, followed by assistances and unsuccessful two and three point shots. The reason for such large differ-

ences can of course be the specific features of competing in Croatia, basketball games not being as elite as those played in European championships. Namely, in the A-1 league there are a lot of young and struggling players that are rarely members of their national team. Also, both successful and less successful teams do not need to play in the A-1 league «at their utmost» i.e. at the maximum competitive level, since the A-1 is some sort of a «warm up» for the Championship League (for more successful teams), or for the «Right to Stay League» (for less successful teams). On the other hand, the probable reason (or one of the reasons) is the specificity of the A-1 championship in the very season that was the subject matter of this research. The players of less successful teams may have even been less motivated for the competition due to the withdrawal of the team «Zabok» from the championship shortly before it was due to start. As a result, there was no suspense of the battle to earn the right to stay in the league. Namely, in that championship no team could be eliminated from the elite competition. In such a competition, in the early phase (when the testing took place) very successful and very unsuccessful teams were already «polarized», making it rather possible that the very efficacy of the two-point shot represented the crucial (and sufficient) factor which contributed to the victory of one of the teams and the defeat of the other team. It is quite possible that in a more balanced competition, the superiority of one team over another would be necessary in several situation efficacy parameters at the same time, to obtain victory (e.g. in addition to the two point shot superiority, superiority would be necessary in the three point or one point shot, assistances, rebounds, etc.). Nevertheless, even under such circumstances the total discriminant function was of border-line importance, in the expected direction.

At the group level of derived situation efficacy parameters, the discriminant function indicates a statistically significant difference between the players of more successful and less successful teams, as expected. Following the analysis of individual discriminant coefficients for standard situation efficacy parameters, there is a difference between the players from more successful and less successful teams on the basis of two-point shot utilization and general situation efficacy, in a theoretically predictable direction. In this case, the results are similar to those obtained by Nakić (2004) on teams participating in the European Basketball Championship: the discriminant function indicated significant differences between more successful and less successful teams, the largest differences being in the total situation efficacy coefficient as well as two-point shot utilization. Consequently, the analysis of the derived parameters confirmed the result obtained by the discriminant analysis for the standard situation efficacy parameters of the players. Having in mind the prevailing conditions of competition in the men's A-1 league during the analyzed championship, it is to be presumed that the two-point shot is practically «crucial» in determining the difference between less successful and more successful teams.

However, the main weakness of the research (in addition to the mentioned specificity of the aforesaid competition) could be the small sample of top players, as well as the specificity of the Croatian population of top senior basketball players. This has a direct influence on the reduced possibility of generalizing results. The potentially most important reason for the obtained results came as a consequence of the chosen sample of participants. It is, however, possible that the relatively small variability of situation efficacy parameters is the result of the multiple selectivity of the samples of basketball player. The number of games played and time in play contributed to the reduction of the number of participants in the final sample, mostly those that are less successful in terms of situation efficacy. Also, the initial decision to carry out the research only on the A-1 league play-

ers, but not the players of the four Croatian most successful teams («Cibona», «Zadar», «Zagreb» and «Split»), most probably additionally decreased the potential variance in situation efficacy. An additional weakness is indirectly mentioned in the article written by Jakovljević, Karalejić & Radovanović (2007): situational efficacy parameters have to be observed in relation to the position of the individual player in the game (outer and inner players). These are: volume and level of development and applicability of technique, individual tactics, tactical knowledge, psychomotor abilities; the importance of anthropometric characteristics of the players with regard to their position in the team and contribution in the game; the level of engagement and responsibility, the originality of the solutions in the game; perception and survey of the game both in attack and defense. Scoring in basketball is the result of team play and of different activities of all the players in the field (points could be more or less easily scored).

On the other hand, some important factors in the game are not covered by efficiency parameters: for example, good defense in one-on-one, or two-on-two situations, aggressive defensive contact "on the border of personal fault", good assistance during defense.

The main advantage of the research lay in the fact that practically all of the available players were tested in the targeted A-1 basketball league championship. Consequently, the principles revealed could be useful for the concrete sample (practically the population) of basketball players, which could serve as stimulation for coaches to increase their effort.

The results of this research, in addition to the scientific (taking a purposeful sample of top Croatian basketball players) can have a practical value as well. They can serve as guideline for more successful selection, but also correction of unwanted deviations in the performance of individual players (i.e. for the more efficient work of coaches).

The potential reasons for the obtained results offer guidelines for future research. Furthermore, in future research work the number of participants could be increased (by testing injured and other absent players). The term «top players» in relation to the mentioned specificities does vary from state to state, depending on the competitive quality of state competitions (which often depends on the financial status of clubs and their ability to keep their most promising players). However, it might be good to include the players of four Croatian most successful teams in the sample, and thus (probably) obtain better variability for situation efficacy parameters. An improvement could also be a multiple repetition of the same type of research during more basketball championships, in which case the minor differences in the term Croatian «top basketball player» could be reflected.

CONCLUSION

We have ascertained the existence of statistically significant differences between various groups of participants (in relation to membership in more or less successful teams) as far as situation efficacy parameters in basketball are concerned. Namely, the discriminant function for the derived situation efficacy parameters indicated a statistically significant difference between the players of less successful and those of more successful teams. This in particular refers to two-point shot utilization, which is higher for the more successful teams. Nevertheless, a statistically significant difference has not been found for standard situation efficacy parameters, for which we have offered hypothetical explanations.

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RAZLIKE VRHUNSKIH SENIORSKIH KOŠARKAŠA IZ RAZLIČITO USPJEŠNIH MOMČADI U PARAMETRIMA SITUACIJSKE UČINKOVITOSTI

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Otkrivanje razlika u situacijskoj učinkovitosti u košarci između igrača uspješnijih i manje uspješnih momčadi moglo bi doprinijeti boljem razumijevanju ukupne situacijske učinkovitosti košarkaša. Cilj našeg istraživanja bio je utvrditi faktore razlika košarkaša koji igraju u uspješnijim i manje uspješnim vrhunskim hrvatskim seniorskim momčadima, u odnosu na standardne i izvedene parametre situacijske učinkovitosti. Finalni uzorak ispitanika (74 košarkaša) je selekcioniran iz inicijalnog uzorka od 107 ispitanika, košarkaša devet muških seniorskih momčadi A-1 Hrvatske muške košarkaške lige iz prvenstva 2006/2007. Utvrdili smo da diskriminacijska funkcija za izvedene parametre situacijske učinkovitosti statistički značajno razlikuje igrače manje i više uspješnih momčadi, osobito po iskoristivosti šuta za dva poena, koja je veća za uspješnije momčadi. Međutim, statistički značajna razlika nije pronađena i za standardne parametre situacijske učinkovitosti, čemu smo dali hipotetska tumačenja.

Ključne reči: *parametri, standardni, izvedeni, razlike, uspješnost.*