

The effects of a nonlinear pedagogy training program in the technical-tactical behaviour of youth futsal players

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Abstract

The aim of this study was to analyse the effect of an intervention program, based on nonlinear pedagogy, on the decision-making and execution of different actions in futsal. The intervention program consisted of 12 training sessions. A quasi-experimental study was developed with eight male futsal players ($M = 15.375$, $SD = 0.517$). The GPET instrument was used to analyse the decision-making and execution of 3442 actions measured during competitive matches (pass, dribbling and shooting). Both variables were analysed with regard to the three tactical principles of attack: keep the ball possession, progression towards the goal and shooting at goal with the lowest level of opposition. With respect to the pass, results showed significantly higher values in decision-making and execution in the first and second principles, but not in the third one. In the dribbling action, results showed significantly higher values in decision-making in the second and third principle, but not in the first one. However, no significant differences were found in the shooting actions. These findings suggest that coaches should take into account in the task design, the tactical principles of play to develop tactical behaviour of youth futsal players.

Keywords

Decision making, football, performance analysis, small-sided games

Introduction

In team sports, such as futsal, in which predominate open motor skills, it is required that players continuously co-adapt their actions to the movements of opponents and teammates to ensure a functional collective behaviour.¹ Thus, players need to be attuned to informational game constraints to decide what to do and how to do.² From the perspective of ecological dynamics, tactical behaviour is an active and continuous process of searching and exploration of relevant information to the game context for performance.³ Based on that, to improve players' tactical behaviour, it is required that the design of training tasks exposes players to game contexts that sample the perceptual-motor demands of competition.⁴

In the last few decades, new teaching-learning approaches such as nonlinear pedagogy (NLP) have emerged with the goal to promote a holistic approach through the use of small-sided and conditioned games (SSCGs), commonly used modified games with modified rules, that take place in tight spaces, and involving

small numbers of players.¹ From the NLP perspective, the teaching process should be focused on the manipulation of relevant task constraints that simplify game situations and highlight the informational constraints that support and guide players towards the task goals.^{5,6} In line with ecological dynamics NLP approaches, the manipulation of task constraints (e.g. task goals, number and dimension of goals, number of

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players involved, level of opposition, playing area dimensions, duration, and rules of the conditioned game) is particularly relevant since they change the way players explore and act on the game context.⁶

The use of SSCG allows coaches to optimize the training sessions due to the fact that the components of behaviour, i.e. technical-tactical actions and physical demands, are developed continuously to reach task goals.^{7,8} In this regard, a previous research on futsal revealed that the use of SSCG allows to improve tactical behaviour of players after an intervention program based on NLP.⁹ Previous studies clearly revealed how the modifications of task constraints (e.g. goal size or goal number and field space, number of touches, balance on the number of outfield players, field corridors or sectors) can change players behaviour.^{4,10-12}

Interestingly, one of the task constraints that have been studied recently is the manipulation of task aim, specifically the accomplishment of tactical principles of attack to perform.⁸ These are refereed as to keep the ball possession, to progress towards the goal or to shoot at goal with the lowest level of opposition.¹³ Thus, to design training sessions based on these principles allows players to develop the decision-making and the execution in each context, in which the tactical intention changes. The establishment of these principles allows players to share knowledge about the functional collective way to explore the game.¹⁴ This idea was reinforced by Gutiérrez et al.¹⁵ and by the recent study of Práxedes et al.,¹⁶ revealing that the definition of tactical principles as a goal improved significantly the successful passing actions.

