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ORIGINAL

BALL RECEPTION SKILLS IN CHILDREN BETWEEN THE AGES OF THREE AND TWELVE

LA RECEPCIÓN DE BALÓN EN NIÑOS CON EDADES COMPRENDIDAS ENTRE LOS 3 Y LOS 12 AÑOS

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ABSTRACT

The main goal of this study is to analyze the static reception of the ball in boys and girls between the ages of three and twelve. We designed a stages model that we termed VCAP. The sample was composed by 365 students (184 boys, and 181 girls) from an Elementary and Junior High School. This model allows the classification of the participants into levels of ability and it helps understand the operative processes. It can also be observed the levels of ability in each of these stages, the extent to which they predict the following phase and its consistency with the children's developmental processes. Differences were observed in relation to the gender and the age of the participants. At the end we discuss the results and propose new lines of investigation.

KEY WORDS: Motor development, motor skills, reception of mobiles.

RESUMEN

La finalidad de este estudio es analizar la recepción estática de balón en niños/as con edades comprendidas entre los 3 y los 12 años. Para ello diseñaremos un modelo en fases sucesivas que hemos denominado VCAP. La muestra estuvo formada por 365 estudiantes (184 chicos y 181 chicas) de un Colegio de Educación Infantil y Primaria. Este modelo ha permitido clasificar a los participantes en niveles de habilidad y ayuda a entender los procesos que operan. También observamos niveles de habilidad en cada una de estas fases en la medida en que anticipan las fases siguientes y que son consistentes con los procesos madurativos de los niños/as. Se han observado diferencias en función del género y de la edad de los participantes. Finalmente se discuten los resultados y se proponen líneas de investigación.

PALABRAS CLAVE: Desarrollo motor, habilidades motrices, recepción de móviles

1. INTRODUCTION

The presence of students with motor coordination difficulties and problems (Ruiz, Mata and Moreno, 2007) is apparent and is evident in many studies. It has also been verified by teachers of physical education (Ruiz, 2005; Henderson and Herdenson, 2002; Hulme, Smart, Moran and McKinlay, 1984). The children do not benefit in the same way as the rest when it comes to performing the motor abilities that normally make up physical education programs (Mata, Ruiz and Moreno, 2005). They also cause problems for the teacher in terms of organizing learning time in sizeable classes. The percentages dealt with are varied and oscillate between 2% and 30% in school aged children (Gómez, 2004; Parker and Larkin, 2003; Ruiz, Gaupera, Gutiérrez and Mayoral, 1977; Ruiz, Mata and Moreno, 2007). This situation causes a low perception of competence, giving rise to low levels of self-determined motivation, low participation/effort in physical education classes, high levels of boredom and a low perspective of active physical exercise in the future (Cecchini et al. 2008; Cecchini, González, Méndez-Giménez and Fernández-Río, 2011; Ntoumanis, 2001).

Meanwhile, there have been numerous studies tackling the classification of motor abilities according to different criteria (Batalla, 2000; Contreras, 1998; Fernández, Gardoqui and Sánchez, 2007; Serra, 1987). By simplifying, they can be divided into two groups (according to Ureña, Ureña, Velandrino and Alarcón, 2008): a) those movements that require control of the body (basic motor abilities involving movement, jumps and turns), and b) those movements that require control of some form of mobile or object (basic motor abilities involving throwing, catching and bouncing).

Handling of mobiles (or objects) is understood as those actions that mainly centre on mobile contact through the idea that the individual has of these objects. In other words, this means the general idea, properties and relationship between objects (Ureña, Ureña, Velandrino and Alarcón, 2008). In essence this implies physical knowledge of mobiles and their shapes, properties and dynamic behaviour (Blázquez and Ortega, 1984).

