



RESEARCH  
PROJECT

**LATERALITY**  
**AND ITS INFLUENCE IN**  
**BASKETBALL**

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## **0. INTRODUCTION**

The research project which is named “Laterality and its influence in basketball” has not been chosen for only one reason, it has been chosen for basically two reasons.

The first reason of this choice is because the topic of Laterality has been heard in some different places, and because of this an interest to discover about this topic has woken up. It was thought to be an interesting topic and that most of people would not be very informed about it, so it would be interesting to investigate it, and this way, to be able to explain people about, maybe, one of the most interesting and important facts that take place in our body. It was also thought that this is a very important tool to discover the function of our complex and perfect machine, the body.

On the other hand the topic of Laterality has always been interesting for me, because, personally, I do most of the quotidian actions with the left hand, meanwhile, when I play sports I usually use the right hand or feet, nevertheless, I play some sports with the left hand, and this does not happen to many people who are close to me, so I found it really interesting to learn more about this topic, and, maybe, be able to understand why this “strange” thing happens to me. Therefore these two facts, woke up a big interest in Laterality.

Then, the second part of the Title: “and its influence on basketball”, has been chosen because basketball is one of my passions, it is my favourite sport, I thought it would be interesting to discover the relation between these two topics: Laterality and Basketball, which is likely to exist. One of the advantages of this part is that this relation has not been much investigated, so it will be a great topic in which to focus all the practical part, doing my own research and studies.

I also chose to write the research project in English because when I found out that it was possible to do the research in this language, I realized that doing it in English would be one of the best ways to improve my skills, especially the writing and speaking skills, and the fluency when using this language.

At the same time this project has been done around some objectives and hypotheses.

This investigation wants to achieve five objectives:

- To know how Laterality is determined and the different types that exist.
- To discover the different stages in the evolution of Laterality.
- To dominate the different methods to determine Laterality.
- To know the relation between cerebral dominance and Laterality.
- To discover the importance of Laterality in sport.

And work around two hypotheses:

- Crossed laterality is advantageous to play basketball.
- Most basketball players have crossed Laterality.

The methodology that has been followed to achieve these objectives and hypotheses has been the following.

On the one hand, the objectives were assumed, mainly, with the theoretical part of the research, and this part has been structured in different stages. First of all an extended information research has been done, mainly on the Internet, this information was compiled in different languages, to be exact in three different languages: Catalan, Spanish and English. Then all the information that was found about the different points on which the research project will turn around was read. After this exhaustive reading of all the information, the main and most important and interesting ideas for this project ideas were decoded, and after that the project started to be written turning around those ideas.

On the other hand, the information to confirm or refuse the hypotheses has been reached by a very different method. There has been an investigation of 60 players who were born between the year 1997 and 2002 (12 to 17 years old). This research has been structured in four parts. The first one, helps to confirm or refuse the first hypothesis, and consists of a test to determine the Laterality of the players. And the second, third and fourth parts, help to confirm or refuse the second hypotheses and consist of one survey to the players about their abilities (third part), and interviews to

the present day and former coaches about players with crossed Laterality (third and fourth parts).

Like all the projects, this one has had some difficulties which are explained when they appear during the project, however there has been two big difficulties, the first it was that, because of the project has been done in English, some of the players or coaches who had to answer the interviews and do the tests and surveys could not understand this language, so to prevent some misunderstandings, all the tests, interviews and surveys were translated into Catalan, and this way there was no misunderstanding. The second one was that it was impossible to find all the former coaches, so the interview about crossed Laterality players to their former coaches could only have been done about some of them.

Lastly, but not less important, it is necessary to give my gratitude to all the people who helped me to do this research project, mainly the two teachers, the tutor and the English teacher who have corrected the research project and also to all my family who have helped me a lot organizing my time. Moreover it is necessary to thank the sportive director of CBiUM (Club Bàsquet i Unió Manresana) and all the players and coaches of that club, because this was the club where all the tests of the practical part were done, so without their collaboration this research project would not exist.

## 1. WHAT IS LATERALITY?

If we look back at our history, we can see that most of the societies have the preference to use the right hand (the handedness is probably the most famous part of Laterality, maybe because the hands are also the most used part of the body). We can see this fact in the word that some languages use to define the parts of the body, like in English, where right means correct, or in Spanish, German or French where the term right (*derecha*) means decent, honest, and we can also see it in Italian and Latin, where left (*sinistro*) is something threatening or mistaken, which is clearly associated to a bad thing. We can also see this preference in some cave paintings, where the people are painted using always the right hand or in the medieval age, where the knights used the right hand to hold the swords, and we could also see it some time ago, when most of the people were forced to use the right hand, because they thought that the left hand had a link with hell.

Apart from these social and historical facts, along science history, scientists have studied a lot of different things, including Laterality, but maybe it is one of the less investigated terms of the science, at least, is not much investigated as it should be. This fact does not mean that Laterality has never been investigated, there are some studies about it, but experts have not reached an agreement to define what Laterality is, in spite of the fact that definitions that different people give are so similar, laterality does not only have one and correct definition.

Doing a little research we can see that the encyclopaedia Britannica defines Laterality as *“the development of specialized functioning in each hemisphere of the brain or in the side of the body which each controls”*, meanwhile some scientists who have investigated Laterality like Le Boulch<sup>1</sup> who defines Laterality as the expression of a motor dominance carried out with the parts of the body which integrate both right and left sides, or Reid<sup>2</sup> who defines it as the tendency to use one side with preference against the other. Even though we can find a common part in these different

1. **Jean Le Boulch** (1924-2001) was a physical education teacher and doctor, who dedicated his life to investigate about psychomotor activity which is much related with Laterality.

2. **Alliston K. Reid** (has been teacher of psychology in some universities and has investigated about topics related with Laterality.

definitions, which would be that laterality has a relation with the different hemispheres or sides of the body, it is very important to emphasize that Laterality involves all the body, not only the hands.

First of all we can distinguish two big different groups of laterality, body Laterality and cerebral Laterality, the first one depends on the second one, but in this research project we will focus on the first one, so from now on, every time that we are talking about Laterality we will be talking about the body one, and if we want to refer to the brain one we will talk about brain dominance.

Secondly, inside the group we will focus on, we can find two different groups, the morphological body dominance, which appears on the spontaneous answers, and a functional or instrumental Laterality which gets built in the interaction with the environment. These two different types of Laterality could be the same or different. We can also arrange this group in another type of classification, which we will see later.

It has also been discovered that laterality has a big influence in the learning process, and if someone does not have laterality well defined, they could have problems in language, reading and writing, space orientation, time organization, tendency to reverse the numbers and the letters when they write, problems choosing between right and left or concentration and comprehension problems.

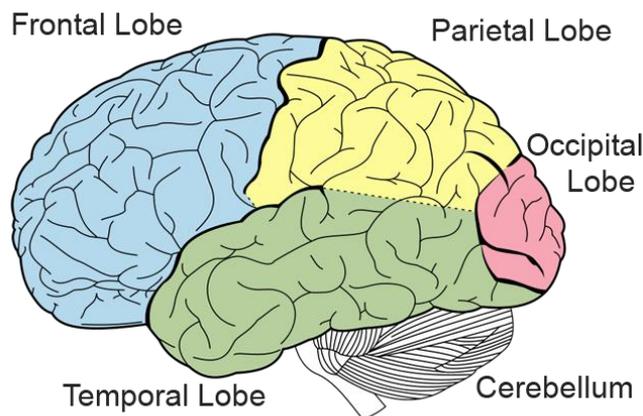
## 2. CEREBRAL DOMINANCE AND ITS INFLUENCE IN LATERALITY

A lot of studies have shown that there is a relation between cerebral dominance and body Laterality, but lately they have shown that this relation is not absolute; it means that having a concrete type of cerebral dominance does not involve having a concrete type of Laterality. In this point I will explain the brain structure, and how the brain and its dominance affect Laterality.

### 2.1. BRAIN STRUCTURE

We know that our brain can be divided in different parts, which are the following ones:

- **Cerebrum or Cortex**, which is the largest part of the human brain and is associated with higher brain function such as thought and action. The cerebrum is very wrinkled, and this makes it more efficient, because this way the surface is bigger, and as a result, the number of neurons are bigger, which makes the brain more efficient. This part of the brain is divided into four sections, and each one is associated to different actions:



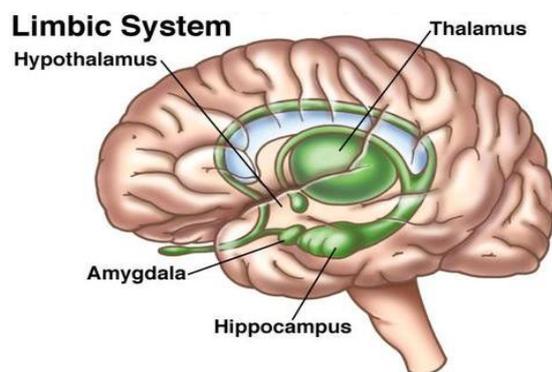
Source: <http://controlmind.info/human-brain/structure-of-the-brain>

- Frontal Lobe, this part is associated with reasoning, planning, parts of speech, movement, emotions and problem solving.

- Parietal Lobe, this part is associated with movement orientation, recognition and perception of stimuli.
- Occipital Lobe, this part is associated with visual processing.
- Temporal Lobe, this part is associated with perception and recognition of auditory stimuli, memory and speech.

This part of the brain is divided in two parts, which are called hemispheres, it is explained in 2.1.1 more extensively, because they are very important when talking about Laterality.

- **Cerebellum or “Little Brain”**, it is similar to the cortex, because it is divided in two hemispheres and has a highly folded surface. This part of the brain is associated with regulation and coordination of movement, posture, and balance.
- **Limbic System or Emotional Brain**, this system contains:

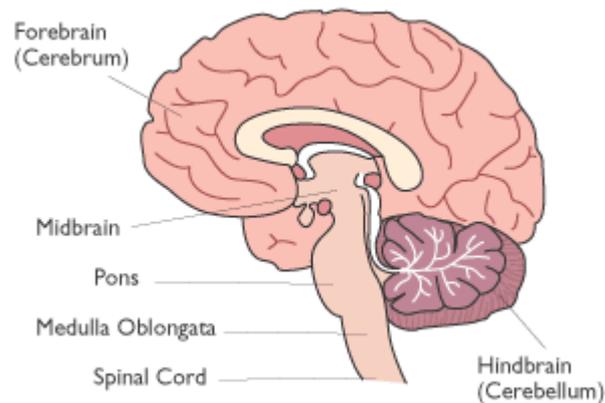


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- Thalamus, which is related to sensory and motor functions.
- Hypothalamus, which is related to homeostasis, emotion, thirst, hunger, circadian rhythms and control of the autonomic nervous system, also it controls the pituitary.
- Amygdala, which is related to memory, emotion and fear.

- Hippocampus, which is related to the learning, memory (to convert short term memory into a more permanent one) and for recalling spatial relationships in the world about us.
- **Brain Stem**, which is responsible for basic vital life function such as breathing, heartbeat, and blood pressure. The brain stem is made of different parts:
  - Midbrain, which is related to functions such as vision, hearing, eye movement and body movement.
  - Pons, which is related to motor control and sensory analysis.
  - Medulla, which is related to breathing and heart rate.