From this perspective, in order to promote a common focus on the exploration of game informational constraints and collective functional behaviours, the instructional strategies are also considered a useful task constraint.¹⁷ This technique consists in asking the players about their actions and especially about the conditions of environment to amplify the sources of information that guide them towards the task objectives. According to Newel and Ranganathan,¹⁷ it promotes motor learning based on the exploration and searching of the contextual information, that supports individual and collective tactical behaviour. Previous studies revealed favourable results on the use of this technique to improve the tactical behaviour of players.¹⁸

However, to our best knowledge, in futsal, and more specifically, in the learning process of the game, there are no research in which interventions had been carried out based on the NLP principles: (1) sampling, based on the games selection that have similar goals with the objective to offer a variety of experiences; (2) tactical complexity, that permits to adapt the task complexity to the level of the players; (3) representation, based on

the design of games with the same tactical structure of the adult game and (4) exaggeration, that permits to exaggerate the tactical idea through the manipulation of the task constraints, although these games should maintain the primary rules of the full game.¹⁹

Moreover, it has not been found the joint application of the task design based on the tactical principles of attack and the use of questioning. Therefore, the main objective of this study was to analyse the effect of an intervention program, based on NLP (task design based on tactical principles of attack and the use of questioning), on the decision-making and execution of passing, dribbling and shooting in youth futsal. It was expected that the intervention program allows improvements on tactical behaviour of players in all actions analysed. Due to the fact that the task design and the questioning were based on tactical principles of attack, it was not expected to observe relevant improvements at the level of execution for all the actions in analysis.

Method

Participants

The participants were eight male futsal players from the under-16 category (age, $M = 15.375$ and $SD = 0.517$; sport expertise in football, $M = 2.375$, $SD = 3.113$; sport expertise in futsal, $M = 4.875$, $SD = 3.313$) of a team from a Spanish club (natural group not modified for research). All the participants had an average skill-level of sport expertise and participate in a regional league. The research has been developed under the recommendations of the Declaration of Helsinki. The participants and their parents were informed of the study. As the participants were under age, the parents signed an informed consent. The research project was fully approved by the Ethics Research Committee of the University of Extremadura (Spain).

Design and procedure

An intra-group quasi-experimental design was carried out. Two research phases were considered in this study.

Pre-intervention phase: to establish the initial level prior to the intervention, the different values of the game action (decision-making and execution) were recorded in the three matches corresponding to three league games, like previous studies.²⁰ This phase was carried out in three consecutive weeks (March, 2017).

Intervention phase: in this phase, the intervention program was applied, based on NLP principles. This phase comprised 12 training sessions (six weeks). At the same time, the six matches corresponding to the regular league were recorded and registered to analyse decision-making and execution (March–May, 2017).

Intervention procedure

In preparation for the intervention, several meetings were conducted between the coach and the main research with the following goals: (a) discussion of NLP approach; (b) definition of discussion practice task contents; (c) design of tasks based on the principles of NLP; (d) test of the tasks designed in a football team of the same age category as the participants of the present study.^{21,22} It is important to emphasize that coach and players did not have previous experience in the work with this methodology.

Table 1 shows the objectives and contents developed on the training sessions during the intervention phase, specified by session.

The intervention program was based on the use and manipulation of SSCG. Specifically, the task goal of each SSCG was modified, being each task referred to a tactical principle of play:¹³ (i) to keep the ball possession without the objective of progression towards the goal (p.e. What movements allow you to receive the ball with less defensive pressure?); (ii) to progress towards the goal beating a defence line and to be near from the opposite goal (p.e. Where do you have more facility to overcome the rival pressure: by the center or by the bands?); and (iii) to shoot at goal with the lowest level of opposition (p.e. Should the attackers finish quickly or retain possession in a situation of numerical superiority?). In addition, the questioning was used as additional task constraint. The coach asked the players about their actions and especially about the conditions of environment in order to amplify the sources of information that guide them towards the task objectives. The questioning was

applied after the seven first minutes of each task. In this sense, the coach asked the question and the players played on again, without a conversation between them.

Two weekly sessions were developed. In each training session, four learning tasks each lasting a total of 15 min, were carried out. There was not a warm-up. The intensity of the task was increasing. Between tasks, there is not an active recovery. Table 2 presents an example of a task, with the focus in the second and third principles.