From a structural point of view, Sánchez Bañuelos (1984) defends that reception can occur with moving objects (strictly speaking reception) and or stationary objects (picking up). Amongst the first the following is distinguished: a) *stops*, when we trap the object between the hands; b) *control*, when without trapping the object we leave it available to be easily used in a subsequent action; c) *clearance*, when we divert the course of the mobile by some form of action. Reception depends on different factors, amongst which we can include the following: a) *the mobile*, shape, size, weight, colour...; b) *the throwing*, distance, force and speed, type, course...; c) *the aim*, stops, control and clearance; d) *the situation*, static, in motion...; e) *the context*, adversary, play situation...; f) *the receiver*, experience and training, age... The studies on the assessment of this group of abilities are very imprecise. In fact, regarding basic

motor abilities there is a void in both national and international documentation (Ureña, Ureña, Velandrino and Alarcón, 2008).

Wellman (1937) outlined three levels of efficiency in the reception of a large ball amongst children in the Infant Education: one where the arms are held out straight with the elbows stiff in front of the body observed in children under three and a half years; the second level in which the elbows remain rigid but hands are opened to receive the ball normally observed in children of four years; and the last level in which the arms and elbows stay next to the body. However, in his motor abilities test, Ulrich (2000) includes elbow flexion and raising of the forearms to the forward position as a positive assessment element in the previous receiver position. Cratty (1982) observed that at five years of age the child can catch a large ball of 20 cm in diameter three to four times out of five when the ball is bounced from a distance of 4.5 m in such a way that it reaches the height of the chest. When assessing the mature structure of reception, it is possible to highlight that the position of the body goes against the ball, the eyes follow the mobile, the arms and the hands absorb the force of the ball and the position of the feet is balanced and stable (Ruiz, 1987). According to Meinel and Schnabel (1987), from three years of age children overcome the primitive motor form in such a way that the arms progressively extend towards the ball in flight, the hand separation is the diameter of the ball and the fingers become slightly separated. The ball is caught in flight with the “tweezer grip position” and then brought towards the body. At this age the children have very limited anticipation capacity (Feigelman, 2007).

The study of mobile capture is an interesting task that allows researchers to build on their knowledge of perceptual-motor function (Bennet, van der Kamp, Savelsbergh and Davids, 2000; Mazyn, Lenoir, Montagne and Sabelsbergh, 2004, 2007; Rushton and Wann, 1999; van der Kamp, Savelsberg and Smeets, 1997). Some of these studies have focused on the spatial and temporal aspects of reception. Magill (2004) suggests that the spatial aspects of movement performance (the movement itself) precede temporal aspects (speed and acceleration) during ability acquisition. Alderson (1974) upholds that through learning and development, children are primarily successful in the spatial positioning of the hands into the course of the ball. This gives rise to the capacity to achieve contact with the ball. Subsequently, it is the temporal aspect that progressively allows for the ball to be seized with more refined movements.

Other researchers have put forward results that contradict this artificial separation of temporal and spatial characteristics in movement control and learning. Various experiments have shown to a certain extent how the spatial and temporal characteristics of interception movements come hand in hand. Therefore, they cannot be considered totally independent from motor action (Caljouw, van der Kamp and Savelsbergh, 2006; Davids, Bennett, Handford and Jones, 1999). Other studies have focused on the effect of posture and hand preference on mobile capture output (Angelahopoulos, Davids, Bennett, Tsorbatzoudis and Grouios, 2005). Lastly, other studies have concentrated on cinematic aspects (Bennet, van de Kamp, Savelsbergh and David, 2000; Mazyn, Lenoir, Montagne and Sabelsbergh, 2004, 2007).

