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Analysis of time-out use in handball and its influence on the game performance

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Abstract

Coaches can use time-out (TTo) to influence performance and use this moment to give tactical instructions and make visible structural modifications (modifications of the game system and players' substitutions). The aim of the present work is the analysis of the time-out usage and its influence on the game performance. 578 TTo were analyzed in three international handball competitions with two different regulations on the number of time-outs available. The variables were: competition, outcome, final difference, difference in the scoreboard during the time-out, difference five minutes before the time-out, defensive change, players' substitution and finalization of the five attacks previous and later to TTo. The use of TTo is mostly done by teams losing or which have had a bad streak on the scoreboard, being the latest factor the most decisive one for its application. Although the percentage of positive actions generally increases after the application of TTo, if analyzed in relation to the visible structural changes, players' substitutions are more effective than defensive system changes.

Keywords: performance analysis, coaching, timeout, handball.

1. Introduction

Game situations in team sports are in constant change. The tactical approach made up by the trainer before the match begins can be modified according to the game dynamics. The trainer's ability to foresee, interpret and react properly to these changing situations can be decisive to obtain victory (Gilbert, Trudel, & Haughian, 1999).

The strategies a trainer can use to influence tactically the game's development are varied. He can usually give instructions from his position during the development of the game with the difficulty that they can be distorted when they reach the players because of the distance, the ambient noise, etc. The manager also has the option of making players' substitutions in order to correct aspects that he thinks are not working correctly, although in some sports, such as football, there is a great limitation in this regard and only three players' substitutions can be made. Variations on the initial tactical approach can also be made by adapting to new situations and changing game systems already employed. All these operations can be made during the development of the game, but there is a

regulation possibility that does not occur in all team sports, which is the chance of applying for an interruption of the game in order to intervene: the so-called “*Team Timeouts*” (TTo), thanks to which the trainer’s direct intervention is facilitated, since the players are gathered close enough to hear the commands. That is why the use of TTo becomes the best tool that a technical body can use to make tactical modifications (Bar-Eli & Tractinsky, 2000; Taylor & Demick, 1994).

TTo request can be made with several purposes, such as to give instructions to the players in order to modify or reinforce tactical behaviours, to make players’ substitutions, to give players a break, to prepare special game situations or to interrupt the adversary’s winning streak (Duke & Corlett, 1992; Gómez, Jiménez, Navarro, Lago-Penas, & Sampaio, 2011). The trainer’s ability to influence a team’s performance has been already treated and research on this topic is directed to several different lines of study. In the first place, there are studies which have analysed the trainers’ cognitive processes during matches (Debanne, Angel, & Fontayne, 2013; Debanne & Fontayne, 2009; Hastie, 1999; Jiménez & Lorenzo, 2010; Zetou, Kourtesis, Giazitzi, & Michalopoulou, 2008). This intervention and the given instructions diverge depending on the game’s and players’ dynamics. Thereupon, the instructions that the trainer can give in the final moments vary depending on whether the team is winning with a significant difference or a small difference on the scoreboard or if they are addressed to novice or psychologically weak players, etc. (Allison & Ayllon, 1980; Bar-Eli & Tractinsky, 2000). But one of the conditions this message must accomplish is to be transmitted clearly and accurately taking into account that there is a time limit to provide the information, which is usually one minute duration. Some other lines of TTo analysis are those whose aim is to give guidelines on the type of information that must be provided at these stages (Iglesias, Cárdenas, & Alarcón, 2007), and which patterns must be followed to solve the problem, that is, to provide solutions. They even quantify the time that must be dedicated to one’s own team (45%) and to the opposing (55%).

Nevertheless, analysing this sort of data may pose considerable problems since, to do it, direct access to the communication established between the trainer and the players would be needed. For this reason, research analysing how to use TTo through objective structural changes has been made. It also analyses the request’s external result, that is, external data visible to an observer who has no direct access to verbal information given during TTo. Within this line, there are several studies on basketball (Duke & Corlett, 1992; Kozar, Whitfield, Lord, & Mechikoff, 1993; Saavedra, Mukherjee, & Bagrow, 2012; Sampaio, Drinkwater, & Leite, 2010) table tennis (Wang, Chen, Lee, & Hsu 2010) and volleyball (Zetou et al., 2008).

