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APRENDIZAJE POR ANALOGÍA EN JUGADORES JÓVENES DE BALONCESTO

Efecto en las acciones motrices individuales y colectivas

Learning by analogy in young basketball players
Effect on individual and collective motor actions

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KEYWORDS

Teaching strategy
Analogy
Mental workload
Performance
Basketball

ABSTRACT

Learning by analogy offers numerous advantages to the basketball player, grouping a variety of information in a single rule. The objective is to analyze if learning by analogy produces an effect on performance and motor actions. Eighteen players participated. Four experimental conditions were designed with temporal and motor limitations and a combination of both. The variables related to space, collective and individual play are influenced by environmental conditions. Learning by analogy places a lower load on working memory resources, due to the reduction in the volume of verbal information processed.

PALABRAS CLAVE

Estrategia de enseñanza
Analogía
Carga mental de trabajo
Rendimiento
Baloncesto

RESUMEN

El aprendizaje por analogía ofrece numerosas ventajas al jugador de baloncesto, agrupando variedad de información en una única regla. El objetivo es analizar si el aprendizaje por analogía produce un efecto en el rendimiento y las acciones motrices. Participaron 18 jugadores. Se diseñaron 4 condiciones experimentales con limitación temporal, motriz y combinación de ambas. Las variables relacionadas con el espacio, el juego colectivo e individual están influenciadas por los condicionantes ambientales. El aprendizaje por analogía supone una carga menor para los recursos de la memoria de trabajo, debido a la reducción del volumen de información verbal procesada.

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1. Introduction

There are many studies that have tried to explain the causes that lead to impaired performance under pressure in the sport context (Gil, 2013; Chow et al., 2015; Conte et al., 2015; Crisp, 2018), with two main attentional models being proposed: (1) the distraction theory, which states that pressure causes a shift of attention to irrelevant cues, creating this a dual-task environment that consumes and limits the capacity of working memory so important for effective performance and (2) the explicit control or self-focus theory, which states that pressure causes the subject to increase their self-awareness about how to correctly perform the movement sequence, direct attention towards its control, alter its automatic nature and as a consequence disrupt their performance (Bray et al. , 2012; Camacho & Calvo, 2018). This theory is consistent with the progression-regression hypothesis in the acquisition of perceptual-motor skills, which postulates that performing under stressful conditions may favor a regression to the early stages of skill acquisition, characterized by reliance on verbal cues and explicit knowledge (Abrantes et al., 2012; Cárdenas et al., 2015; Clemente, 2016; Conte et al., 2016; Gonçalves et al., 2017; Grand et al., 2017; Camacho et al., 2020).

In basketball, players must select relevant information to conveniently decide among several options. Moreover, these decisions are generally linked to situations of high pressure, little time and available information (Delextrat & Martinez, 2014; Clemente et al., 2016; Conte et al., 2016; Lima et al., 2020). These are situations where it is not possible to make a conscious selection of all the information, as well as of the possible solutions. The choice of the latter may in many cases mean success or failure (Bennis & Pachur, 2006; Lopes, 2012; Macnamara, 2015).

Because deliberate strategies need consecutive processing and focusing attention to particular information, and because their main limitation is that the subject's short-term memory capacity is limited, the amount of information that can be handled by this type of processing is low (Perreault et al., 2015; Rienhof et al., 2015). Internal chaos would occur if the subject were aware at all times of all the information in his environment, due to his inability to act and difficulty in responding to external and internal stimulation (Núñez, 1998). However, it seems that in incidental or automatic processing information is treated in parallel, considering multiple information simultaneously (Buszard et al., 2013; López-Herrero & Arias-Estero, 2019), with the enormous advantages that this may entail in an environment where players must constantly and simultaneously execute motor actions while making decisions.

In response to these cognitive limitations, the subject has developed different strategies that favor the use of important adaptive functions, thereby allowing inferences and predictions to be made with surprising accuracy (Pereles et al., 2011; Raab & Laborde, 2011; Roca et al., 2013; Moreira et al., 2018; Sanabria & Oliveros, 2019; Torreblanca-Martínez et al., 2019). These strategies or rules of thumb are shortcuts that avoid processing irrelevant information and focus our attention on what really matters, thereby favoring fast and efficient decision making. This improved adaptation to the structure of the environment in which we develop makes us ecologically rational subjects (Gigerenzer & Todd, 1999).