Mobile reception is a dimension of motor coordination (Mazyn, Lenoir, Montagne and Sabelsbergh, 2007). In our opinion, motor coordination could be defined as the action and the effect of ordering, organizing and arranging motor actions to reach a certain object, which requires all movement parameters to be adjusted within a specific context of space and time. There have been many theoretic models attempting to explain motor actions. In this study we have used the work of Bernstein (1966, 1967) as a starting point. This author establishes that in the case of voluntary movement, the initial component is the intention or “future necessity model” or the “desired level” (schematic representation of what is to be achieved). This goal to achieve is constant and invariable. But, movement performance is not carried out thanks to a mechanized succession of fixed and invariable movements but rather by a set of variable movements that culminate into reaching the desired object. This is possible because the main responsibility for movement is transferred to the ‘afferent synthesis’, which provides continuous information on the spatial position of the mobile in that moment. The difference between “desired level” and “actual level” give us the coefficient of this difference which determines movement structure (Cechini, 1993, 1998).

Bruner (1991) puts his own take on the model of Russian neurologist N. Bernstein, which, as we have already seen, establishes that ability acquisition occurs when the subject shortens the existing distance between a preconceived scheme and the movement as it is executed. In this way, according to Bruner and Bernstein, motor skills and abilities imply the capacity to control the great extent of freedom that the neuromotor system possesses. Bruner shows that two processes play a role in the error rate reduction: Control by way of intelligence and the restriction of the marginal deviations originating from the excessive tension intrinsic to the attempt to control the situation which feedbacks the motor and emotions system. Bruner’s cyclical model comprises three essential motor action components: intention, feedback and action patterns.

Bearing in mind such contributions, Meinel and Schnabel (1987) established that motor coordination is the ordering and organization of motor actions geared towards a certain aim. This ordering signifies the harmonization of all movement parameters in the interaction process between the subject and the respective environmental situation. The model presented by these authors was conceived using the Bernstein diagram as a base. It has various partial functions, amongst which the most salient include: 1. The reception and processing of afferent and reafferent information (afferent synthesis: Anochin, 1967). This means that it is possible to obtain and transmit information on the initial situation (situative information), the partial results (motor reafference) and the final results of motor execution (resultant reafference). 2. Movement programming according to the objective, implying a decision on the motor act to carry out as well as anticipation (prediction) of the partial and final results. 3. The consultation of the motor memory and memorizing of performance and correction diagrams. 4. Command and regulation through the emission of command efferent and correction impulses to muscles. 5. Movement performance by motor organs. 6. The comparison of incoming information (real parameters) with the predetermined objective and the action program (ideal parameters).

From these models, we suggest that mobile reception in children requires: 1) Understanding of the situation/problem at hand. 2) Knowledge of the mobiles' behaviour and respective anticipation of their course, speed and distance. 3) Anticipation of an objective. 4) Program choice and anticipation. 5) Anticipation of adjustment processes between the movement's real and ideal parameters. All these aspects come prior to launch. After this stage, following the same model, we have considered it fitting to differentiate four different successive phases for their study: 1) Adjustment phase while the mobile is in flight. 2) Contact phase. 3) Cushioning phase. 4) Stop phase.

The aim of this study is to analyze the static ball reception in children between the ages of 3 and 12 years. We have therefore designed a successive stage model that we termed VCAP (Spanish acronym for flight, contact, cushioning and stop). We formulated the hypothesis that it is a consistent model for this type of ability as it allows us to classify participants into skill levels and understand those processes that operate. We also proposed ability levels in each one of these phases which anticipate the following phases and are consistent with the maturational processes of the children.

2. MATERIAL AND METHOD

2.1. PARTICIPANTS

A sample of 365 students (184 boys and 181 girls) from an Infant and Primary School in a Spanish city took part in this study. They were aged between 3 and 12 years ($A = 7.87$, $SD = 2.65$). Students were in the three Infant Education grades and five Primary Education grades. The school was selected at random and all students participated in the study.