Regarding handball, there are few studies found on this topic. Regulation on TTo application changed in the season 2011-2012, replacing two TTo allowed (one for each half) for three: one for each half plus an additional one that can be requested whenever wanted. But two TTo can never be applied for in each period’s last five minutes.

The first of them is the study by Antúnez, Ureña, and Escudero (2001), which analyses the use of TTo in high level handball and concludes that it is usually requested in the match’s final minutes by the team that is losing. This same approach is found in Debanne and Fontayne’s study (2009), which focus on the case of a successful handball trainer by

observing how he organises the activity at this stage regarding six tasks: the control of the players' physical load, the management of collective duels, the management of individual duels, the referee's actuation, the players' level of commitment and the technical-tactical instructions given to the players. Valle, Antúnez, Sáez, García, and Cañadas (2012) carry out a study of 15 TTo in the Spanish handball League (ASOBAL) with the recent regulation and they conclude that the trainers do not use all TTo available and that they use it mostly when losing, in each period's last ten minutes and when a losing streak on the scoreboard occurs. These same conclusions are contributed by the last study on the use of TTo in handball published so far: the one by Gomes, Volossovitch, and Ferreira (2014), which analyses 2178 TTo in the ASOBAL League.

The aim of the present research is to find behaviour patterns in asking TTo (to know when and which team ask for TTo) and value the results of TTo related to structural changes and team substitutions.

2. Methods

The sample is formed by the 558 TTo applied for in the European Championship (EC) of 2012, held in Serbia (156), the World Championship (WC) of 2013 held in Spain (346) and the Olympic Games (OG) of London in 2012 (76).

During the European Championship of Serbia in 2012, the regulation allowed each trainer to apply for a TTo for each half. In the Olympic Games of London in 2012 and in the World Championship held in Spain in 2013, regulation in this regard changed so as to allow three TTo for match and team.

The difference of all the games analysed shown on the scoreboard was 5.64 ± 6.03 goals, and the most usual difference was of two goals.

The variables taken into account were: championship (EC,WC,OG), final result of the match (home team winner, visitor team winner and draw), final difference (number of goals), differences on the scoreboard when requesting TTo (Score in favour of the team which applies for time out, Draw, Score against the team which applies for time out), difference on the scoreboard five minutes before minute the TTo is requested (Score in favour of the team which applies for time out, Draw, Score against the team which applies for time out), modification of the defence system (occurrence or not occurrence), players' substitutions (occurrence or not occurrence), and finalization of the five attacks previous and subsequent to the moment the TTo is requested (action type and number of positive and negative actions).

The data were gathered through video observation. Positive and negative actions and their percentages before and after applying for a TTo were registered by two experts on handball who presented a very high rate of agreement (Cohen's kappa coefficient of 0,988).

For each TTo, results of the five previous attacks and of the five subsequent attacks of the team applying for the TTo have been analysed.

Tables of absolute frequencies, relative frequencies and bar charts are generated. The description of the variables is made through the average and the standard deviation.

The difference of goals five minutes before and at the moment of applying for the TTo is analysed with the Wilcoxon test –due to the lack of normality of the variables involved. In order to evaluate the level of association between the results in the moment of applying for the TTo and the players' substitutions or the changes of the defence system after the TTo, we use contingency tables. Contingency coefficient and the Cramer's V are obtained as measures of association.

To compare if positive and negative actions vary depending on players' substitutions or on the change in the defensive strategy, the Mann-Whitney test has been applied - due to the lack of normality of the variables involved.

Given that after the TTo we will not necessarily find five attacks -because of its proximity to the end of the first half or the end of the match- the number of positive actions and the number of negative actions has relativized (percentage). The comparison of the percentage of positive actions previous and subsequent to the TTo has been made by means of the sign test.

The level of significance has been established through $p < 0.005$ in all cases.

3. Results

The TTo temporal distribution can be observed in table 1 and Figure 1.

Table 1. Temporal distribution of the time out.