Diagram of Brain Stem



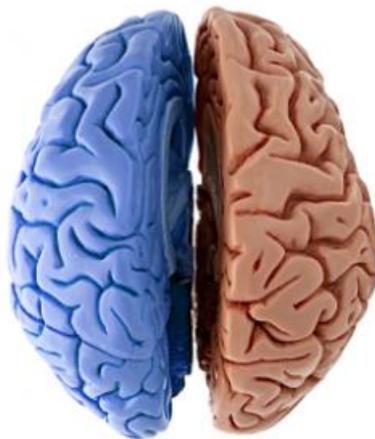
Source:

<http://corticalchauvinism.com/2013/03/25/key-players-in-autism-iv-the-brainstem/>

### 2.1.1. BRAIN HEMISPHERES

As it was said before, the cerebrum is formed by two cerebral hemispheres, the right one and the left one, separated by a groove, the medial longitudinal fissure, and linked by the corpus callosum, a very large pack of nerve fibres. Moreover, there are some small commissures like the anterior commissure, the posterior commissure and the hippocampal commissure, which transfer information between the two hemispheres to coordinate some functions.

#### Brain Hemispheres

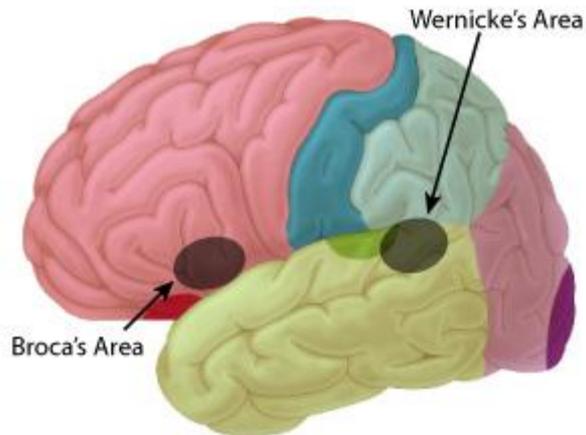


Source: <http://createsubliminalmessages.com/subliminal-recordings-left-handed/>

If we take a macroscopically look at both hemispheres we will see that they are almost mirror images of each other, with only some little differences. Sometimes one side is a little bigger than the other.

But if we focus on their function, it has always been said that the left hemisphere is related to logical and more scientific things, it is more closed, and that the right hemisphere is freer, more artistic. But that is not true, the truth is that **most of the actions are distributed across both hemispheres**, but there are some which are more favourable to being done in one hemisphere, this way we can see that the **right hemisphere** is chiefly related to intuition, and in working with the special relations and the simultaneous situations, on the other hand, the **left hemisphere** is mainly related with logical terms, verbal terms and is capacitated to work in a sequential way,

and then the most important function of the left brain hemisphere is the language, because the two most important language areas (Broca's area and Wernicke's area) are in the left hemisphere, and this function is what is going to be explained below.



Source: <http://sites.sinauer.com/wolfe3e/chap11/brainareas.htm>

## **2.2. RELATION BETWEEN CEREBRAL DOMINANCE AND LATERALITY**

As it has been stated in the previous point, our brain is divided in two hemispheres, the right hemisphere, and the left hemisphere, these hemispheres have an important influence to body Laterality, because each hemisphere controls the opposite side of the body, as a consequence, the right hemisphere of the brain controls the right side of the body, at the same time as the left hemisphere of the brain controls the left side of the body. So we can say that the two brain hemispheres work across one another in the body, because they control the opposite side.

The most definitive relation between brain hemispheres and body Laterality is that, following the rule that has been previously pointed out, the one which says the brain hemispheres act across one another in the body, we can see that mostly, the brain hemisphere which determines body Laterality is the same which has more influence in the language of this person, this fact is very clear in homogeneous right people, which

means that the brain hemisphere which determines Laterality will be the left one, in these people the left hemisphere of the brain has about a 90% influence in the language. However this fact is not as clear in homogeneous left people, who have their Laterality determined by the right hemisphere, which is only about the 30%. The reason why these people have the right hemisphere as the dominant one, and therefore the hemisphere which controls Laterality, it is not because of an early damage of the left brain hemisphere, but it is neither clear if it is because of a natural phenomenon, it could be, but scientists are not yet certain about it.

### 3. TYPES OF LATERALITY

There are different types of Laterality; first of all we must distinguish two groups, which classify Laterality into morphological and functional.

- **Morphological.** It is expressed in the voluntary movement and in the general motor and spontaneous adaptation answers.
- **Functional** or instrumental. It expresses the driving dominant ability, which has been acquired by one or the other side of the body in the social learning, and it is built in voluntary interaction with the environment.

Most of the times these two different types of Laterality are the same, the dominant side is the same one of the body, but not always, for this reason there are some people who do some activities with their right hand, foot, eye or ear, and other actions with the opposite one.

In the next points we will see the different types of Laterality studying the dominance of each four of the most important parts of the body, the two sensitive ones, eye and ear, and the two physical ones, hand and foot. These types of Laterality can be classified into two big groups, homogeneous lateralities and heterogeneous Laterality.

#### 3.1. HOMOGENEOUS LATERALITIES

To have a homogeneous Laterality means that the four parts of the body which can be lateralized have the same dominant side. So the dominant eye, ear, foot and hand will be the same. These types of Laterality are the most common ones. Then, depending on the side that is the dominant one, we can distinguish between the homogeneous right laterality and the homogeneous left Laterality.

### **3.1.1. HOMOGENEOUS RIGHT LATERALITY**

Homogeneous right Laterality is the Laterality where the dominant side of the body is the right one, so the dominant eye, ear, foot and hand will be the right ones. This Laterality is the Laterality that most people have.

### **3.1.2. HOMOGENEOUS LEFT LATERALITY**

Homogeneous left Laterality is the Laterality where the dominant side of the body is the left one, so the dominant eye, ear, foot and hand will be the left one. This laterality is not as represented in society as the homogeneous right one, but it is the second most represented. In sports that require an interaction with a team and against an opponent the homogeneous left Laterality is overrepresented.

## **3.2. HETEROGENEOUS LATERALITIES**

Not to have a homogeneous Laterality means that you do not have one side that is dominant to the other a hundred per cent, on the contrary; it means that you have a different dominant eye, ear, foot or hand from the other ones; they are not all the same. These types of Laterality are not as common as the homogeneous ones. Apart from this fact there are more types of Laterality than the homogeneous ones. We can distinguish among four different types of heterogeneous lateralities: inverted Laterality, undefined Laterality, ambidextrous Laterality and crossed Laterality.

### **3.2.1. INVERTED LATERALITY**

This kind of Laterality takes place when one person is “forced” to use the different hand that is not the innate dominant hand for him. Most of the times this happens to the innate left handers, which are forced to use the right one. This could happen for different reasons, in the past this used to happen because people believed that being left handed was associated with hell, and they wanted people to be right handed, they did not accept that there were left handed people. But this is not happening nowadays, nevertheless this type of Laterality still exists, but most of the times it takes place because we live in a society prepared for the right handed people, and sometimes it is much easier to do things with the right hand, also most of the teachers are right handed and when they explain something they do it with their right hand,

then the children who are left handed, sometimes tend to do the same. This kind of Laterality could lead to similar problems to such of crossed Laterality.

### **3.2.2. MIXED LATERALITY**

Mixed Laterality means that the person who has this kind of Laterality has heterogeneity in doing some actions, for example they write with one hand and they eat with the other. The people who present this kind of Laterality sometimes have problems to decide with which hand or foot they do a specific action.

### **3.2.3. AMBIDEXTROUS LATERALITY**

The people who present this kind of Laterality present indifference in using one hand or the other in any action, or at least for most of the actions, so they could eat or write with the two hands, play football with the two feet, etc.

### **3.2.4. CROSSED LATERALITY**

We say that someone has a crossed Laterality when they have a different hand dominance from the foot, eye or ear. When this happens with the hand and eye we can also talk about “functional asymmetry”. This part of the crossed Laterality (hand-eye) is the one which has been more investigated, because it could lead to different problems in the learning of the writing and reading. The most common problems given by crossed Laterality are the following ones:

- Difficulties in reading, writing and calculation automation.
- Reading and numbers and letters writing inversions.
- Reading mistakes.
- Substitutions of one letter for another.
- Difficulties in the basic mathematics concepts.
- Spatial and temporary disorientation.
- Psychomotor ineptitude and lack of rhythm.

All these problems can appear from the ages of 4 or 5, and the treatment has to be specific for each patient, related to the origin and the difficulties that each one has.

In spite of this a direct cause-effect relation has not been found. But this does not mean that it is not influent, it is known that Laterality has an influence in some diseases, because some studies have found that the percentage of people with dyslexia is higher with the people who have crossed or inverted Laterality than other

kinds of Laterality. Also, a lot of people who have dyslexia or Down's syndrome present a crossed Laterality.

## 4. LATERALIZATION

Lateralization is the process where the body defines the predominance of one side of the body against the other. There has been more than one scientist who has investigated this process, and because of this reason we can distinguish different classifications. But the best classification is the Le Boulch one, because in his explanation and classification of the different stages we can see the developing of Laterality in a clear way.

### 4.1. LE BOULCH CLASSIFICATION

According to Le Boulch, the evolution of Laterality follows three big stages, but the evolution is something continuous. The three stages are the following:

- 1. 0-3 Years**, in the first weeks of life it is possible to discover the future lateral dominance of someone by observing their tonic cervical reflection. Despite this, during the first year there is instability when choosing one side of the body to do the movements. So we can say that during the first year it does not exist a clear dominance of one side of the body against the other. Lateral preference starts to appear when children are 18 months old (when the child starts catching things), but around the ages of 2 or 3 years of age there could be an instability in the lateral preference of someone. For this reason it is said that until they are 30 months old someone has not got a good defined hand Laterality preference. If we talk about foot preference, the instability lasts longer because you need to use both legs in most actions.
- 2. 3-6 Years**, It is from the age of four when we can say that someone has defined their Laterality. In the legs this process is a little longer, but it also happens during this stage. Then, from the age of 5 to the age of 6 and half, the child starts to know the terms right and left in their own body, due to their lateral dominance.
- 3. 7-8 years**, at the age of 7, the child suffers again instability, but it is corrected in a quick way, because it is from the age of 8 when the process of Laterality is completely finished, and Laterality is definitely strengthened.

## 4.2. OTHER CLASSIFICATION

Apart from the Le Boulch classification there is another one which appeared in a study<sup>3</sup> about the process of lateralization which is very interesting for the parents of the child, because this one tells us more visible things, the things that the child does in each period.

1. **Undifferentiating stage (0-2 Years):** Laterality is not defined and the child is discovering that he has two hands, and that they permit him to interact with the environment.
2. **Alternating stage (2-4 Years):** During this stage the child is interested in everything around him; he uses the two hands indifferently to do his everyday activities.
3. **Automation stage (4-6 Years):** The child starts to automate his actions, and it is possible to observe that he uses more one side than the other (dominant side) in the different activities he does.

3. "El proceso de Lateralización y lateralidad" done by Lorena Bower and Erika Jofré in 2010.