2.2. PROCEDURE

Two static reception tests were carried out with a volleyball ball (65 cm in circumference, 265 g in weight and an inner pressure of 0.3 kg/cm²) thrown from a distance of 3 meters by an adult who had been previously trained for these purpose. Both the adult and the child were situated inside a hoop of 70 cm in diameter. The ball was thrown softly with two hands in an up to down semi-circle course towards the centre of the hoop where the child was situated. In the first test, the participant had to catch the ball using both arms and then press it into the chest, and in the second test only both hands were used. Once the group had been put together, the lead author explained the tests that the participants had to then undergo and that they only had one attempt. The idea of just one attempt was conceived to increase difficulty and facilitate the analysis of motor perceptive processes, given that both tests were simple. Reception was filmed by a specialized individual on a fixed camera situated 4 meters away from participants. The study in its entirety had the authorization of the school principal and the student's parents.

2.3. ANALYSIS OF THE VIDEOS

In order to extract the information from the videos, the theoretical model shown in figure 1 was used. The model is divided in four phases that take place successively:

- *In flight adjustment phase.* Corresponds to the period while the mobile is in the air once it has left the hands of the thrower. It includes the overall and segmentary movement of the receiver's body to accommodate to the mobile's speed, course and distance. These movements should display two characteristics to be registered as such: a) clear evidence of intention and therefore reaction and other types of movement are not considered valid, b) there is no time delay, since the adjustment function is an anticipatory process. In this phase the observer must record either their presence or their absence and the specific type of specific adjustment or movement carried out by the participant.
- *Contact phase.* Occurs at the very moment when the mobile makes contact with the receiver. The observer should record its presence/absence along with the contact surface used at the very moment of contact.
- *Cushioning phase.* Corresponds to the moment after contact. Cushioning is understood as the decreasing of the mobile's inertia force. If, for example, the ball bounces into the arms of the receiver, it is understood that cushioning has not taken place. The observer should note its presence/absence and how it occurs according to the movements of the different body parts used.
- *Stopped phase.* Occurs at the end of the cushioning phase with the controlled detention of the mobile. The observer should register its presence/absence and the body parts that are used.

We gave a score of between 0 and 4 to each participant as a way of measuring ability level. If no adjustment is made while the mobile is in flight, we deem the process as over and award 0 points. If adjustment takes place in flight but the ball does not come into contact with the participant, we award 1 point. If there is contact but no cushioning we award 2 points. If there is cushioning but no stop we give 3 points and 4 points are awarded if the mobile is fully stopped. We also collect qualitative data on each one of the phases in order to explain how they are resolved. Likewise, we recorded information of the receiver's initial position before the mobile was thrown, and once the video was viewed we grouped these into four according to arm position: 1 = arms held out at the front, 2 = elbows semi-bent at 90°, 3 = elbows semi-bent at 45°, 4 = arms to the side of the body. In effect these are measurements of 1 to 4 that go from the arms held out at the front to the arms down by the side position. When observing intermediate positions, we grouped them according to their proximity. All observations were simultaneously carried out by two researchers. For every case, the video was played at a normal speed and then in slow motion. When a doubt arose, the video was replayed until both observers reached a decision. The kappa coefficient = 97.7% was used to determine the level of agreement between observers.