This incidental processing is the product of automatic associative processes that operate independently of cognitive load, associating only those elements that are held simultaneously in working memory. Input to this processing is provided primarily by knowledge stored in long-term memory, acquired mainly via associative learning. The input is processed automatically, without conscious awareness (Betch, 2008; Headrick et al., 2012; Schlapkohl et al., 2012; Suarez Cadenas et al., 2015; Sansone et al., 2019).

In order to overcome the limitations of rational, explicit or intentional processes, and to take advantage of the advantages of the indicental processing discussed above, learning by analogy emerges as an alternative strategy, aiming thereby to reduce the amount of information that is consciously processed, this time by administering a single explicit instruction in the form of a metaphor or unit of information, thereby encompassing several rules in one and omitting the declarative stage of learning, associated with the preparation, control and correction of the movement.

Some studies have tried to test the effectiveness of this type of teaching strategy in basketball, concluding that reducing the amount of information provided to players reduces the possibility of performance degradation (Craig, & Watson, 2011; Glockner et al., 2012; Duarte et al., 2013; Conte et al., 2016; Clemente el al., 2016; Gamero Portillo et al., 2019; Reina et al., 2019; Lima et al., 2020).

But for the most part, these studies have been conducted under the design of high-control and decontextualized environments, far from the reality of the game, where important elements of the competition, such as teammates or defenders, were eliminated in the tasks (Correia et al., 2012; Chow, 2013 ; Schücker et al., 2013; Lohse et al., 2014; Perreault & French, 2015).

Our study aims to contribute to the study of the use of this type of strategies in specific environments of the game of basketball, in order to increase the generalizability of the results and conclusions of our study.

2. Objectives

The aim of our study is to analyze the effect of using the analogy teaching strategy for learning individual and collective basketball attacking game concepts in the motor actions of young players of different ages under stress or time-limit conditions.

3. Metodology

3.1. Participants

Eighteen basketball players corresponding to 3 male teams of different ages from a professional basketball Club (infantile, cadet and junior), aged between fourteen and eighteen years old (team 1: 6 players, 14.54 years, s = 0.75; team 2: 6 players, 15.72 years, s = 0.54; team 3: 6 players, 16.48 years, s = 0.89) voluntarily participated in this study.

All players were informed of the experimental objectives and conditions, and signed an informed consent prior to the study. Players were randomly distributed within each group in order to obtain homogeneity among all players. Teams faced only teams of the same level.

3.2. Design

A total of four experimental conditions (CE1, CE2, CE3 and CE4) were performed. In all of them, a full-court basketball game of three attacking players against three defending players (3v3) was performed. The rules of the conditions were as follows: CE1, normal play; CE2, limitation of 7 seconds per possession; CE3, 3 passes maximum per possession; and CE4, combination of conditions 2 and 3 (maximum 7 seconds and 3 passes per possession). An intrasubject design with repeated measures pretest and posttest was developed for these situations.

The 3 groups performed the 4 experimental conditions, which were counterbalanced to avoid the order effect. A total of 2 sessions were carried out. In both, the groups performed the 4 experimental conditions. The sessions consisted of 5 minutes of play for each condition.

The participants, in addition to being given the rules corresponding to each experimental condition, were given a single rule corresponding to the collective attacking game, which was as follows: “you can only pass to the unmarked player”. If this rule was not complied with in any situation, possession would automatically pass to the other team (contingency control procedure through the application of an aversive stimulus, in this case the withdrawal of a positive stimulus: possession of the ball), in order to encourage the reduction or extinction of the erroneous behavior performed.

3.3. Variables and instruments

To determine the motor actions of the players, these were grouped into 3 large blocks: (1) variables related to collective play: number of attack phase, duration of attack phase, number of passes in possession; (2) variables related to individual play: obtaining possession, completion of possession and duration of possession; and (3) variables related to space: ball recovery and first pass.