## 5. LATERALITY DETERMINATION

There are different factors that can influence the Laterality of a person, according to Rigal<sup>4</sup>, none of these factors are definitive, but all of them have an influence, it does not matter if it is in a higher or a lower grade, the important thing is that Laterality is determined by more than one factor. These factors are the following ones:

- Neuropsychological Factors
- Genetic Factors
- Social Factors
- Environmental factors

### 5.1. NEUROPSYCHOLOGICAL FACTORS

It is related to the dominance of one hemisphere of the brain, as it has been explained in the second point of the project. This could happen because there is a better blood irrigation to one hemisphere than the other.

### 5.2. GENETIC FACTORS

This theory tries to explain the hereditary transmission of lateral dominance saying that the Laterality of the parents because of their hemispheric dominance will affect the Laterality of their children.

It has been discovered that the percentage of left handers when their parents are both left handers too is 46% (a very high percentage), meanwhile when the parents are both right handers (21%) or there is only one who is left hander (17%) the percentage decreases a lot. It has also been found that there are some identical twins who have different lateralities (20%), so this is the definitive evidence that laterality has not a total dependence on genetic factors.

4. **Robert Rigal** is a teacher of Quebec University who has done different studies about Laterality, motor development and some similar topics.

### 5.3. SOCIAL FACTORS

There exist some different social factors which have an influence in the laterality of a person, but there are two which are thought to be the most important ones. And they are the following ones:

- **Religious meaning:** During the XX century, there was a strong religious belief, and for religion the left was associated with bad things, for this reason, sometimes the children were forced to use the right hand, instead of the left, which would be their dominant hand.
- **Language:** This could have influenced the Laterality of a person, because right means correct, a good thing, otherwise left, in some languages which come from Latin, means something wrong, incorrect. And this could lead some people to use the right hand when their dominant hand was the left one.

### 5.4. ENVIRONMENTALY FACTORS

These are the factors of the society which could influence the Laterality of a person; the most important are the following ones:

- **Familiar area:** There are some factors which could have influenced Laterality, like the resting position of the pregnant mother, the way how the mother took the baby to nurse it, the way parents transport the baby, the way parents give the baby objects, etc. Besides, because the little children tend to take their parents or brothers as an example, their Laterality could influence the Laterality of the person.
- **Urban furniture and utensils:** We all know that we live in a world prepared for the right handers, so the adaptation of the left handers or bad lateralised people would be difficult, this could lead to change the dominant hand in some actions, because it is much easier.

## 6. METHODS TO DETERMINE LATERALITY

Laterality is the dominance of one side of the body against the other, and it is shown in four different parts of the body, two which are more physical, hand and foot dominance, and two which are more sensitive, eye and ear dominance.

There are different methods to determine the dominance of these different parts of the body, which will show us our Laterality, but most of them consist in doing some everyday actions and noting which hand is used these actions. Nevertheless there is one test to discover dominance which is more popular than others, and it is an adaptation of the Harris Test<sup>5</sup>.

### 6.1. THE HARRIS TEST

The Harris test is a manual of different tests which have been published by “The Psychological Corporation” and, which have been compiled and some of them studied by Albert J. Harris<sup>6</sup>. This manual can be used until the age of 6. But all the manual is rarely used, what is most used is a Harris Test Adaptation, which contains some questions about eye actions, some about ear actions, some about hand actions and some about foot actions. Like the ones that are going to be explained in the next points.

5. “Harris tests of lateral dominance: Manual of directions for administration and interpretation” done by Albert Josiah Harris and edited by the Psychological Corporation in 1958.

6. **Albert Josiah Harris** was a scientist who has investigated a lot about laterality and their influence in some aspects, focusing on reading.

## **6.2. ACTIONS TO DISCOVER EACH DOMINANCE**

### **6.2.1. HAND DOMINANCE**

There are a lot of actions that we do every day with our hands, but to determine hand dominance we can focus only in some of them, which could be reflected in the following questions:

- Which hand do you use to write?
- Which hand do you use to draw?
- Which hand do you use to eat?
- Which hand do you use to brush your teeth?
- Which hand do you use to open a door?
- Which hand do you use to pick up a cup of water?
- Which arm do you use to throw a ball?
- Which hand do you hold a tennis racket?
- Which hand holds a match when you light it?
- Which hand holds an eraser when you erase things?
- Which hand do you use to cut with scissors?
- Which hand do you use to deal cards?
- Which hand do you use to open a door?
- Which hand do you use to get your hair done?

### **6.2.2. FOOT DOMINANCE**

Actions we do with our feet are fewer than actions we do with our hand, however there are a lot of different actions we do with our feet, and maybe the most important ones answer the following questions:

- Which foot do you use to kick a ball?
- Which foot do you use if you have to write a number at the air with it?
- Which leg do you use if you have to hop on one leg?
- Which is your preferred leg to keep your balance in one leg?
- Which foot do you use to climb a step?

- Which is the foot you do not move to spin around itself?
- Which foot do you use to take a ball which is under a chair?
- Which foot do you use to carry a ball for 10 metres?
- Which is your preferred leg to elevate over a table or a chair?
- Which leg do you move forward when you lose your balance?

### **6.2.3. EAR DOMINANCE**

Specific actions that involve the ear, and in which we could see the eye dominance are few, but we can find some actions which show us this ear dominance, and these actions answer the following questions:

- Which ear do you use to listen to a whisper?
- Which ear do you use to listen to sound from a box?
- Which ear do you use to listen through a wall?
- Which ear do you use to listen to the floor?
- Which ear do you use to listen when you answer a call?

### **6.2.4. EYE DOMINANCE**

Lastly there is the eye dominance, which it is not as much represented as hand and foot dominance in quotidian actions, but maybe it is more represented than ear dominance. To determine eye Laterality there is more to do than only answer questions. There are also some tests. But this does not mean that there are no questions, because there are, and they are the following ones:

- Which eye do you use to look through a camera?
- Which eye do you use to look through a tube?

Then there are some different tests:

- Sighting Test

This test consists of looking at a distant object across the room (such as a clock on the wall) and line up one finger with the distant object so that this finger is blocking the object, then you have to close one eye, then the other. When you close one eye, the object will remain blocked, meanwhile if you close the other eye the eye will “jump” out of the way, and you will see the object. The dominant eye will be the one which when it remained opened you still saw the object blocked with your finger.

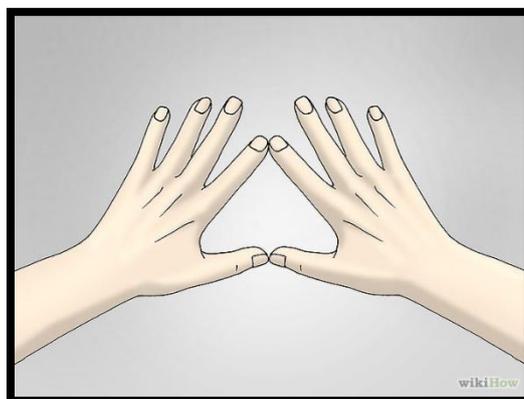
- Cardboard Test

This test consists in cutting a small circle (the size of a euro) out of the middle of a cardboard. Then you have to look with both eyes to a distant object, through the hole, but it must remain at about 20 cm of distance from your eyes, then you have to bring closer the cardboard while looking at the object through the hole, until the cardboard touches your nose, when this happens the hole will be situated in front of only one of your eyes, this eye will be the dominant one.

- “Triangle” test

This is one of the easier tests and it could be explained in five easy steps:

1. Extend your arms in front of you with your palms facing away.
2. Bring your hands together, forming a small hole by crossing the thumbs and fore fingers.



Source: <http://www.wikihow.com/Determine-Your-Dominant-Eye>

3. Choose a small object about 15-20 feet away from you. With both eyes open, focus on the object as you look through the small hole.
4. Close one eye and then the other. When you close one eye, the object will be stationary. When you close the other eye, the object should disappear from the hole or jump to one side.
5. If the object does not move when you close one eye, then that eye is dominant. The eye that sees the object and does not move is the dominant eye.

## **7. LATERALITY AND SPORT**

In sport, Laterality has a fundamental role in the mobility and the results, being the hand-eye and foot-eye relations the most important ones. One “scientist” who has investigated a lot about the relation between Laterality and sport is Paul Dorochenko.

### **7.1. PAUL DOROCHENKO**

Paul Dorochenko is a French osteopath and physiotherapist who has done a lot of research about Laterality, and tried to translate it and make it useful to different sports. Nowadays he is an eminence in the Laterality and sport worlds. He has focused in tennis, where he has worked with some famous tennis players such as Roger Federer, Sergi Bruguera and Carlos Moya.

Nowadays with his knowledge about laterality, he is helping some players to increase the level of their non-dominant hand, reaching the first one the level of the other one, he is also working in a project in Valencia, which is called “Jóvenes Talentos”, where he tries to help children between the ages of 2 and 8 to become one day professional players of their sport, and he does it by working with their Laterality.

One of the reasons why he is so popular in this world is because of his project “Activa concepts”. A project which consists in giving the player of one sport the correct move, and the most suitable one according to his real abilities in doing one specific action. This program is indicated for professional players, who want to improve their moves, or want to have a good ability with the non-dominant hand or foot. It is also indicated for players who have been injured, and they want to recuperate their technique level in a quick way.

This program is based on the idea of Paul Dorochenko that an imaginary gesture is the same as a done gesture, talking about mental terms, the image in our brain is the same, and its function is also the same, so Dorochenko believes that the total control of the gesture can only take part in the conscience and it can only take part before or after the specific gesture. So the process that Paul Dorochenko follows is the following one (We will take an example of a basketball player):

1. He looks with the player at the gesture of a specific action; for instance a long shot and they discuss what the player is doing wrong and what he has to improve.
2. They construct the image of the perfect gesture of the long shot, correcting the errors of the original shot.
3. The player imagines this image (the image of a perfect shot), without doing it, in order to have a specific move, always the same one.
4. The player lies under some sound and motor encouragements, while he is imagining the perfect shot.

The last point will make a difference to ordinary training, because this way the image of perfect movement will be fixed under the subcortical level, which is the most effective in memorising sensations in a quick and effective way. After all this process if the player, when he gets to the court, the first thing he does is to shoot the way he has learned before, he will have the perfect move acquired.

One example of a player which has reached a perfect move with the non-dominant foot, thanks to Active Concepts is the football player Laurent Courtouis, who had played for Levante UD in 2007.

## **7.2. BASKETBALL AND LATERALITY**

Laterality has a big influence in all sports, as it has been said before, and basketball is not an exception. In basketball the most important Laterality relation is hand-eye dominance relation.

According to a study by Núria Baldrich and María Marín (postmaster project)<sup>7</sup>, the relation between basketball and Laterality is the following one:

7. "La lateralidad en el deporte" by Núria Baldrich and María Marín as a post master project of "XXII Master en Optometría y Terapia Visual".

According to the fact that most moves in basketball are done by the dominant hand, which finishes further of the rim than the non-dominant hand, the eye which finishes closer to the basket is the eye of the other side of the dominant hand. So there could be a great number of players with crossed Laterality.

This is, maybe, the most important relation between basketball and Laterality.

But also, like other sports which require interacting with other players the left handers would be overrepresented, because they could have advantage, for the reason that all the players are used to defend or play against the right handers, and when they play against a left hander, they have to change their preferences and automatism when they defend, and this, as has previously stated, sometimes could give an advantage to left handers.

## 8. BASIS OF THE HYPOTHESES

This practical part has been done according the two following hypotheses:

- Crossed laterality is the best one to play basketball.
- Most basketball players have crossed laterality.