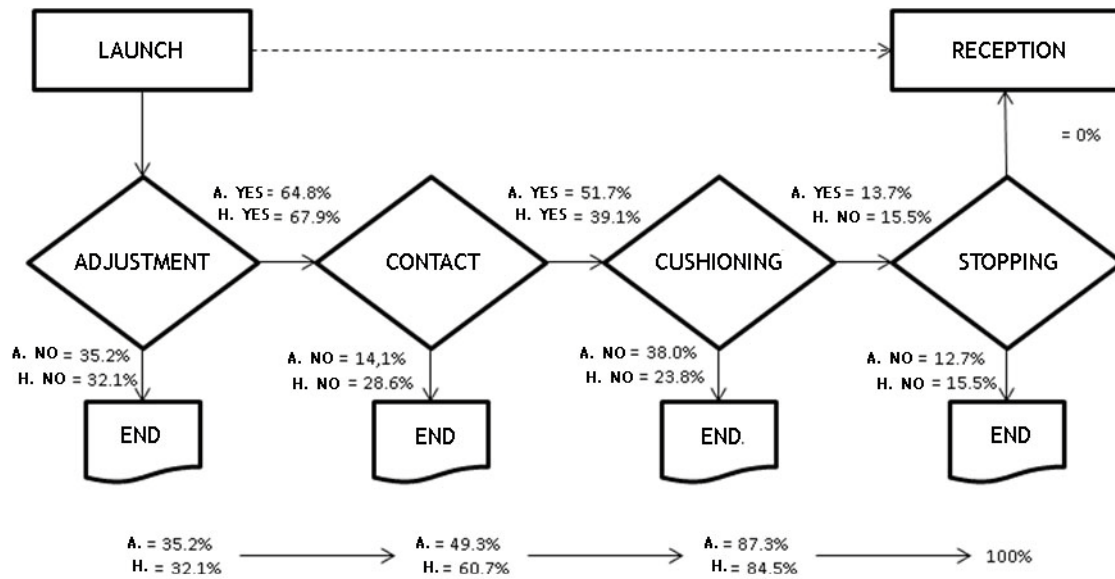


Figure 1. VCAP model and the error percentage in each one of the phases.

2.4. ANALYSIS OF INFORMATION

All information taken from the videos was entered into the SPSS 18.0 statistics pack. Descriptive and frequency analysis was carried out alongside bivariate correlations, multivariate analyses, chi-squared tests in some qualitative variables and covariance structure analyses (SEM) with the AMOS 18.0 program.

3. RESULTS

Table 1 shows the percentage of positive outcomes, the ability average, the standard deviation in terms of gender and age and the Pearson correlation between variables. Figure 1 includes the partial error percentage in each one of the phases in terms of total percentage (H = hands, A = arms).

	Age	%	Total		Males		Females		E.BR.B V	E.2M.B V
			A	SD	A	SD	A	SD		
E.BR.BV	3-5	37.	2.1	1.6	2.4	1.6	2.0	1.7	1.00	
		7	5	9	1	8	0	0		
	5-7	74.	3.4	1.0	3.7	.66	3.1	1.2		
		1	3	4	5		2	4		
E.2M.BV	7-12	99.	3.9	.25	4.0	.00	3.9	.37	.74**	
		0	7	0		0				
	Tota	80.	3.4	1.1	3.6	.94	3.2	1.3		
	I	4	6	8	7		6	5		
E.2M.BV	3-5	11.	1.1	1.3	1.7	1.4	.82	1.0	1.00	
		4	7	2	8	7		9		
	5-7	68.	3.2	1.1	3.6	.88	3.0	1.3		
		7	9	6	1		2	1		
E.2M.BV	7-12	95.	3.9	.29	3.9	.16	3.8	.38	.74**	
		9	4	7		7				
	Tota	74.	3.2	1.3	3.5	1.0	3.0	1.5		
	I	6	7	3	5	4	1	2		

Table 1. Average, standard deviation, positive outcomes and correlations percentage for static reception of arms (E.BR.BV.) and of hands (E.2M.BV) in terms of gender and age.

3.1. MODEL VALIDITY

A covariance structure analysis known as SEM was used to verify the model in Figure 1. SEM is an advanced statistics technique that allows researchers to analyze all variables at once and verify complex models. Given that the Mardia's coefficient was high ($A = 69.17$, $H = 350.46$), the method of maximum likelihood was used in the analysis along with the bootstrapping procedure. In this way, it could be assumed that data were robust in instances of abnormality (Byrne, 2001). With the view of assessing the adjustment of the proposed model to the data, various adjustment rates provided by EQS were examined. These included the Satorra-Bentler scaled χ^2 ratio (used with a solid analysis of the maximum probability) for degree of freedom ($\chi^2 / d.f.$), the Robust Comparative Fit Index (RCFI), the Bentler-Bonett Non-normed Fit Index (NNFI), the Root Mean Square Error of Approximation (RMSEA), standardized root mean square residual (SRMSR). A good fit of a specific model to the data is, as a general rule, indicated when the $\chi^2 / d.f.$ proportion is lower than 3, the RCFI, NNFI and rates are above .85 (ideally above .90), and the RMSEA and SRMSR are less than .07. Considering the model structure in progressive phases in which each phase depends on the previous while predicting the next, we come to the hypothesis that adjustment of data must be total. In fact, adjustment rates showed that the model hypothesis can be perfectly adjusted in both tests (fig. 2): $\chi^2(3) = .000$, $p = .1$; $\chi^2 / df = .0$; RCFI = 1.00; NNFI = 1.00; RMSEA = .0; SRMSR = .0 (Fig. 2).