Dependent variables

The dependent variables considered for analysis were decision-making and execution of player's behaviour. Decision-making was measured as the percentage of successful decisions over the total number of decisions made.²³ Execution was measured by the percentage of successful execution over the total number of executions made.²³

Instrument

To assess the decision-making and execution of players, the GPET observation instrument (Game Performance Evaluation Tool) was used, assigning value 1 to appropriate decisions/executions and 0 to inappropriate decisions/executions.²⁴ This assessment tool was used because of several reasons: the age of our sample (U16), futsal is an invasion sport (like soccer, basketball...) and it allows to evaluate based on offensive game principles. This instrument, which was designed by García-López et al. in Spain, evaluates the player's tactical problem-solving skills and considers both measurements (decision-making and execution) in competitive game situations, as recommended by Travassos et al.²⁵ In addition, the GPET has been proven to be a reliable tool for game-performance assessments ($\alpha = .97$).²⁴ Successful decisions were considered analysing the context in which players performed, related to each principle of play: keep the ball possession, progress towards the goal and shoot at goal with the lowest level of opposition.⁸

To evaluate decision-making and execution, all the actions (pass, dribbling and shooting) that each player executed were recorded. All the matches, which followed an official competition format (two parts of 20' at a stopped clock), were recorded using a Sony HDRXR155 camera, from a fixed position, using a Hama Gamma Series. The camera was always placed in the background of the playing field, at a height of 4m, guaranteeing an optimal view of all the game actions.

To calculate the percentage of successful decisions and executions for each participant, the total number

Table 1. Scheme of work used in the study in the intervention phase.

Session number	Session objectives and main contents
1	Introduction to SSCG and questioning.
2	Pass and interception. Attack superiority numerical. Formation: 3-1 (center).
3	Pass and interception. Output pressure – pressure. Introduction to 4 × 3.
4	Pass and interception. Goalkeeper – field player: pressure and attack.
5	Unmarking – Ball possession. Formation: 4-0.
6	Unmarking – Progression: dribbling and 1 × 1. Formations 4-0 and 3-1.
7	Unmarking – Finalization: shots. Transitions: attack-defence.
8, 9, 10	Counterattack and retreat. Finalization: shots.
11, 12	Offensive and defensive tactics.

Table 2. Example of learning task of a training session based on NLP principles.

TP	Objectives	Explanation	Graphic
<p>Progress towards the goal and shoot with the lowest level of opposition</p>	<p>Attack Overcome the first opposite pressure line. Successfully finish the attack in superiority.</p>	<p>4 vs. 2 + 2: Pressure output of 4 players (Figure 1), who must make a minimum of 5 passes before moving to the opposite half field. The central line must be passed in controlled dribbling or by connecting through a pass (Figure 2), with a player located in the central zone. After that, a 3 × 2 is made.</p>	
<p>Defence</p>	<p>Avoid the output of rival ball. Temporize and successfully manage defenses in inferiority.</p>	<p>Defence</p>	
<p>Questioning</p>	<p>Attack: Where do you have more facility to overcome the rival pressure: by the center or by the bands? What situation do we seek to strengthen with the placement of a central zone where the player receives and turns to attack? Defence: Do you try to avoid the pass to the center player or try to avoid progression by dribbling? In which area of the field do you consider is more dangerous to receive for the opponent?</p>	<p>Attack: Where do you have more facility to overcome the rival pressure: by the center or by the bands? What situation do we seek to strengthen with the placement of a central zone where the player receives and turns to attack? Defence: Do you try to avoid the pass to the center player or try to avoid progression by dribbling? In which area of the field do you consider is more dangerous to receive for the opponent?</p>	

TP: tactical principle.

of these decisions and executions was divided by the sum of the number of the total of decisions and executions and multiplied by 100.²⁶