These hypotheses have been created following some basis, in other words, following some ideas of their author. So, which are these foundations or basis for those hypotheses?

### 8.1. FIRST HYPOTHESIS

The first hypothesis, “Crossed Laterality is the best one to play basketball”, came up because it was believed that in some actions of the game, having a crossed Laterality would give the player and advantage, especially in the vision of the rim, when doing some different actions. Below we will explain how it is believed that crossed laterality affects these different actions.

#### 8.1.1. SHOOT



Source:

<http://dogsanddoubles.com/phototbdc/ray-allen-shooting-a-basketball>

A shoot could be defined as the action which the player throws the ball to the rim to score a point. And it is believed that Laterality could have an influence in this shoot. Let’s see how. In the image on the left we can see Ray Allen, one of the best shooters of NBA history, and according to some shooting experts, one of the players with a most perfect shooting mechanism. As we can see this player shoots with the body balanced, he has the body looking straight to the rim, without rotations of the shoulders or the hip, which could probably make it much easier to do a good shot, because it will be more difficult to lose your balance while you are shooting, and this will give your shot a higher

accuracy, so, the results of your shot will be better. The reason why this player is

balanced when he is shooting could be the following one; the vision of the rim you have with your dominant eye when you are shooting. Because while you are shooting, in most of the shooting mechanisms your hand or arm hides the rim to the eye from the same side of your dominant hand, so, this means that if you have homogeneous Laterality it is more probable to have a less effective shoot, because you will not see the rim correctly during all the shooting process. On the contrary, if you have crossed Laterality, you will see the rim much better during all the shooting mechanism, because you will not have your arm in front of your dominant eye, and this maybe will make your shoot more effective. It is true that the time that the arm is hiding the rim from your dominant eye is only a very little part of a second; however it could have an effect on your shoot. What most of the players with homogeneous Laterality do is change their body position, by rotate their shoulder or hip, also changing the position of their arm, but this will change their shooting mechanism, and it could reduce their efficacy, because they have to do a more unnatural move to do the shoot, and on the other hand it is easier to lose your balance in these kind of positions.

### 8.1.2. LAYUP



**Source:**  
[http://clippers.topbuzz.com/modules/gallery/chris-paul/Chris\\_Paul\\_driving\\_layup\\_past\\_Chris\\_Kaman](http://clippers.topbuzz.com/modules/gallery/chris-paul/Chris_Paul_driving_layup_past_Chris_Kaman)

A layup could be defined as the action of doing a shoot while they are running and controlling the ball with only one hand, this action is usually done close to the rim, as we can see on the image on the left. We can see that laterality affects layups in a very similar way as does with shooting. To have a crossed laterality gives the player a better range of vision to do the action. This is believed because when you do a typical layup, as we can see image on the left, you finish with the hand which is further from the rim, and this means that the eye which is closer to the rim will be the one from the opposite side of the body of your dominant hand, and this could give the player with crossed Laterality an advantage when doing

layups, because he will have a better vision of the rim than the vision a player with homogeneous Laterality has, this would make it easier for the player with crossed Laterality to do layups with his dominant hand, which is the most used.

This advantage also takes place when we talk about another type of layups, the reverse layups; as we can see in the image on the right, you finish with the hand which is more under the rim, and if you have homogeneous Laterality it will be more difficult for you to see the rim. The opposite will happen if you have crossed Laterality, you will see the rim better, because your eye will be the one that it is more inside the court, so, the rim will not cover any of your vision, and this could lead to a higher percentage of converted reverse layups when doing them with the dominant hand, which, like in normal layups, it tends to be the most used. So to have crossed Laterality could also be advantageous when doing any kind of layups.



**Source:**  
[http://clippers.topbuzz.com/modules/gallery/dan-dickau/Dan\\_Dickau\\_reverse\\_layup](http://clippers.topbuzz.com/modules/gallery/dan-dickau/Dan_Dickau_reverse_layup)

### 8.1.3. DRIBBLE



**Source:**  
<http://sportforweb.com/basketball-dribbling/>

Dribble could be defined as the action of throwing the ball again and again to the floor with one hand, like it can be seen in the image on the left. This kind of action permits the players to move without doing any violation. In the case of dribble, maybe, Laterality has a lower influence, because it

players are supposed in the players to be able to dribble without looking at the ball, for this reason the influence is not really focused on dribbling, it is more focused on what the player can do while he is dribbling. According to this, the positive influence of having crossed Laterality is that when the player is dribbling with his dominant hand, which

happens most of the times, he can see what is happening all around the court better, and he surely has a better vision of the other side of their dominant hand than a player with homogeneous Laterality. As seen in image of previous page, the player will see his defender better if he has a crossed Laterality, but if he has homogeneous Laterality, it is possible that he will not see the player. So, what crossed Laterality gives a player is a better vision of what is happening at opposite side of where he is moving, he is supposed to have a clear vision of the side where he is going to, so he will be able to react quickly when a player tries to defend him from the opposite side. This advantage is related to the advantage that a player has when passing, which is going to be explained in the next point. Another big advantage when dribbling against other players of the team when playing with the weak hand, because when someone dribbles with the weak hand does not have enough control to dribble always without looking at the ball, and if you have to look at the ball to control it would be easier if you had crossed Laterality, because at that moment the dominant eye will be at the same side of the hand which is dribbling, so it would be easier to look at the ball and as a consequence to control it.

#### 8.1.4. PASSING

Passing could be defined as the action of throwing a ball to another player of your team; it could be done with one or two hands, as we can see in the image on the right. If we talk about advantages that a player with crossed Laterality has when passing, these will be closely related to the advantages that the player has when dribbling. As it has been stated before the



Source:

<https://www.onlinebasketballcamp.com/pages/basketball-passing-drills>

best advantage of crossed Laterality when dribbling is the vision of the court, and what is happening around you. So with passing it could be the same. For a player with crossed Laterality it will be easier to pass the ball to the other side, because he will see better if there is teammate who is alone or not, he will have a better vision of the

opposite side of where he is going, and this could lead the player to do surprising passes that no one can expect, and this way make it easier for his teammates, for a player with crossed Laterality it will be easier to make a pass to any side of the court.

## **8.2. SECOND HYPOTHESIS**

The basis of the second one hypothesis, “Most basketball players have crossed Laterality”, it is closely related to the first one.

The second hypothesis has been formulated because if crossed Laterality is advantageous to play basketball, following the logic, most basketball players should have crossed Laterality.

On the other hand most basketball players should have crossed Laterality, because when they start trying to play basketball, if they have crossed Laterality, it is easier for them to do some basketball actions, and they like this sport better, because at very young ages, if they have success doing something they would prefer it to another action where they are not as successful, which in this case is basketball. Moreover some young boys, with homogeneous Laterality, which have tried to play basketball, have had some difficulties doing basic actions (shoot, layup, dribble and pass) or they have seen that they are not the best doing this sport, and it is easier for them or they are better at doing another sport which people with crossed Laterality do not have an advantage, and they decide to do that sport, because at very young ages children tend to be very competitive and they want to win everything, and if they do not win they do not like it. And as it has been said before it could also happen in the opposite way. For example one person, with crossed Laterality, who plays a sport where crossed Laterality is not advantageous and one day tries to play basketball, and he may see that it is very easy for him, and that he is are one of the best players in this sport, this could give him extra motivation to practice basketball.

## 9. METHODOLOGY

This point it is going to explain what has been done to confirm or reject the hypotheses that have been stated in the previous one.

To confirm or reject these hypotheses a study of some basketball players has been carried out, more specifically, masculine players from “Club Bàsquet i Unió Manresana” (CBIUM) which were born between 1997 to 2002 (they are 12 to 18 years old) and they play in the best Catalan basketball categories of their ages, they have been chose because it is the club where the author of the research project plays, therefore it was much easier to do the research with them.

According to the conditions in which the research project has been done, the results are only applicable to masculine basketball, since there are more teams, and it was much easier to have a representative population of players to have good results, it was very difficult to do this with feminine teams.

The number of players who have been studied is about sixty (six teams of about ten players each).

The research project is structured into four parts, each one gives a different view about how Laterality can affect basketball. The four parts are the following ones:

- Players Harris Test.
- Players Survey.
- Present day coaches interview.
- Former younger coaches interview.

All these tests, surveys and interviews have been translated into Catalan, in order to make the comprehension easier for the people who were going to answer them and this way avoiding any misunderstanding. These translations can be found at the annex.

## 9.1. PLAYERS HARRIS TEST

NAME AND FAMILY NAME: .....

DATE OF BIRTH: .....

In the next document you can find three different tables which indicate different types of actions, and you must decide whether you prefer hand or eye when doing one specific action. Choose ONLY ONE OPTION with a cross (X).

### HAND DOMINANCE (SPORT ACTIONS)

ACTION	RIGHT	LEFT	INDIFFERENT
1. Dribble			
2. Shot			
3. Pass			
4. Drive to the hoop			
5. Throw a tennis ball			

### HAND DOMINANCE (EVERYDAY ACTIONS)

ACTION	RIGHT	LEFT	INDIFFERENT
1. Eat			
2. Write			
3. Get your hair done			
4. Open a door			
5. Brush your teeth			

### EYE DOMINANCE

ACTION	RIGHT	LEFT	INDIFFERENT
1. Look through a photo camera			
2. Look at an object through a tube			
3. Look at an object through a hole			
4. Cover an object with your finger			

This is an adaptation of the Harris Test of hand dominance and a test to determine eye dominance. What has been done is to divide the test in two parts, one related to quotidian actions and the other one related with basketball or sport actions. The quotidian actions have been chosen among the list of actions of the theoretical part, and the basketball actions are the four more representative and important in a basketball game. Another sport action has been added, which is to throw a tennis ball. Eye actions, like hand quotidian actions, have been chosen from the list of theoretical part, so each action is explained there.

The actions will be tested in three different ways:

First of all, the first part of the Harris Test will be answered directly by each player, because it is easy to remember with which hand you do the most usual actions.

Secondly, the sportive part of the Harris test will be answered by the author, who will watch a complete training of every team and will mark the hand with which the players do the basketball actions. And for the question of throwing a tennis ball, the author will ask each player to do this action and notes of the results will be taken. The first idea was that the players played three 1on1 and this way determines with which hand each player does each action, but this was not possible because it was not possible to change the structure of the trainings.

And lastly the eye test will be answered by the player, but under the supervision of the author of the research project, because they will do each action, and if they have any doubts, they can ask the author and solve it.



Source: Own elaboration

This test will give the research the information whether each player has crossed Laterality, and it will probably be the part which will confirm or reject the second hypothesis. It will also discover the players to whom the coaches interviews will be aimed at.

## 9.2. PLAYERS SURVEY

NAME AND FAMILY NAME: .....

DATE OF BIRTH: ..... POSITION: 1 2 3 4 5

In the next survey you can find different types of basketball actions, which you have to indicate your grade of difficulty when you learnt them for the first time and now (**1 is very very easy and 5 is very very difficult**).