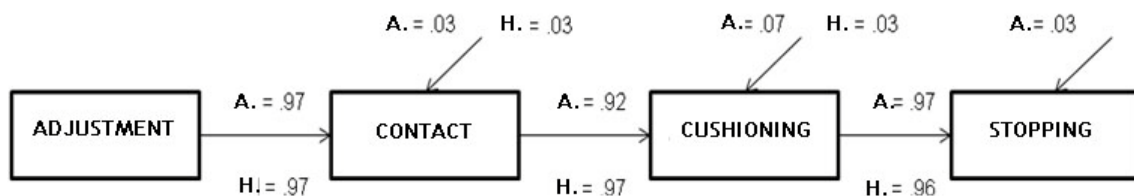


Fig. 2. Analysis of structural equations for reception with arms (A) and with hands (H).

The MANOVA 2 (gender) x 3 (age) analysis was then carried out. Beforehand however, ages were grouped into three coincident sections with the following phases in the body diagram structure: 3-5 years, 5-7 years, 7-12 years (Vayer, 1977; Cecchini, Fernández-Losa, 1993). The notion of covariance homogeneity was examined using the Box M test. The result revealed no resolution (Box $M = 244.12$, $F = 19.81$, $p < .001$). As a result, we followed the suggestions of Olson (1979) and Tabachnick and Fidell (1996) to use the Pillai's Trace instead of the Wilks lambda to assess the multivariate significance of the main effects and interactions. The MANOVA gave a significant main effect for age, Pillai's Trace = .63, $F_{(4, 630)} = 74.61$, $p < .001$, $\eta^2 = .32$ and for gender Pillai's Trace = .06, $F_{(2, 314)} = 10.22$, $p < .001$, $\eta^2 = .06$. Later univariate ANOVAs revealed that there were significant statistical differences for age, both in the reception test with arms [$F_{(1, 315)} = 105.83$, $p < .001$, $\eta^2 = .48$] and with hands [$F_{(1, 315)} = 255.45$, $p < .001$, $\eta^2 = .62$]. Significant statistical differences also appeared for gender, in

both the reception test with arms [$F_{(1,315)} = 9.73, p < .001, \eta^2 = .04$], and with hands [$F_{(1,315)} = 19.34, p < .001, \eta^2 = .06$]. Males showed higher values than females. Post hoc tests were performed using Tukey's HSD for comparisons in pairs between each age section. In both tests significant statistical differences ($p < .001$) were found amongst each and every one. As the child grows, the level of ability increases too.

Initial Position. A positive correlation was found between the starting position and ability levels in each one of the tests ($A = .40^{**}, H = .35^{**}$). The closer the arms are to the body, the higher efficiency level.

In flight adjustments. Three types of behaviour were defined: a) No intentional movement is made, or if it is, it is clearly reactive and in the best of cases only the arms moved very slightly (4 years, $A = 53.1\%, H = 50\%$; 5 years, $A = 15.6\%, H = 22.2\%$; 6 years, $A = 2.3\%, H = 2.3\%$). This is one of the phases displaying the largest number of errors in both tests (fig. 2). As of 7 years of age, all participants moved as the mobile was in flight; b) They extended the arms to the front in an attempt to cover more contact area, no adjustment was made that involved adapting the centre of gravity of the whole body and dependence on flight is limited (occurring up to the age of 8 years); c) The ball in flight is constantly controlled and arms are extended accordingly while adjusting their position moment by moment with movement of the centre of gravity and anticipation of the most adequate area of impact (mainly from the age of 7 – 8 years). In order to determine the extent of influence on the final result, the chi-squared tests were performed ($A, \chi^2 = 181.04, p < .001, H, \chi^2 = 130.04, p < .001$).