Reliability

With respect to the inter-observer reliability, an observer was trained to analyse decision-making and the execution of the three actions. He was trained by a soccer expert (Level 1 by the Spanish Soccer Federation), who also had four years' experience in observational methodology. As a preliminary step to the observations, the expert met with the observer to clarify possible doubts about the observation instrument and the coding criteria of each dependent variable (decision-making and execution) on the three actions. Subsequently, the observations were carried out using a sample higher than 10% of the total.²⁷ Inter-observer reliability was estimated using the following formula: $\text{agreements} / (\text{agreements} + \text{disagreements}) \times 100$ measure. Once this value was calculated, the Cohen kappa index was used. Values above .90 were obtained for all training sessions, surpassing the value of .81 from which adequate concordance is considered.²⁸ The data "therefore" achieved the necessary reliability for subsequent coding of dependent variables. For the analysis of the temporal reliability of the measurement, the same coding was developed at two different moments, with a time difference of 10 days. Cohen kappa values were found to be higher than .92.

Data analysis

The statistical software SPSS v21.0 (Chicago, IL) was used for data analysis and processing. Data normality was examined and confirmed by the Shapiro–Wilk test, which led to the use of parametric statistics. Descriptive statistics were calculated, obtaining the mean (M) and the standard deviation (SD) for all variables and to examine the possible differences between the two phases considered in the study, pre-intervention and intervention, a MANOVA (multivariate analysis of variance) of repeated measurements of a single group was carried out. Effect sizes were calculated using the partial eta-squared statistic (η^2). The level of statistical significance was established at $p \leq .05$, with a confidence interval for differences set at 95%

Results

A total of 3442 actions were observed. With respect to the pass action, players developed 2234 in total (1123 in the first tactical principle, 882 in the second one and 229 in the third one). With respect to the dribbling action, there were 990 in total (371 in the first tactical principle,

472 in the second one and 147 in the third one). And with respect to the shooting actions, players developed 218 shoots at goal.

The pairwise comparisons between the two phases of the study regarding the action and the tactical principle are presented in Table 3.

The analysis of passing actions revealed significantly higher values for the intervention phase in comparison with the pre-intervention phase for execution. Similarly, higher values for the intervention phase in comparison with the pre-intervention phase were observed for decision-making in the first and second principles (keep the ball possession and progression towards the goal). The analysis of third principle (shooting at with the lowest level of opposition) did not reveal any difference between pre-intervention and intervention phase.

The analysis of dribbling actions revealed no significant differences for execution but revealed significant differences for decision-making. Higher values for the intervention phase in comparison with the pre-intervention phase were observed for the second and third principles (progression towards the goal and shoot at goal). The analysis of shooting actions revealed no significant differences for execution nor decision-making.

Discussion

The main objective of this study was to analyse the effect of an intervention program, based on NLP (task design based on tactical principles of attack and the use of questioning), on the decision-making and execution in youth futsal. Moreover, both variables, in the pass, dribbling and shooting actions, were analysed regarding the tactical principles of attack.

In terms of passing actions, the results revealed significant differences after the intervention program for both decision-making and execution in first and second principles. However, such differences were not found in the third principle. Generally, these results indicate that the intervention program has been effective in improving decision-making and execution in the passing action. In relation to the dribbling actions, the results revealed significant differences in decision-making in second and third principles. In contrast, the results did not show significant differences in the first principle for this variable. The analysis of execution for dribbling actions revealed no significant differences for the three tactical principles of attack. And, finally, in relation to the shooting actions, the results revealed no significant differences after the intervention program in any of the variables studied.

In this sense and within the NLP perspective, SSCG and questioning seem to be effective methodological

Table 3. Descriptive statistics and pairwise comparisons of decision-making and execution skills, regarding the three actions and the three tactical principles, between the different measures.