ACTION	1	2	3	4	5
1. Right hand long shot.					
2. Left hand long shot.					
3. Right hand short shot.					
4. Left hand short shot.					
5. Right hand free throw.					
6. Left hand free throw.					
7. Left-right two steps stop.					
8. Right-left two steps stop.					
9. Right hand layup.					
10. Left hand layup.					
11. Right hand 1 dribbling layup from 6,75.					
12. Left hand 1 dribbling layup from 6,75.					
13. Right reverse layup.					
14. Left reverse layup.					
15. Right hand pass.					
16. Left hand pass.					
17. Right hand pass after dribbling.					
18. Left hand pass after dribbling.					
19. Right hand baseball pass.					
20. Left hand baseball pass.					
21. Right hand static dribbling.					
22. Left hand static dribbling.					
23. Right to left in front of the body crossover.					
24. Left to right in front of the body crossover.					
25. Right to left between the legs crossover.					
26. Left to right between the legs crossover.					
27. Right to left behind the back crossover.					
28. Left to right behind the back crossover.					
29. Right to left reverse.					
30. Left to right reverse.					

This survey pretends to test the grade of difficulty of the players when doing some typical basketball match actions. It will be answered by the players, following their feelings when doing these actions.

This survey will give the research project the information whether the players with crossed Laterality have it easier when doing the most done actions in a game.

### **9.3. PRESENT DAY COACHES INTERVIEW**

1. Is it easier for the player (compared with the other players in the team) to do layups from both sides, right and left?
2. Has the player a bigger percentage of shooting with a defender in front of him than other players in the team?
3. Is it easier for the player (compared with the other players in the team) to create advantages in 1 on 1?
4. Has the player a wider range of vision than other players in the team?
5. What does his game give to the team?
6. Is it easier for the player (compared with other players in the team) to play both sides of the court?

This interview will be given to the coaches who are training players with crossed Laterality.

It is only asking about the players with crossed Laterality because most of the questions are made comparing the players who are being asked with the other players of the team, and for this reason it is not necessary to pass the interviews to all the players in the team.

This interview will give the research project the information whether the players with crossed Laterality have a better influence in the team than the players with homogeneous Laterality, so it will be related to the first hypothesis, because if you

have a better influence in the team you are playing, you have an advantage while playing basketball.

#### **9.4. FORMER COACHES INTERVIEW**

1. Was it easier for the player to learn the new game actions that the coach introduced?
2. Was it easier for the player to improve his individual technique?
3. Did he read the passes better than other players in the team?
4. Was it easier for the player to do the action learned in the trainings in the game?

This interview will be given to the coaches who have trained players with crossed Laterality years ago.

It is only asking about players with crossed Laterality because most of the questions are made comparing the player who is being asked with the other players of the team, and for this reason is not necessary to hand out interviews about all the players in the team.

This interview will give the research project the information whether the players with crossed Laterality had easiness, compared with the player with homogeneous Laterality, in learning some abilities, and to introduce them in their game. So this interview will be related to the second hypothesis because if you had easiness in learning your abilities, this is an advantage compared with the other players.

## 10. RESULTS

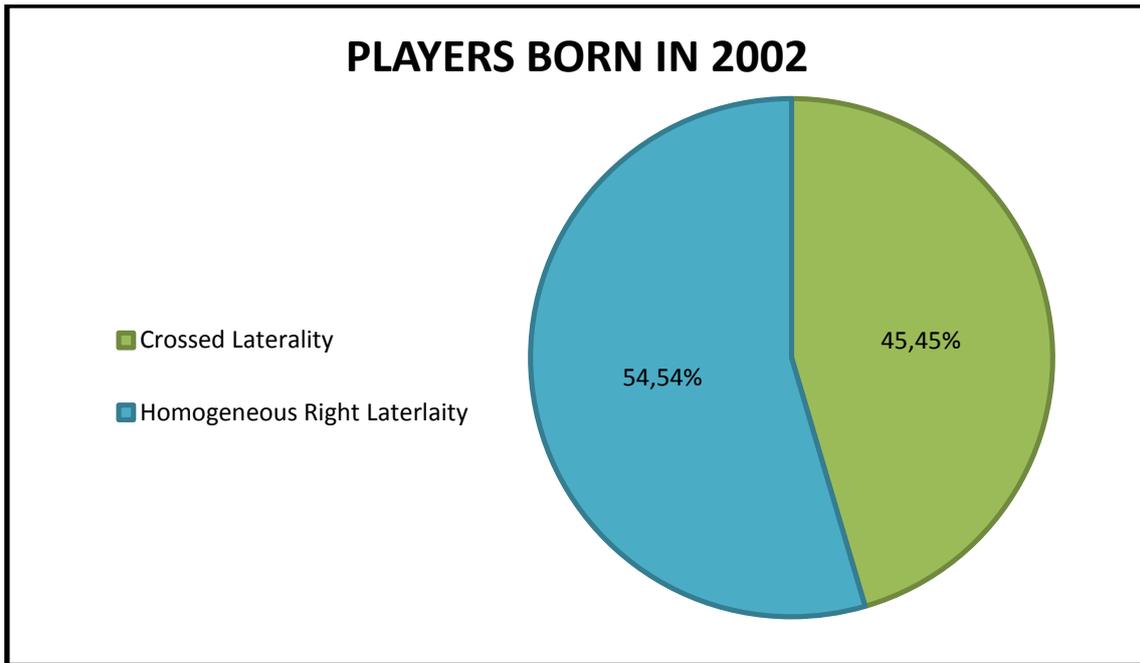
In this point the results of the surveys, tests and interviews which have been explained in the previous point are going to be shown by different tables and graphics.

### 10.1. HARRIS TEST RESULTS

Below, are shown the different results of The Harris Test, and they are firstly organized by year of birth and then there is one graphic which analyses the results all together.

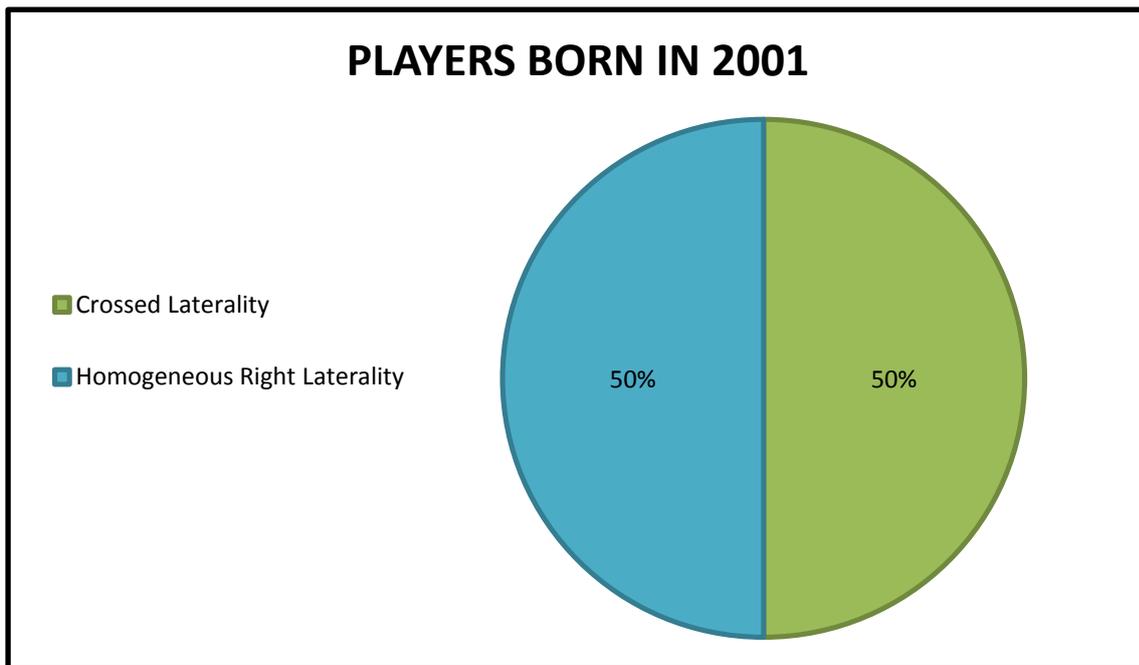
#### 10.1.1. PLAYERS BORN IN 2002

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
<b>Enric Codina</b>	2002	Right	Left	Crossed
<b>Bernat Piella</b>	2002	Right	Left	Crossed
<b>Pablo Requena</b>	2002	Right	Left	Crossed
<b>Ignasi Juncadella</b>	2002	Right	Right	Homogeneous Right
<b>Albert Planell</b>	2002	Right	Left	Crossed
<b>Pau Treviño</b>	2002	Right	Right	Homogeneous Right
<b>Jan Osul</b>	2002	Right	Right	Homogeneous Right
<b>Adrià Palà</b>	2002	Right	Right	Homogeneous Right
<b>Jordi De La Rosa</b>	2002	Right	Right	Homogeneous Right
<b>Marc Peñarroya</b>	2002	Right	Left	Crossed
<b>Enric López</b>	2002	Right	Right	Homogeneous Right



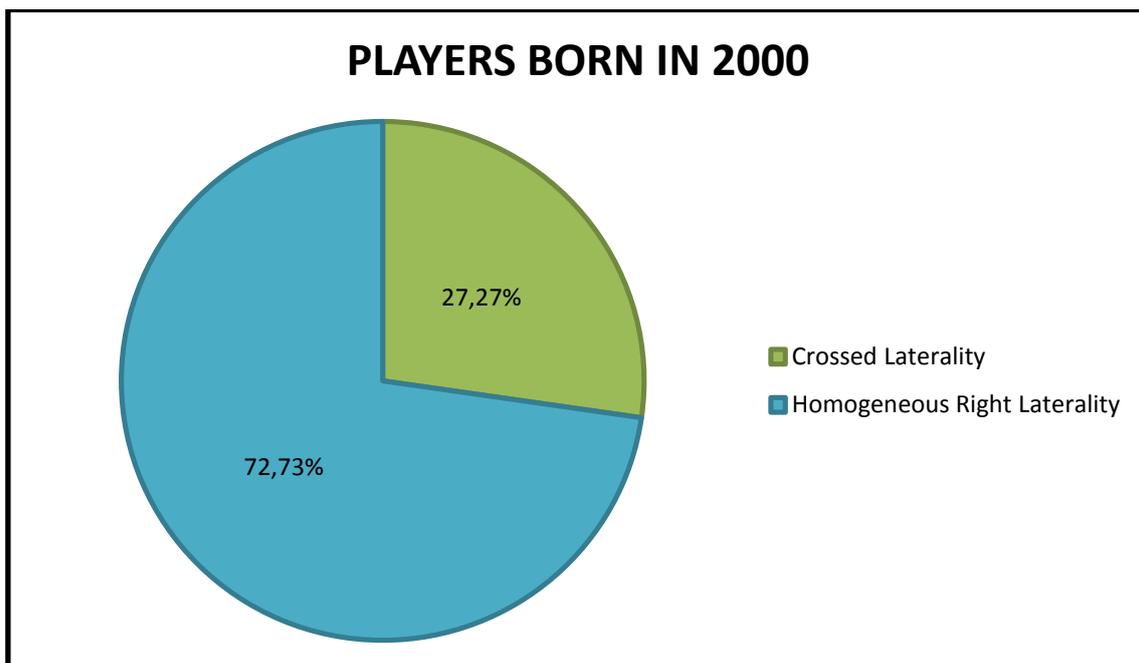
**10.1.2. PLAYERS BORN IN 2001**

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
Joel Claver	2001	Right	Right	Homogeneous Right
Àlex Cuenca	2001	Right	Left	Crossed
Àlex Flores	2001	Right	Right	Homogeneous Right
Gerard Marsol	2001	Right	Left	Crossed
Robert Marsol	2001	Right	Left	Crossed
Guillem Lao	2001	Right	Left	Crossed
Adrià Oluera	2001	Right	Right	Homogeneous Right
Eric Manzanares	2001	Right	Right	Homogeneous Right
Sergi Romero	2001	Right	Right	Homogeneous Right
Arnau Güell	2001	Left	Right	Crossed