3.4. Statistical analysis

In order to evaluate and analyze the players’ motor actions, a descriptive study of the variables that significantly affect the players’ motor behavior was initially carried out. Taking the experimental condition as a factor, and through a one-factor ANOVA comparison of means, contrasts were made with each of the variables involved in the players’ performance.

4. Results

The study of the motor variables is considered according to the category of the player and the experimental condition developed. The second and following paragraphs should have a first line indentation of 0.5.

The following tables show the contrasts of the set of variables that form part of the motor variables and have been found to be significant in the contrast carried out. They show which variables are significant when comparing means for one or two factors. The main level of significance is 0.05, although in some contrasts 0.1 has been used, since it has been considered appropriate to highlight these variables, considering the results obtained to be significant as well.

4.1. Variables related to collective play

The results of the descriptive analysis show that, in general, the mean for the type of attack variable does not exceed 1.6. Therefore, we can affirm that the type of attack with the highest mean is obtained in the cadet category when performing experimental condition 3.

When studying the two-factor ANOVA table we obtain five columns of data: type III sum of squares, gl degrees of freedom, mean square, the value of the F-Snedecor statistic and the associated p-value. We should pay attention to the last column, since it confirms whether the contrast is significant or not.

The rows that refer to the contrast are the third, fourth and fifth. In them we can see that for the three contrasts the p-value obtained is less than 0.05, so the crosses are significant (Table 1).

Table 1. Two-factor ANOVA test Type of attack

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	23,532	11	2,139	11,910	,000
Interception	1464,632	1	1464,632	8153,921	,000
CATEGO	1,154	2	,577	3,213	,041
COND_EXP	18,598	3	6,199	34,513	,000
CATEGO * COND_EXP	3,138	6	,523	2,911	,008
Mistake	156,631	872	,180		
Total	1640,000	884			
Total corrected	180,163	883			

Source: Own elaboration.

There are differences when measuring the variable type of attack in each of the categories (0’041). Similarly, this variable shows significant differences when measured under the different experimental conditions (0.000). The contrast that interests us is the crossing of the three, observing that there are significant differences (0’008), so we can affirm that the type of attack in the infantile category for experimental condition 1 is not the same for the cadet category in experimental condition 2, and likewise the type of attack recorded in the junior category is significantly different than in the infantile category when performing test 4.

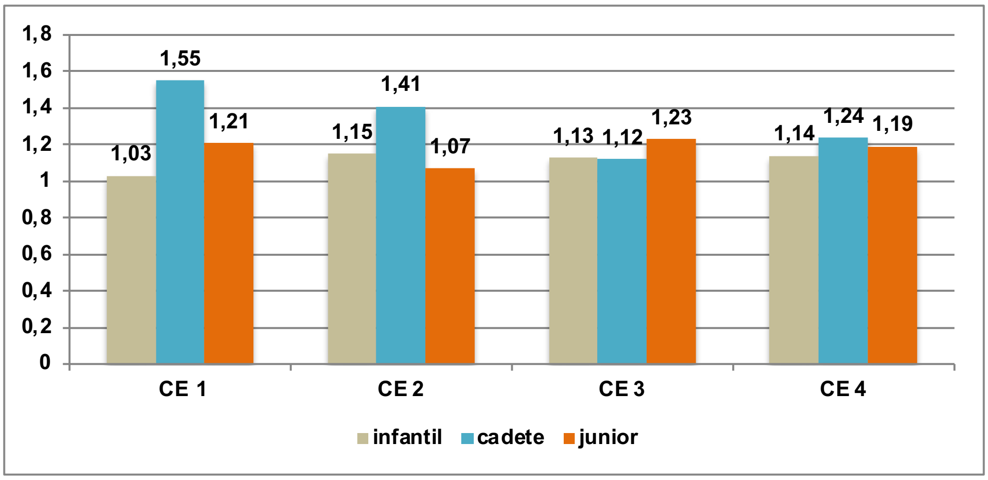
4.2. Variables related to individual play

Shooting to the basket

In the following analysis, the number of throws made by each player is measured, distinguishing the categories and the experimental test.