	TP	Var.	Pre (I)		Int (J)		<i>p</i>	η_p^2	Differences 95% CI	
			M	SD	M	SD				
Passing	1	DM	.938	.033	.994	.006	.001	.792	-.082	-.031
		Ex	.934	.036	.984	.012	.003	.735	-.076	-.023
	2	DM	.765	.132	.900	.026	.018	.577	-.242	-.032
		Ex	.609	.116	.738	.097	.017	.582	-.227	-.031
	3	DM	.843	.124	.963	.047	.068	.400	-.251	.011
		Ex	.682	.189	.657	.238	.751	.015	-.152	.202
Dribbling	1	DM	.883	.130	.982	.027	.072	.391	-.208	.011
		Ex	.892	.138	.910	.091	.789	.011	-.171	.135
	2	DM	.737	.186	.848	.119	.042	.469	-.216	-.005
		Ex	.747	.183	.818	.081	.269	.171	-.210	.068
	3	DM	.667	.192	.951	.056	.002	.754	-.430	-.139
		Ex	.671	.178	.853	.120	.074	.386	-.386	.023
Shooting	3	DM	.671	.187	.891	.126	.069	.396	-.464	.023
		Ex	.379	.368	.361	.115	.886	.003	-.262	.297

TP: tactical principle; I: 1st principle (keep the ball possession); 2: 2nd principle (progression towards the goal); 3: 3rd principle (shooting with the lowest level of opposition); Var: variable; M: mean; SD: standard deviation; DM: Decision-making; Ex: Execution; Pre: pre-intervention phase; Int: intervention phase; CI: confidence interval; LL: lower limit; UL: upper limit.

tools to optimize the tactical behaviour of youth futsal players with an average skill-level of sport expertise.^{29,30} In addition, the manipulation of limitations by the coach is a powerful aspect of non-linear pedagogy to encourage transitions and acquisition of new preferred stable movements behaviors in a learning system.³¹ In line with previous studies, it becomes clear that this approach allows players to be more attuned to the most relevant information from game environment and to adjust their behaviour to tactical principles of play proposed.^{14,29,30} The combination between variability on game context through SSCG with the questioning focused on spatial-temporal relations between players and on tactical principles, has had a decisive influence on the results obtained for decision-making.^{18,32} In line with the above, questioning can be considered as a tool that guides players to explore and discover new individual and collective functional tactical solutions for play.³³

However, different results were observed for decision-making and execution of the actions in analysis. With regard to passing actions, the results indicate that the proposed program has been effective in improving decision-making and execution in the passing actions. Considering that the learning tasks promoted numerical superiority of attack to maintain ball possession and progress on the field, our results are in line with previous studies.^{4,11} The numerical unbalance in the

defense increases the number of passing possibilities of attacking team to maintain ball possession or to progress on the field due to the increase on the distances between attacking and defending players. It is a good strategy to highlight passing lines and to guide players to explore information that sustain their passing decisions and actions.

A possible justification to the results found may be that in the modified games with numerical superiority in attack, form in which third principle exercises of the program were focused, there may be in all the plays a player free of individual mark and/or less pressure of rival defenders. All of this can lead to the player having the ball having more time to decide the best option and can execute it better as the distance between the attacker and the direct defender is greater. The less defensive pressure exists, and hence the higher the probability of performing successfully.⁴ A possible explanation to not observe differences in the third principle of passing actions can be related with the lower space that exists. When in numerical unbalance in the defence, previous results revealed that defending team retreat is position on the field and decreases the space occupied creating a situation of defensive pressure much greater than the one exposed in the two contexts defined above to avoid rupture passes or shoots at goal.¹⁰ Thus, with the retreat of defending team, attacking team loses space to explore successful rupture passing actions.

The results of dribbling actions revealed significant differences in decision-making in second and third principles and no differences for the first principle. The inexistence of differences on the first principle can be related with the notion of dangerousness and with the space available for play at the first moment of attack. Headrick et al.³⁴ revealed that proximity-to-goal influences the attacking–defending interactions, particularly when attacking. In line with our results, it seems that attackers at the first moment of play, due to the identification of a free space to pass the ball to the free attacking player, preferred to pass the ball than to dribble the defending player. Thus, it seems that using unbalanced relations between teams promoted more passing actions than dribbling action on the first moment of play. Such results need to be considered on the design of practice tasks in the future, to accomplish with the proposed tactical principles of the practice tasks. The improvements on decision-making for second and third principles can be justified by the lower level of dangerous in relation of a losing of ball by the attacker,³⁴ and also due to the possible retreat on the field by defending team with the correspondent restriction of space to ensure secure passing lines.