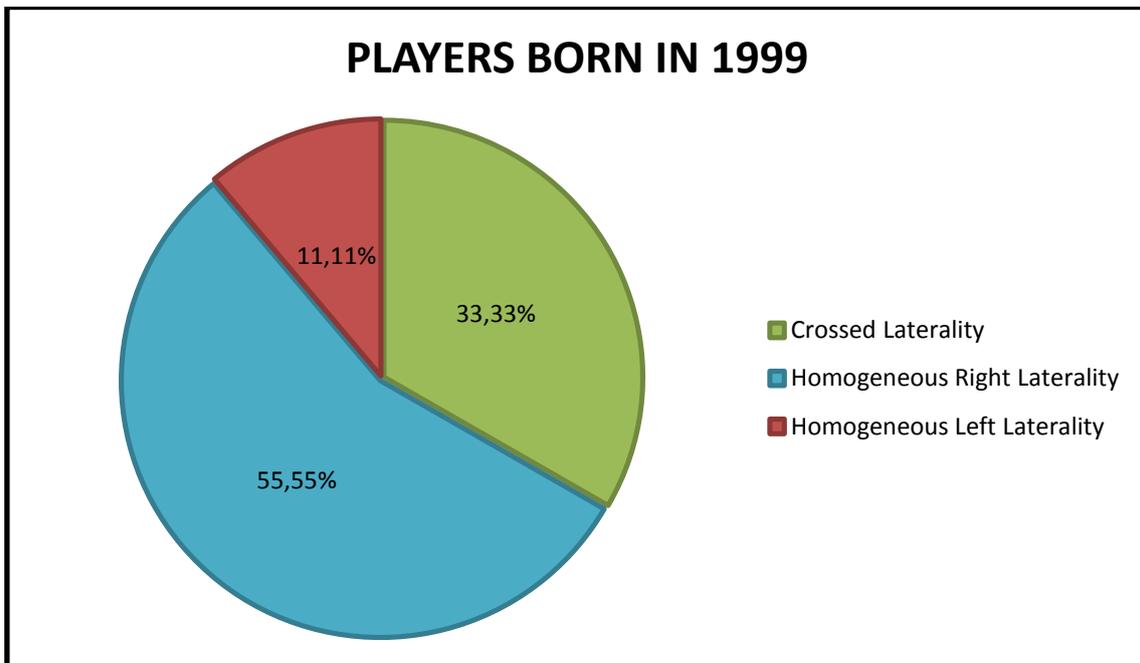
**10.1.3. PLAYERS BORN IN 2000**

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
Guillermo Baltà	2000	Right	Left	Crossed
Gerard Talarn	2000	Right	Right	Homogeneous Right
David Òrrit	2000	Right	Right	Homogeneous Right
Sergi Algué	2000	Left	Right	Crossed
Miquel Oliva	2000	Right	Left	Crossed
Borja López	2000	Right	Right	Homogeneous Right
Martí Garriga	2000	Right	Right	Homogeneous Right
Ferran Ladera	2000	Right	Right	Homogeneous Right
Sergi Soler	2000	Right	Right	Homogeneous Right
Carles Clotet	2000	Right	Right	Homogeneous Right
Jofre Canal	2000	Right	Right	Homogeneous Right



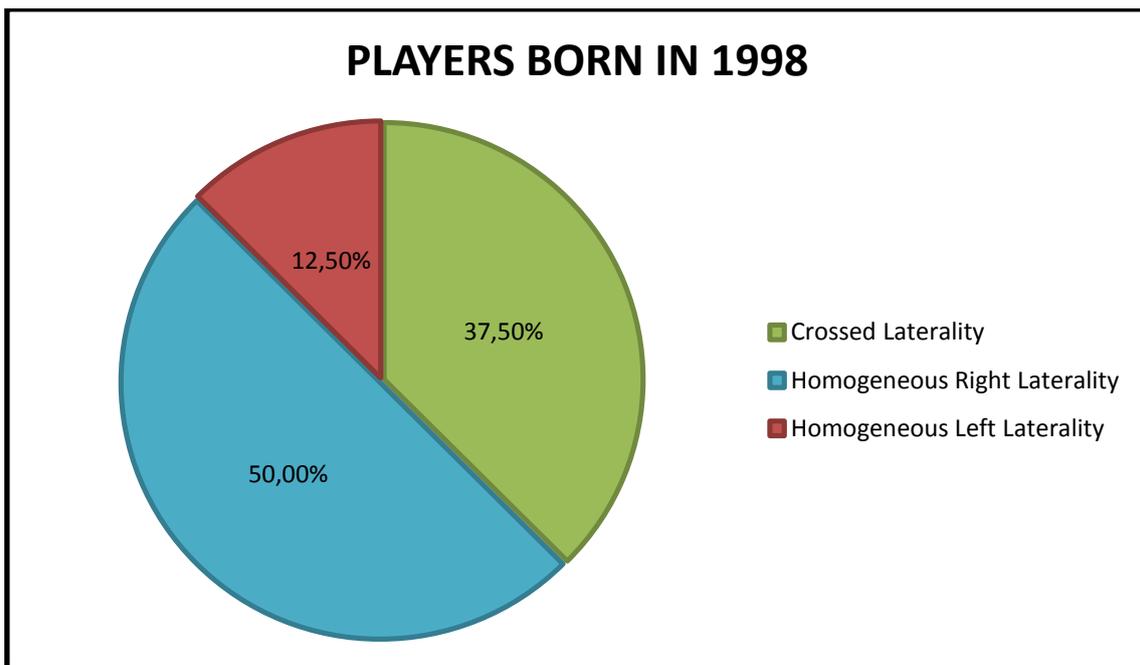
**10.1.4. PLAYERS BORN IN 1999**

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
Eloi Edo	1999	Right	Right	Homogeneous Right
Arnau Màrquez	1999	Right	Left	Crossed
Guillem Albà	1999	Right	Right	Homogeneous Right
Xavi Company	1999	Left	Left	Homogeneous Left
Enric Aliaga	1999	Right	Right	Homogeneous Right
Max Claver	1999	Right	Right	Homogeneous Right
Joan Morera	1999	Right	Right	Homogeneous Right
Pau Martínez	1999	Right	Left	Crossed
Miquel Aliaga	1999	Right	Left	Crossed



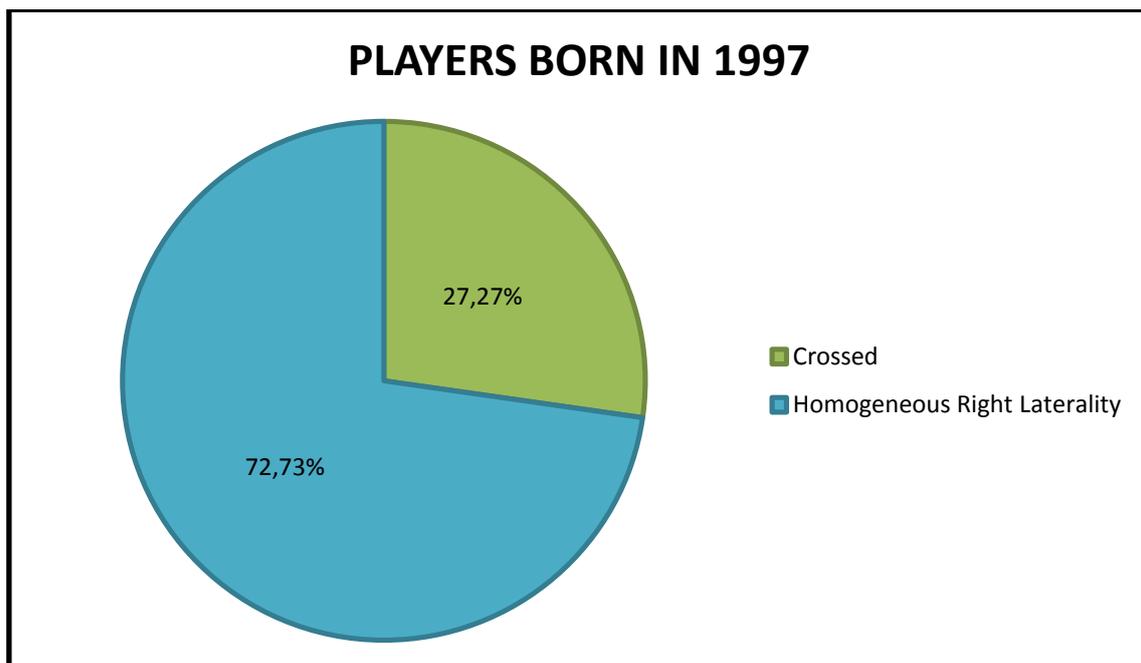
**10.1.5. PLAYERS BORN IN 1998**

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
Andrés Hernangómez	1998	Left	Left	Homogeneous Left
David López	1998	Right	Left	Crossed
Xavier Roqueta	1998	Right	Right	Homogeneous Right
Daniel Rodríguez	1998	Right	Right	Homogeneous Right
Oriol Font	1998	Right	Right	Homogeneous Right
Arnau Segura	1998	Right	Left	Crossed
Joan Pons	1998	Right	Right	Homogeneous Right
Eduard Mas	1998	Right	Left	Crossed

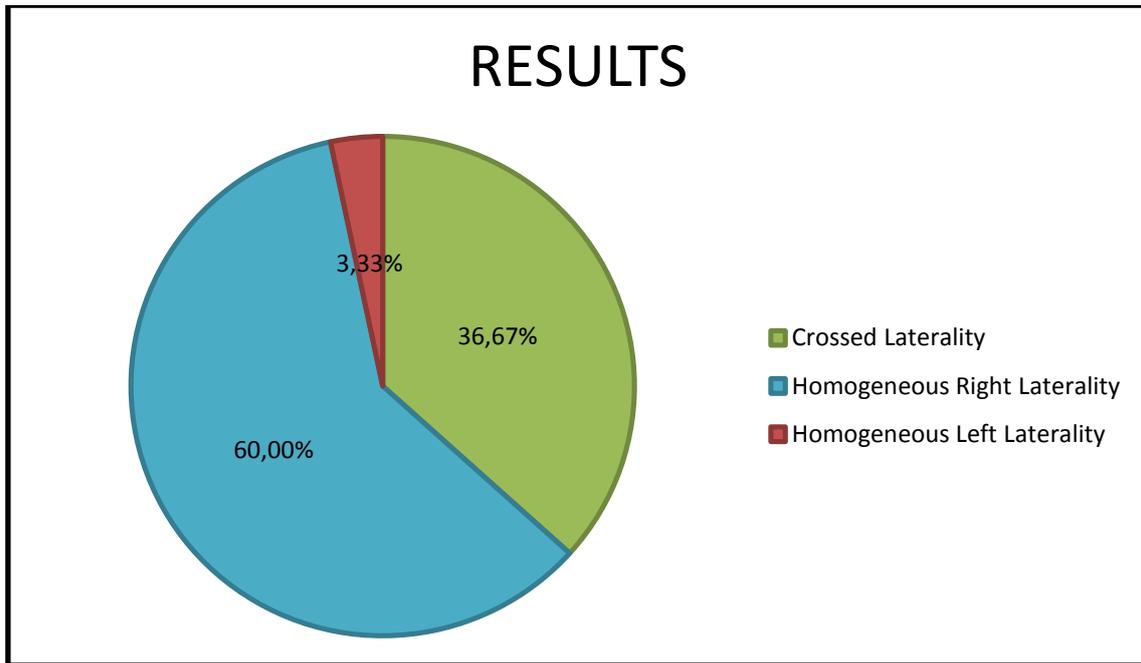


**10.1.6. PLAYERS BORN IN 1997**

Name of the player	Year of birth	Hand Dominance	Eye dominance	Type of Laterality
Deng Mayot	1997	Right	Left	Crossed
Quim Fernández	1997	Right	Left	Crossed
Juan Ayala	1997	Right	Right	Homogeneous Right
Ferran Mas	1997	Right	Right	Homogeneous Right
Arnau Crespo	1997	Left	Right	Crossed
Arnau Doñate	1997	Right	Right	Homogeneous Right
Jordi Fornells	1997	Right	Right	Homogeneous Right
Ian Valverde	1997	Right	Right	Homogeneous Right
Genís Canal	1997	Right	Right	Homogeneous Right
Guillem Jou	1997	Right	Right	Homogeneous Right
Adrià Hernández	1997	Right	Right	Homogeneous Right