	Global		EC		WC		OG	
Time	n	%	n	%	n	%	N	%
0 to 5 minutes	4	0.69	1	0.64	3	0.87	0	0
5 a 10 minutes	19	3.29	4	2.56	13	3.76	2	2.63
10 to 15 minutes	36	6.23	8	5.13	24	6.94	4	5.26
15 to 20 minutes	48	8.30	11	7.05	28	8.09	9	11.84
20 to 25 minutes	84	14.53	22	14.10	51	14.74	11	14.47
25 to 30 minutes	86	14.88	41	26.28	37	10.69	8	10.53
30 to 35 minutes	9	1.56	1	0.64	7	2.02	1	1.32
35 to 40 minutes	24	4.15	5	3.21	18	5.20	1	1.32
40 to 45 minutes	48	8.30	2	1.28	35	10.12	11	14.47
45 to 50 minutes	46	7.96	8	5.13	32	9.25	6	7.89
50 to 55 minutes	68	11.76	12	7.69	47	13.58	9	11.84
55 to 60 minutes	106	18.34	41	26.28	51	14.74	14	18.42
Total	578	100	156	100	346	100	76	100

EC= European Championship; WC= World Championship; OG= Olympic Games

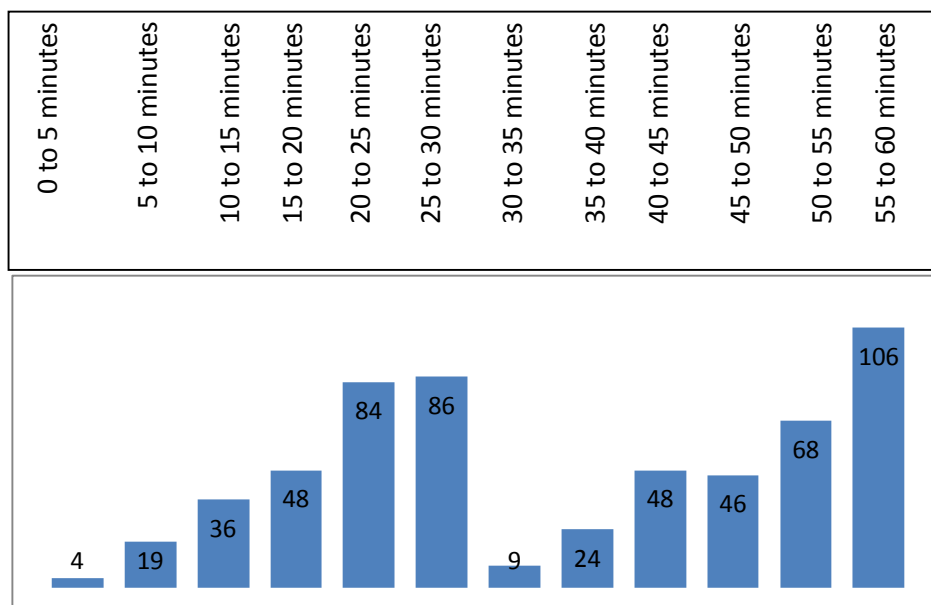


Figure 1. Temporal distribution of TTo.

It can be observed (Table 1) that most of the TTo are applied for within the last ten minutes of each period (29.4% at the end of the first half and 30.1% at the end of the second half). The teams which have the score against them usually ask for more TTo (53.7%) than the teams which have it in favour (Table 2).

Table 2. TTo applied for depending on the scoreboard at the moment of the application.

Value	Times out	
	N	%
Score in favour of the team which applies for time out	224	38.8
Draw	43	7.5
Score against the team which applies for time out	310	53.7
Total	577	100

The difference of scores five minutes before applying the TTo and at the moment of the application can be seen in Table 3.

Table 3. Difference of scores five minutes before applying for the TTo and at the moment of the application.

Value	Difference of scores			Sig. Wilcoxon
	Average	σ	Average range	
Difference of scores five minutes before applying for the TTo	3.79	4.18	236.49 ^a	0.002
Difference of score at the moment of applying for the TTo	4.02	4.12	212.83 ^b	

^a The difference of scores is smaller five minutes before applying for a time out

^b The difference of scores is biggest at the moment of applying for a time out

Substitutions of players during TTo (30.2%) and modification of the defence system (6.9%) after the request of TTo can be observed in Table 4.

Table 4. Substitutions of players and changes of defence after time out.

Value	Player's substitutions		Changes of defence	
	N	%	N	%
Yes	161	30.2	37	6.9
No	372	69.8	496	93.1
Total	533	100	533	100

In Table 5 it is seen that when the result is in favour of the team which demands a TTo, the trend is not to make players' substitutions. On the contrary, when the scoreboard is against the team which applies for a TTo, the number of substitutions is highest than expected.