With regard to the execution of dribbling actions, no significant differences were found in any of the three tactical principles of attack. Similar results were observed in a previous study.³⁵ These results may be due to the fact that the players, in the formative stages, have more limitations in some technical-tactical actions, as in the case of the dribbling actions.³⁶ It indicates that, with very youth players, programs based only in SSCG and questioning do not allow the development with the same magnitude of some technical skills such as dribbling in comparison with passing.³⁷ Indeed, Vera et al.³⁸ have pointed out that the execution component for the dribbling action is more complex than the decision component, due the fact that the management of the ball requires high levels of coordination and good relation with the ball. Thus, actions that require high levels of coordination and management of spatial-temporal relations with opponents, such as the dribbling, there is a need to improve such actions in more controlled game environments, with lower level of variability. Thus, to develop dribbling actions more effectively in futsal, during the first stages of learning, a complementary practice focused on the management of space with direct opponent and improving the relation with the ball, to guarantee the prevalence of the execution of this skill, should be ensured.

Finally, in relation to the shooting actions, the results revealed no significant differences after the intervention program not for decision-making or for execution. Previous results revealed that the use of numerical unbalance in the defence increases the number of

shooting possibilities of attacking team.¹¹ Accordingly, the shooting actions observed during the sessions are the least numerous. However, as previously advocated, due to the retreat of defence on the field and the decrease on the available space for shooting, it was not possible that players with the capabilities of the observed players improved their decision and execution to improve their performance. Perhaps, different SSCG should be created that improved the misalignment between attacking and defending players in order to highlight the shooting lines of the goal.³⁹ Also, due to the level of players (average skill-level of sport expertise), we can hypothesise that a longer intervention program is needed to improve shooting actions. It is necessary to note that previous studies revealed that to ensure a significant improvement in decision-making and execution, an intervention learning program of 12 sessions is required.⁴⁰

Conclusions and practical implications

The study carried out represents a significant contribution to improve the understanding of the effect of an integral training program in decision-making and execution of futsal actions. Clearly, in line with NLP, the joint application of the SSCG and the questioning is a good pedagogical strategy to improve technical-tactical skills in futsal.

Summarizing, SSCG based on the manipulation of the games principles promotes adaptive behaviours of young futsal players with an average skill-level, similar to competition. In this study, players improved decision-making and execution of the pass action in the first and second principles. However, they only improved the decision-making of dribbling action in the second and third principles. This study has clear implications for practice as it emphasizes that modifying game principles on SSGs can help to improve a specific action. For example, the manipulation of the first principle seems to be ineffective in improving the dribbling action, which indicates that, if we want to achieve an effective training, this action should be treated in tasks focused since a more appropriate game principle. With regard to the shot actions, it seems necessary to train a long-term in order to obtain any significant improvement.

On the other hand, in line with NLP, the feedback should be focused on questioning and on the identification of possibilities for action more than on the prescription of game solutions. Also, the use of questioning could be considered as an effective tool to improve the decision-making since it guides players to explore new solutions for the play. In addition, considering our results, it seems advisable to use it in the middle part of the task, after an initial practice, thus

allowing the player to reorient his performance during the game.

However, due to the use of a small sample, the short duration of the program and the lack of control group, the results should be interpreted as exploratory. Further studies should be developed with higher number of participants and with teams of different age categories and levels of expertise to improve the understanding of the SSCG and questioning in decision-making and execution in futsal. The intervention has been carried out in natural context, where some contextual variables are difficult to control (e.g. quality of opposition). While the teams belonging to the same league may be of similar performance, in turn there are always stronger and weaker teams. And it is clear that the players' behaviors are affected by the contextual variables. Thus, it can be considered as a limitation. Future research in this line is necessary to establish to provide scientific knowledge and help coaches to improve their intervention programs and better control the learning process of players.

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