### 10.1.7. GENERAL GRAPHIC



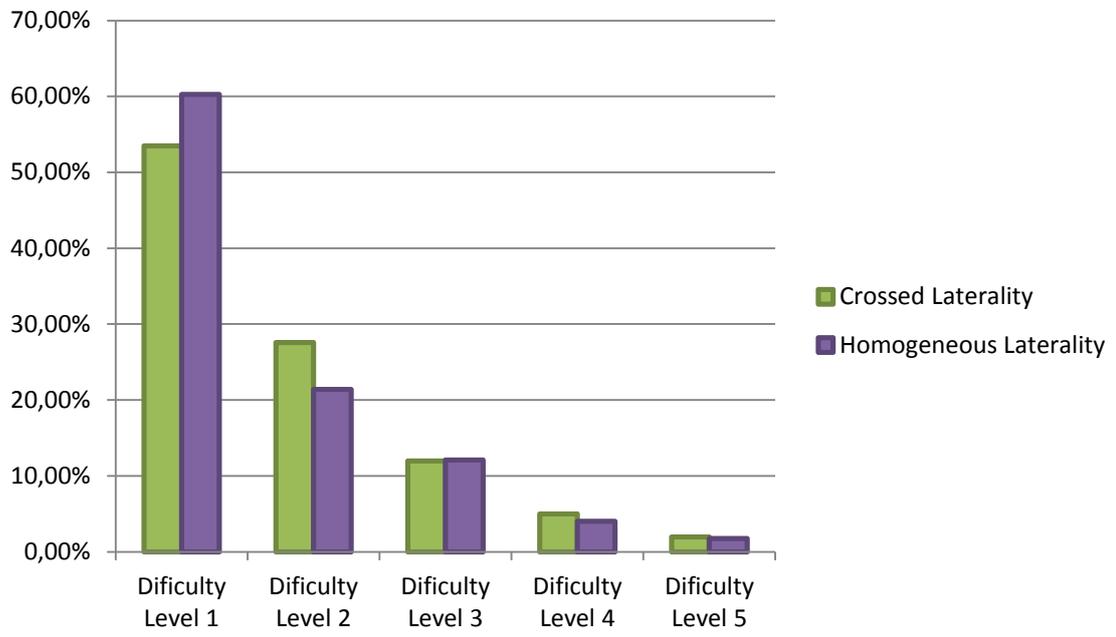
## **10.2. PLAYERS SURVEY RESULTS**

Here are shown the answers that the players gave to their survey, indicating their grade of difficulty when doing 30 different actions.

The answers are organized by the percentage of times that each player has marked each grade of difficulty.

LATERALITY AND ITS INFLUENCE IN BASKETBALL

NAME	YEAR	QUESTION 1		QUESTION 2		QUESTION 3		QUESTION 4		QUESTION 5	
		Answers	%								
Arnau Crespo	1997	19	63,33%	7	23,33%	3	10,00%	0	0,00%	1	3,33%
Ian Valverde	1997	20	66,67%	5	16,67%	3	10,00%	2	6,67%	0	0,00%
Adrià Hernandez	1997	14	46,67%	10	33,33%	4	13,33%	2	6,67%	0	0,00%
Guillem Jou	1997	25	83,33%	1	3,33%	2	6,67%	1	3,33%	1	3,33%
Jordi Fornells	1997	19	63,33%	6	20,00%	3	10,00%	2	6,67%	0	0,00%
Arnau Doñate	1997	20	66,67%	8	26,67%	1	3,33%	1	3,33%	0	0,00%
Quim Fernandez	1997	21	70,00%	5	16,67%	1	3,33%	2	6,67%	1	3,33%
Deng Mayot	1997	10	33,33%	13	43,33%	3	10,00%	3	10,00%	1	3,33%
Juan Ayala	1997	26	86,67%	2	6,67%	1	3,33%	1	3,33%	0	0,00%
Ferran Mas	1997	15	50,00%	10	33,33%	4	13,33%	0	0,00%	1	3,33%
Genís Canal	1997	18	60,00%	5	16,67%	7	23,33%	0	0,00%	0	0,00%
David Lopez	1998	19	63,33%	6	20,00%	2	6,67%	2	6,67%	1	3,33%
Arnau Segura	1998	8	26,67%	14	46,67%	6	20,00%	2	6,67%	0	0,00%
Xavier Roqueta	1998	19	63,33%	6	20,00%	2	6,67%	2	6,67%	1	3,33%
Joan Pons	1998	27	90,00%	0	0,00%	1	3,33%	2	6,67%	0	0,00%
Eduard Mas	1998	20	66,67%	7	23,33%	1	3,33%	1	3,33%	1	3,33%
Oriol Font	1998	16	53,33%	10	33,33%	3	10,00%	1	3,33%	0	0,00%
Andres Hernangomez	1998	17	56,67%	9	30,00%	3	10,00%	1	3,33%	0	0,00%
Daniel Rodriguez	1998	22	73,33%	4	13,33%	3	10,00%	1	3,33%	0	0,00%
Eloi Edo	1999	25	83,33%	4	13,33%	1	3,33%	0	0,00%	0	0,00%
Arnau Marquez	1999	22	73,33%	4	13,33%	3	10,00%	1	3,33%	0	0,00%
Xavi Company	1999	21	70,00%	7	23,33%	1	3,33%	1	3,33%	0	0,00%
Enric Aliaga	1999	18	60,00%	8	26,67%	3	10,00%	1	3,33%	0	0,00%
Max Claver	1999	21	70,00%	6	20,00%	2	6,67%	1	3,33%	0	0,00%
Guillem Alba	1999	27	90,00%	1	3,33%	1	3,33%	1	3,33%	0	0,00%
Pau Martinez	1999	19	63,33%	9	30,00%	0	0,00%	1	3,33%	1	3,33%
Joan Morera	1999	16	53,33%	5	16,67%	7	23,33%	1	3,33%	1	3,33%
Miquel Aliaga	1999	27	90,00%	2	6,67%	1	3,33%	0	0,00%	0	0,00%
Carles Clotet	2000	10	33,33%	12	40,00%	5	16,67%	0	0,00%	2	6,67%
Marti Garriga	2000	19	63,33%	7	23,33%	4	13,33%	0	0,00%	0	0,00%
Sergi Soler	2000	17	56,67%	6	20,00%	6	20,00%	1	3,33%	0	0,00%
Ferran Ladera	2000	24	80,00%	4	13,33%	2	6,67%	0	0,00%	0	0,00%
Jofre Canal	2000	23	76,67%	4	13,33%	3	10,00%	0	0,00%	0	0,00%
Gerard Talam	2000	4	13,33%	11	36,67%	11	36,67%	3	10,00%	1	3,33%
Borja Lopez	2000	15	50,00%	3	10,00%	7	23,33%	4	13,33%	1	3,33%
Sergi Algue	2000	19	63,33%	6	20,00%	3	10,00%	0	0,00%	2	6,67%
Guillermo Baltà	2000	15	50,00%	10	33,33%	4	13,33%	1	3,33%	0	0,00%
Miquel Oliva	2000	24	80,00%	5	16,67%	1	3,33%	0	0,00%	0	0,00%
David Orrit	2000	21	70,00%	7	23,33%	2	6,67%	0	0,00%	0	0,00%
Adrià Oluera	2001	4	13,33%	12	40,00%	10	33,33%	3	10,00%	1	3,33%
Eric Manzanares	2001	12	40,00%	5	16,67%	5	16,67%	6	20,00%	2	6,67%
Alex Flores	2001	4	13,33%	11	36,67%	12	40,00%	1	3,33%	2	6,67%
Joel Claver	2001	23	76,67%	4	13,33%	3	10,00%	0	0,00%	0	0,00%
Alex Cuenca	2001	6	20,00%	12	40,00%	8	26,67%	4	13,33%	0	0,00%
Robert Marsol	2001	19	63,33%	9	30,00%	0	0,00%	2	6,67%	0	0,00%
Sergi Romero	2001	16	53,33%	8	26,67%	5	16,67%	0	0,00%	1	3,33%
Guillem Lao	2001	11	36,67%	10	33,33%	7	23,33%	1	3,33%	1	3,33%
Gerard Marsol	2001	10	33,33%	13	43,33%	4	13,33%	1	3,33%	2	6,67%
Arnau Güell	2001	4	13,33%	15	50,00%	10	33,33%	1	3,33%	0	0,00%
Enric Lopez	2002	24	80,00%	3	10,00%	2	6,67%	1	3,33%	0	0,00%
Enric Codina	2002	9	30,00%	6	20,00%	9	30,00%	6	20,00%	0	0,00%
Albert Planell	2002	16	53,33%	7	23,33%	5	16,67%	1	3,33%	1	3,33%
Bernat Piella	2002	16	53,33%	10	33,33%	2	6,67%	1	3,33%	1	3,33%
Adrià Palà	2002	17	56,67%	7	23,33%	3	10,00%	2	6,67%	1	3,33%
Marc Peñarroya	2002	17	56,67%	7	23,33%	4	13,33%	2	6,67%	0	0,00%
Pau Treviño	2002	10	33,33%	14	46,67%	4	13,33%	1	3,33%	1	3,33%
Ignasi Juncadella	2002	17	56,67%	8	26,67%	2	6,67%	0	0,00%	3	10,00%
Jordi de la Rosa	2002	21	70,00%	7	23,33%	2	6,67%	0	0,00%	0	0,00%
Pablo Requena	2002	22	73,33%	5	16,67%	2	6,67%	1	3,33%	0	0,00%
Jan Osul	2002	20	66,67%	4	13,33%	2	6,67%	3	10,00%	1	3,33%