Table 5. Association between the result at the moment of applying for a time out and the players' substitutions after a time out.

Contingency table			Players' substitutions		
			Yes	No	Total
Result:	In favour of the team which applies for a TTo	Count	47	164	211
		Expected count	63.9	147.1	211.0
		Standardized residual	-2.1	1.4	
	Draw	Count	12	28	40
		Expected frequency	12.1	27.9	40.0
		Standardized residual	.0	.0	
	Against the team which applies for a TTo	Count	102	179	281
		Expected count	85.0	196.0	281.0
		Standardized residual	1.8	-1.2	
	Total	Count	161	371	532
		Expected count	161.0	371.0	532.0
Measures of association		Value	Sig.		
Cramer's V		0.145	0.004		
Contingency coefficient		0.144	0.004		

When the same analysis between the result and the change of the defensive system is made, significant differences are not found ($p=0,435$ for the contingency coefficient and Cramer's V). The actions related to the five attacks previous and subsequent to the request of TTo are observed in Table 6.

Table 6. Description and comparison of attacks before and after applying for TTo.

		Results of the five attacks previous to the time out			Results of the five attacks subsequent to the time out			Comparison of percentages of positive actions before and after the TTo			
		N	%	% Actions	n	%	% Actions	After Before	–	N	Sig*
Positive actions	Goal	994	34.8	37.7	1030	42.0	46.8	Positive differences		186	0.000
	7 metres	83	2.9		120	4.9		Negative differences		302	
Negative actions	Failed launch	1045	36.6	62.3	826	33.6	53.2	Draws		83	
	Attack without launch	736	25.8		479	19.5					
Totals		2858	100	100	2455	100	100				

*Significance of the signs test

The number of positive actions is 9.1% times higher after the request of a TTo. In addition, the comparison between the percentage of positive actions before and after applying for TTo shows a significant difference ($Z=-5.205$; $p<0.001$).

The effect of TTo is not the same in all the championships analysed; notable differences were found in the OG ($Z=-2.233$; $p<0.027$) and in the WC ($Z=-5.009$; $p<0.001$), but not in the EC ($Z=-0.861$; $p>0.389$).

Positive effects of the TTo are found regardless of the local team winning ($Z=-3.382$; $p<0.002$) or losing ($Z=-0.861$; $p>0.389$).

In Table 7 it is observed that a change in the defensive system does not modify the difference of positive actions relevantly ($p=0.866$). Nonetheless, the improvement of performance is of nearly ten percentage points higher when after a TTo, players are substituted than it is when players are not substituted, and that difference is statistically meaningful ($p<0.016$).

Table 7. Comparison of the improvement of game actions according to the change of defence or the players' substitution after a TTo.

	Change of defence		Players' substitutions	
	Average $\pm\sigma$	Sig. Mann-Whitney	Average $\pm\sigma$	Sig. Mann-Whitney
Percentage difference of positive actions (after a TTo-before a TTo)	9.81 \pm 34.10	0.866	14.52 \pm 37.03	0.015

4. Discussion

The regulatory option of applying for a TTo gives the trainer a direct and unique tool to modify his team's performance tactically. That is why knowing how to use that tool and knowing the results obtained can help employ it more properly.

It is observed that the use of this period of time usually occurs in the final moments of each half, when the timeframe to make any sort of modification is shorter than at the middle of one of the halves and the trainer needs to make a change. This coincides with the studies of Kozar et al. (1993), Mechikoff, Kozar, Lord, Whitfield and Brandenburg (1990), Gomes et al. (2014), Sevim and Taborsky, (2004) and Valle et al. (2013). In the present research it can be seen how pronounced this trend was when regulation only allowed a TTo per half (until Serbia European Championship of 2012) which occurred in the last five minutes of each half 26, 28% of the entirety of TTo requested, with a really huge difference from the previous five minute period –more than 12 points in the first half and nearly 19 points in the second.

However, after the change of regulation enabled to apply for three TTo, it can be observed that the number of TTo requested in the last five minutes of each half decreases importantly. In the five minute period previous to the first half, that is, between minute 20 and minute 25, the percentage of TTo requested is maintained despite the regulatory change, but it is in the period between minute 50 and minute 55 that the number of TTo applied for clearly increases with respect to the system which allowed only a TTo per half and the last two periods of five minutes are equalised.