Contact phase. We have also grouped observed behaviours into three categories: a) It either does not occur or does so by chance far away from the optimal point, as intervening body parts are not positioned correctly (4 years, $A = 56.3\%, H = 62.5\%$; 5 years, $A = 22.2\%, H = 46.7\%$; 6 years, $A = 9.1\%, H = 13.6\%$). All subjects manage to have contact with the ball after the age of 8 years. b) Contact occurs closest to the optimal point and position of intervening body parts is more stable than in the previous instance (up to the age of 7-8 years). c) Contact occurs at the optimal point and the relative position of the different body parts is very stable (as of the age of 7-8 years, although there are some participants that are capable of contact even if not in the best place as they rectify and solve the situation). There are a greater number of errors in reception with hands than with arms (fig. 2). In order to determine the extent of influence on the final result, the chi-squared tests were performed ($A, \chi^2 = 202.09, p < .001, H, \chi^2 = 201.55, p < .001$).

Cushioning phase. We have observed three different types: a) No cushioning or it is limited. The ball bounces because there is no mobile accompaniment to slow the inertia force or it is lightly touched (4 years, $A = 62.5\%, H = 71.9\%$; 5 years, $A = 48.9\%, H = 66.7\%$; 6 years, $A = 26.2\%, H = 25.0\%$). From the age of 8 years over 95% of participants were able to cushion the ball in both tests. b) There is a slowing process involving some body parts which are not always the most appropriate or used at the correct moment. c) As the ball moves in its falling direction it is accompanied by a coordinated action at the precise moment and the entire body is used (although a greater level of efficiency is

seen in older children when it comes to eliminating unnecessary movements). During reception with arms, this is the phase in which the greatest number of errors occur (fig. 2). In order to determine the extent of influence on the final result, the chi-squared tests were performed ($A, \chi^2 = 309.03, p < .001, H, \chi^2 = 282.39, p < .001$).

Stopping. We have also observed three levels: a) It does not occur or other body parts are used for support in the final stopping of the ball. b) It occurs through sole use of the appropriate body parts but positioning is not very stable and with some hesitancy. c) The objective is perfectly reached with a totally stable body position (4 years $A = 25\%$, $H = 4.0\%$; 5 years, $A = 46.7\%$, $H = 16.2\%$; 6 years, $A = 70\%$, $H = 55.6\%$). At the age of 8 years, 97.5% successfully completed the reception tests with arms and 86.7% with hands.

4. CONCLUSIONS AND DISCUSSION

The aim of this study is to analyze static ball reception among children aged between 3 and 12 years. For this purpose we designed a model in four successive phases (flight, contact, cushioning and stopping). In order to demonstrate its validity, covariance structure analysis was employed, which is known as a structural equation modelling (SEM). The adjustment of the proposed model to the data was totally proper, the reason being that each phase precedes and anticipates the next. In this way, if a mistake is made the test is over for that participant. This allowed us to make five classifications of the different levels of ability (0-4 points). We saw that the correlation between the tests studied is very high and behaviour according to gender and age is very similar.

We also proposed ability levels in each one of these phases which anticipate the following phases and are consistent with the maturational processes of the children. We have observed that the adjustment phase is influenced by the level of adaptation to the mobile's speed, course and distance; in the contact phase with the distance of the mobile from the optimal point; in the cushioning phase with the intervening body parts and the level of coordination; and in the stopping phase with the extent to which the final objective is achieved.