The first thing we show is the graph of the averages, showing how the results are distributed on average in each of the categories and for the four experimental tests (Figure 1).

Figure 1. Basket throwing averages



Source: Own elaboration.

When studying the variables separately, two by two, we observe that the crossover of category with throwing is significant (0.000), but that of throwing with the experimental condition is not (0.115).

The players register on average the same number of throws in the four experimental conditions, unlike when we distinguish the throws made by the infantile, cadet or junior categories (Table 2).

Table 2. Calculation of the two-factor ANOVA of shots at the basket

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	16,628	11	1,512	7,890	,000
Interception	1204,985	1	1204,985	6289,129	,000
CATEGO	7,116	2	3,558	18,570	,000
COND_EXP	1,139	3	,380	1,982	,115
CATEGO * COND_EXP	7,673	6	1,279	6,674	,000
Mistake	158,452	827	,192		
Total	1403,000	839			
Total corrected	175,080	838			

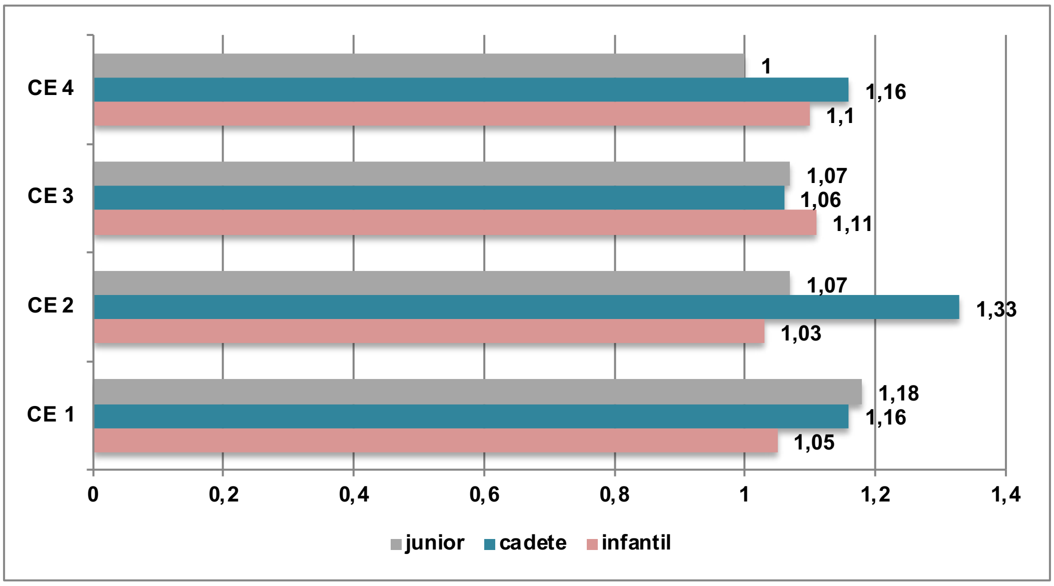
Source: Own elaboration.

Performance

In the same way, we propose the crossing of both factors with the performance variable. This variable measures, as its name indicates, the performance of the players in the different tests, making a distinction by age.

In the descriptive analysis, the mean obtained in each of the crosses is low, with the highest value in the cadet category in experimental condition two (1.33). There are differences in the means when measuring the performance variable, with a greater difference in experimental condition 2, so we suspect that these differences are significant (Figure 2).

Figure 2. Performance Averages



Source: Own elaboration.

The one-factor ANOVA test shows that the performance according to categories is significant (0.018). The infantile category shows a different performance than the cadet and junior categories (Table 3).