The analysis of the scoreboard evolution at the moment of applying for a TTo can explain the reasons why the trainers utilize them. Data show that the trainers mostly apply for a TTo when they have lower punctuation in the scoreboard (53.7 %), which shows the intention to have influence on the match's development by trying to break a dynamics which is being negative for them. This negative trend is shown on table 3, where it can be seen that the average of goals the teams have against them five minutes before applying for TTo is of 3,79 goals, while at the moment of applying for it, it is of 4,02 goals. This difference can be considered as decisive, for because of it, it is possible to recover the difference in the scoreboard before it is insurmountable. These results are in line with the studies by Ortega, Palao, Gómez, Ibáñez, Lorenzo, and Sampaio (2010), Valle et al. (2013) and Gomes et al. (2014), which also affirm that the use of TTo is done mainly by the teams which are losing and after a losing streak.

That would entail analysing the reasons why the trainers use TTo. Antúnez et al. (2001) and Saavedra et al. (2012) expose several probable causes, among which some tactical ones are found: breaking a positive sequence of actions of the opposite team, searching for a successful solution of an action at a particular moment of the match, make tactical modifications, etc.

It would only be possible to know verbal information given by trainers by recording those conversations for further analysis. This intervention goes beyond the aims of the present research, but there are objective signs which show the intention of modifying the team's tactical behaviour through structural changes. On the first hand, there is the modification of the game's system that was being used. In handball, attack systems are changed constantly, so it would be difficult to determine if a new conduct is the product of technical instructions or not. On the contrary, the use of defence systems is much steadier, with very few variations throughout the match. In this case, it can be clearly seen if the defensive game's system has been modified after the instructions received during TTo. Other objective signs can be players' substitutions. Although handball regulation allows

players' substitutions to be made at any moment and with no limitation, TTo is usually employed to readjust the occupation of the specific positions of those players who are not achieving the expected performance.

In order to analyse these questions, data of Table 4 were collected. It shows that the trainers mostly lean towards giving verbal instructions rather than making structural changes. That is to say, there is a greater trend to using players' substitutions (30.2%) than to modifying the defence game's system (6.9%). This may be due to the trainer's opposition to the idea that his initial tactical approach is failing, and that what must be changed are the players who are applying it inappropriately, thus maintaining his initial design.

Once analysed when and why TTo is used, it is necessary to know which its result is. In Table 5, the result of the five attacks previous and subsequent to the request of TTo is shown. It indicates if they have been positive actions (they end up in goal or in seven-metre throw) or negative actions (they end up in failed launch or in ball loss). A positive influence of the use of TTo can be observed, since after it the number of positive actions increases notably, with an augmentation of more than 9% and 46.8% of successful actions. This data are in the same line of previous research (Sampaio, Lago-Penas, & Gómez, 2013; Ortega et al., 2010; Valle et al., 2012). But although there seems to be a positive influence on performance immediately after the petition of TTo, there are studies which suggest that it does not affect the match's final result, for both teams have the same chance of using this strategy (Saavedra et al., 2012).

When the variation of efficiency is analysed independently according to the structural changes made, it is observed that the modification of the defensive game's system is less efficient than players' substitutions. This may suggest that tactical performance can be often determined by individual questions of diverse nature. Despite in some occasions it must be necessary to vary the game's system employed it is the players' substitutions in the same game's system that modifies the game's system favourably. This may be due to factors related to players' accumulated fatigue, to the influence of the match's development on the players or their previous interventions.

5. Conclusions

TTo is mostly used by teams which are losing or which have had a negative streak on the scoreboard. The ends of each of the two halves are the favourite moments to apply for time out. In spite of the percentage of positive actions being increased generically after the request of TTo, if it is related with the visible structural changes carried out, players' substitutions are more effective than defence system's changes.

Most of the TTo are applied for within the last ten minutes of each period. The losing teams usually ask for more TTo than the winning teams. The losing teams shows a negative increase in the difference of goals in the previous five minutes before asking for a TTo.

When the team asking for a TTo is losing, the trend is to make players' substitutions and defence changes. The number of team positive actions increases after the request of a TTo (in OG and WC, but not in EC). A change in the defensive system does not modify the difference of positive actions relevantly after asking for a TTo, but the effect is positive when players are substituted.

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