At the age of 7-8 years the large majority of participants were capable of successfully receiving the volleyball ball with both hands and arms when it is thrown from a distance of 3 m. However, at the age of 4 years just 25% were capable with arms and 4% with hands.

Between 3 and 5 years of age children have serious problems when anticipating the flight of the ball. Up to 4 years, when an object is thrown to them, they either do not move or their movements are clearly reactive ($A = 53.1\%$, $H = 50\%$). We believe that this is due to difficulties in understanding the situation/problem, a task that implies anticipating a mental representation of the body in a given space during an evolutionary stage in which they are still not capable of associating the visual and topographic information with motor and kinaesthetic elements (Vayer, 1977; Cecchini, Fernández-Losa, 1993). Furthermore, they do not have sufficient knowledge of the behaviour of mobiles within the space. This

makes it considerably difficult to anticipate their course (Feigelman, 2007). This all hinders the possibility to choose an adequate motor program and adjust it moment by moment (Bernstein, 1967). In summary, there is a low level of metacognitive knowledge: declarative, procedural and affective (Dominguez and Espeso, 2002; Ruiz, 1994). In order for the ball to be caught it must be thrown in a very precise way into the arms of the receiver who catches it into their chest. Only a very few make contact with the ball in the optimal point. There are hardly any movements from the centre of gravity and cushioning is carried out solely with the arms without bending the knees or the hips. When the thrower releases the ball more or less than expected, only very few adjust their distance with movements from the centre of gravity. Between the ages of 4 and 5 years adjustment movement according to the mobile flight improved ($A = 37.5\%$, $H = 27.8$), which brought about a significant improvement in the contact phase ($A = 34.1\%$, $H = 15.8\%$). An improvement during the cushioning phase was also observed but it was not so significant ($A = 13.6\%$, $H = 5.2\%$). This all leads to a reception increase ($A = 21.7\%$, $H = 14.2\%$). In spite everything though, the majority was unsuccessful in this test.

Between the ages of 5 and 7 years a significant improvement is seen in the adjustment movements while the ball is in flight. At the age of 6, almost all participants performed this type of adjustment and the majority sought the ball with both arms extended accordingly. At this age children associate visual information with kinaesthetic information (Le Boulch, 1986), which allows them the advantage of an operating body image on a static level or in very simple movements. The contact phase improves further still and it occurs in places closer to the optimal point. Cushioning considerably improves with regards to the previous age and is performed mainly through flexion of the elbows. Between 6 and 7 years of age an improvement is observed but it is not so significant. The greatest achievements occur in the cushioning phase.

From the age of 7 years, the last phase of body scheme development begins. Now they are able to sustain constant control of the flight of the ball by extending their arms accordingly and accommodating their relative position in the space with movement of the centre of gravity. This allows them to anticipate the most adequate area for impact. Contact is made on a stable surface area, posture is balanced and is accompanied by cushioning. Furthermore, it is effective, efficient and unnecessary movements are eliminated (Ruiz, 2007).

We have also observed how the initial position has a bearing on ability levels as the arms relax and are situated over the body. This results fall in line with those found by Wellman (1937) and question the motor abilities test created by Ulrich (2000), which considers elbow flexion and raising of the forearms to the front as positive elements. We believe that this is consequence of an increase of competence perception, thus leading in higher levels of self-confidence and efficiency.

We have found differences in both tests according to gender. The males displayed higher values than females. Ruiz and Graupera (2003) also found better results in boys amongst the ages of 7-8 and 11-12 years in ball reception tests.

Our study has certain limitations. The first relates to the sample used and the second to the type of tests carried out. We therefore suggest carrying out new studies that increase and diversify the sample population. These studies should modify *the mobile* (shape, size, weight, colour), *the throwing* (distance, force/speed, type, course), *the objective* (stopping, control and clearance), *the situation* (static, moving, suspended), *the context* (adversary, play situation), and *the receiver* (experience/training, age).

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