Table 3: ANOVA Performance Test

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	2,399	11	,218	2,141	,017
Interception	412,956	1	412,956	4053,496	,000
CATEGO	,831	2	,415	4,077	,018
COND_EXP	,283	3	,094	,925	,429
CATEGO * COND_EXP	1,437	6	,240	2,352	,031
Mistake	34,231	336	,102		
Total	467,000	348			
Total corrected	36,629	347			

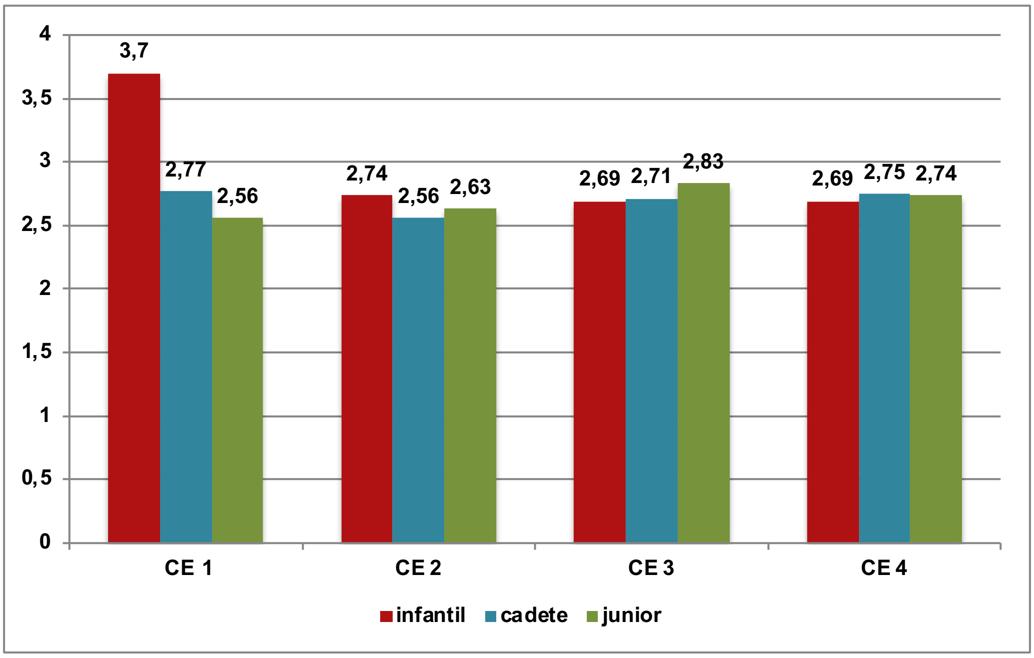
Source: Own elaboration.

4.3. Space-related variables

This variable measures the ball recoveries made by the players throughout the duration of the test. It is studied whether significant differences are registered or not when crossed with the experimental condition and player category factors.

The descriptive analysis clearly shows the difference between the mean of condition 1 in the children's category with respect to the rest (Figure 3).

Figure 3. Space averages



Source: Own elaboration.

In the ANOVA table that has been created from the contrast it can be seen that the crossing of the variable under study and the two factors is significant (0.00), so the null hypothesis is rejected and it is concluded that the recovery of the ball is different in the infantile category when they perform test two versus the cadet category when they perform test three.

In the contrast of the variable ball recovery versus category, we observe that the variables behave significantly different (0.000). The number of recoveries is not the same in the infantile category as in the cadet and youth categories.

In the second pair of contrasts, experimental condition and ball recovery, we can see that the p-value is 0.000, so we can affirm that the recoveries are significantly different in each of the tests performed (Table 4).

Table 4: Spatial ANOVA test

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	68,921	11	6,266	9,129	,000
Interception	7378,151	1	7378,151	10750,513	,000
CATEGO	13,880	2	6,940	10,112	,000
COND_EXP	17,869	3	5,956	8,679	,000
CATEGO * COND_EXP	42,359	6	7,060	10,287	,000
Mistake	654,737	954	,686		
Total	8109,000	966			
Total corrected	723,657	965			

Source: Own elaboration.

First pass

In the descriptive analysis it is observed that the highest value is registered in the infantile category in the first experimental condition, 2‘64, and the lowest value, 1‘90, in the junior category when performing test 4.

If we look at the ANOVA table, the three p-values that inform us about the null hypothesis are less than 0.05, so it can be stated that both the category and the experimental condition they are performing at that moment affect the measurement of the first pass variable (Table 5).

Table 5. ANOVA test of the first pass

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	26,747	11	2,432	8,294	,000
Interception	3244,480	1	3244,480	11066,225	,000
CATEGO	10,006	2	5,003	17,065	,000
COND_EXP	7,291	3	2,430	8,289	,000
CATEGO * COND_EXP	10,154	6	1,692	5,772	,000
Mistake	213,441	728	,293		
Total	3491,000	740			
Total corrected	240,188	739			

Source: Own elaboration.

Completion of the attack

This last variable studies the completion of the players‘ attack. The aim was to study whether the age of the player and the test they are performing influence this variable. The null hypothesis is that there are no differences between categories or experimental conditions when we are studying this variable. The descriptive analysis indicates that in each of the experimental conditions the players, according to category, do not behave in the same way. In the first experimental condition the mean of the infantile category is significantly higher than in the rest of the categories. If we also contrast the factors separately, we observe that the completion of the attack is significantly different in the different categories (0.016), so the age of the player influences the results of this variable. If we focus on analyzing whether the experimental condition is significant when measuring the completion of the attack, we observe that with 0.004 it is significant, i.e., the results collected in the tests are very different, influencing the test being performed (Table 6).

Table 6. ANOVA test Completion of attack

Origin	Sum of squares	gl	Quadratic mean	F	Sig.
Corrected model	13,250	11	1,205	3,232	,000
Interception	2031,321	1	2031,321	5451,281	,000
CATEGO	3,079	2	1,540	4,132	,016
COND_EXP	4,920	3	1,640	4,401	,004
CATEGO * COND_EXP	5,022	6	,837	2,246	,037
Mistake	339,468	911	,373		
Total	2446,000	923			
Total corrected	352,717	922			

Source: Own elaboration.

5. Discussion

The aim of our study is to analyze the effect of using the analogy teaching strategy for learning individual and collective basketball attacking game concepts in the motor actions of young players of different ages under stress or time-limit conditions.

Some studies have been conducted in order to test whether analogy learning invokes behavioral mechanisms similar to incidental processes (Lam et al., 2009), developing modified throwing skills in basketball, based on the conception that subjects will improve their performance if the amount of information they consciously process is reduced. Results showed that the analogy groups accumulated fewer explicit rules than the intentional learning group, explicitly instructed through a set of rules. When a secondary task was added, the analogy learning group did not deteriorate its performance, unlike the intentional learning group, with the authors finally concluding that analogy learning invokes incidental learning processes.

It has previously been argued that analogy learning places a lighter load on working memory resources than intentional learning, due to the reduced volume of verbal information processed relative to explicit instructions (Masters, 2000).

In the selected studies, experimental subjects in the analogy group are given only one rule, while those in the intentional group are given eight. We have only found two studies referred to figure skating (Haguenauer et al., 2005) and volleyball (Wulf, et al., 2002), in which both groups were given the same number of rules, analyzing in the first study some kinematic variables related to the figure jump, obtaining results of null effects on the execution of the skill, arguing that providing additional verbal instructions does not generate any effect in the early stages of learning. In the second study, the type of feedback did not significantly affect the quality of the movement, but the external focus group performed more accurately in the serves, regardless of the level of experience of the subjects.

6. Conclusions

In relation to the influence of the different constraints on the actions performed by the players during the game, the findings we have obtained in our studies reflect that the variables related to space, collective and individual play are influenced by environmental constraints.

As a conclusion we can state that learning by analogy places a lighter load on working memory resources than intentional learning, due to the reduction in the volume of verbal information processed in relation to explicit instructions. This frees up resources for other more complex processes also necessary to solve the problems posed by the high uncertainty game, such as decision making.

Therefore, we could affirm that the aforementioned studies are biased in favor of the analogy group, because the attentional load associated with the processing of a single rule is lower than that associated with the processing of multiple rules (Lam et al., 2009), making the latter subjects dependent on the limited availability of working memory resources during the processing of such explicit information.

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