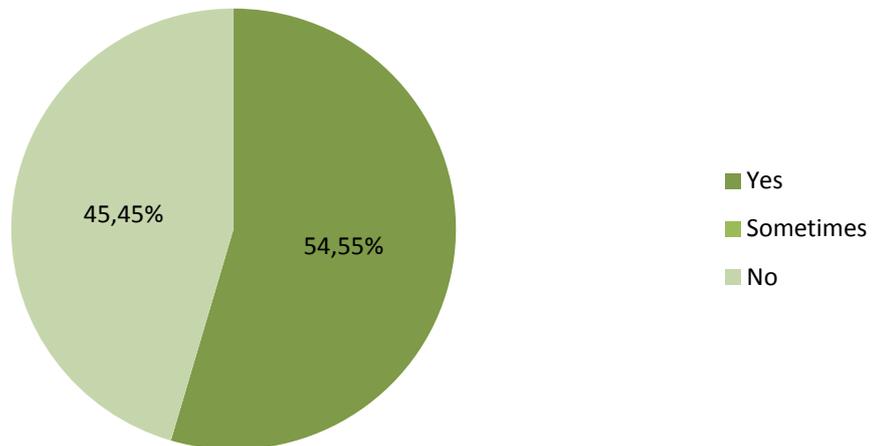


### 10.3. PRESENT DAY COACHES INTERVIEW RESULTS

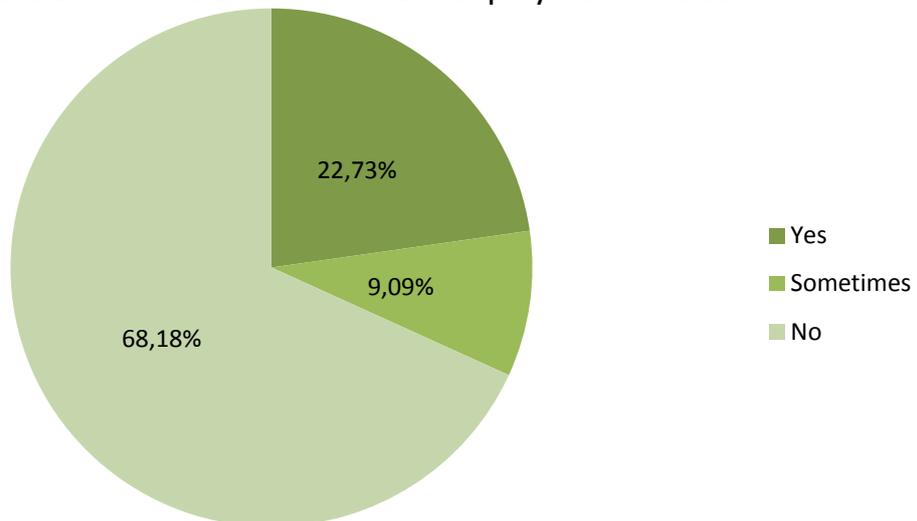
In this point are shown the different answers that present day coaches have given according to how players with crossed Laterality play.

PRESENT DAY COACHES INTERVIEW						
Players with crossed Laterality						
NAME	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6
<b>Deng Mayot</b>	NO	YES	YES	NO	Phisical advantage in the rebound. Inside-Outside balance.	NO
<b>Arnau Crespo</b>	YES	NO	YES	NO	Ofensive speed.	NO
<b>Quim Hernandez</b>	YES	NO	YES	NO	Speed, game reading, dribbling 1on1.	YES
<b>Eduard Mas</b>	YES	YES	YES	NO	Competitivity, Points.	YES
<b>David Lopez</b>	YES	NO	NO	YES	Shooting.	NO
<b>Arnau Segura</b>	NO	NO	NO	NO	Energy in deffense and struggle.	NO
<b>Pau Martinez</b>	NO	NO	YES	NO	Offensive intensity.	NO
<b>Arnau Marquez</b>	NO	NO	YES	NO	Good 1on1 defense.	NO
<b>Miquel Aliaga</b>	YES	YES	YES	YES	Anotation and offensive intensity.	YES
<b>Marc Peñarroya</b>	YES	YES	YES	YES	Game vision, points and leadership.	YES
<b>Bernat Piella</b>	YES	SOMETIMES	SOMETIMES	NO	Good decisions.	YES
<b>Albert Planell</b>	NO	NO	NO	NO	Rebound.	NO
<b>Pablo Requena</b>	NO	SOMETIMES	YES	NO	Strenght and toughness.	NO
<b>Enric Codina</b>	NO	NO	NO	NO	Good 1on1.	NO
<b>Miquel Oliva</b>	YES	NO	YES	YES	Verticality, game control and soundness.	NO
<b>Sergi Algué</b>	NO	NO	YES	NO	Integrity, work and competivity.	NO
<b>Guillermo Baltà</b>	YES	NO	YES	NO	Selfconfidence, work and verticality.	YES
<b>Guillem Lao</b>	YES	YES	YES	NO	Hard defense.	YES
<b>Robert Marsol</b>	YES	NO	NO	YES	Fluency.	YES
<b>Gerard Marsol</b>	NO	NO	NO	NO	Finalizations.	NO
<b>Arnau Güell</b>	NO	NO	YES	NO	Hard playing.	NO
<b>Alex Cuenca</b>	YES	NO	NO	NO	Balance.	YES

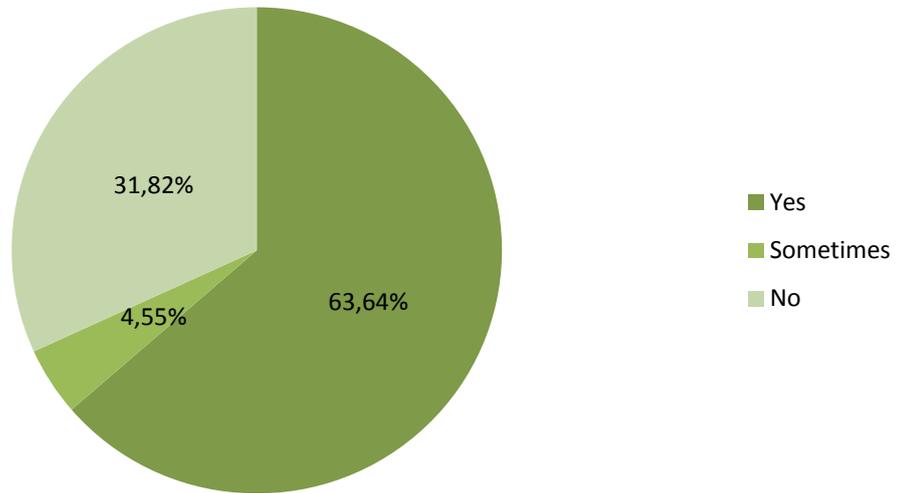
Q.1. Is it easier for the player (compared with other players in the team) to do layups from both sides, right and left?



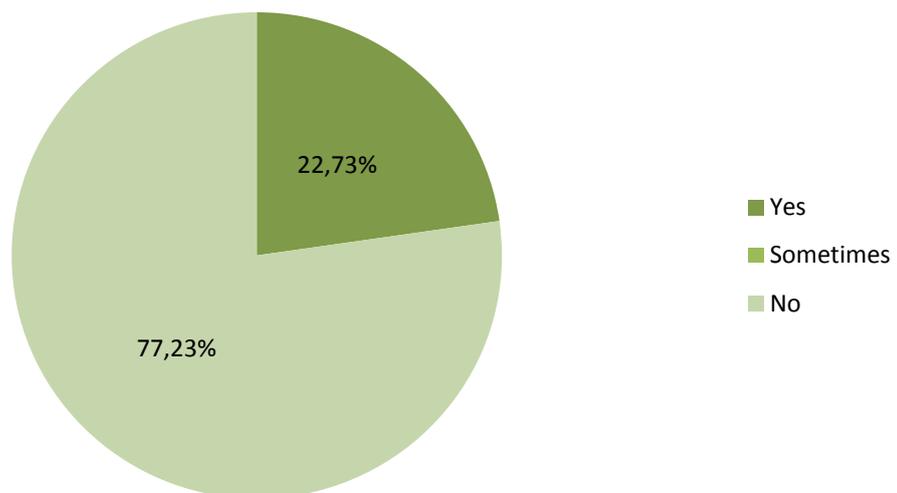
Q.2. Has the player a bigger percentage of shooting with a defender in front of him than other players in the team?



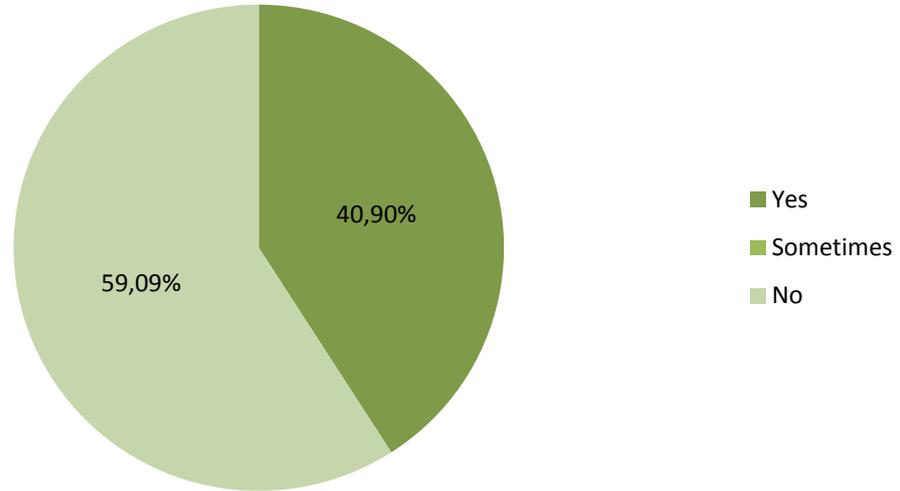
Q.3. Is it easier for the player (compared with other players in the team) to create advantages in 1 on 1?



Q.4. Has the player a wider range of vision than other players in the team?



Q.6. Is it easier for the player (compared with other players in the team) to play both sides of the court?

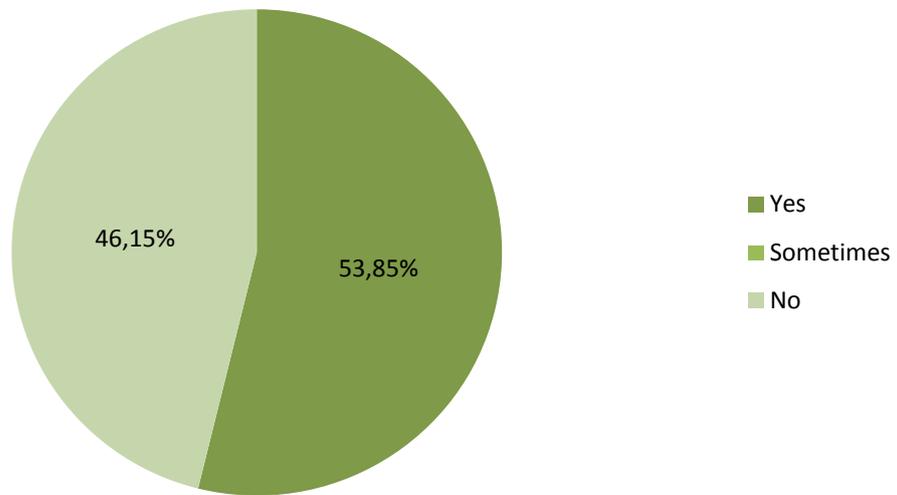


## 10.4. FORMER COACHES INTERVIEW RESULTS

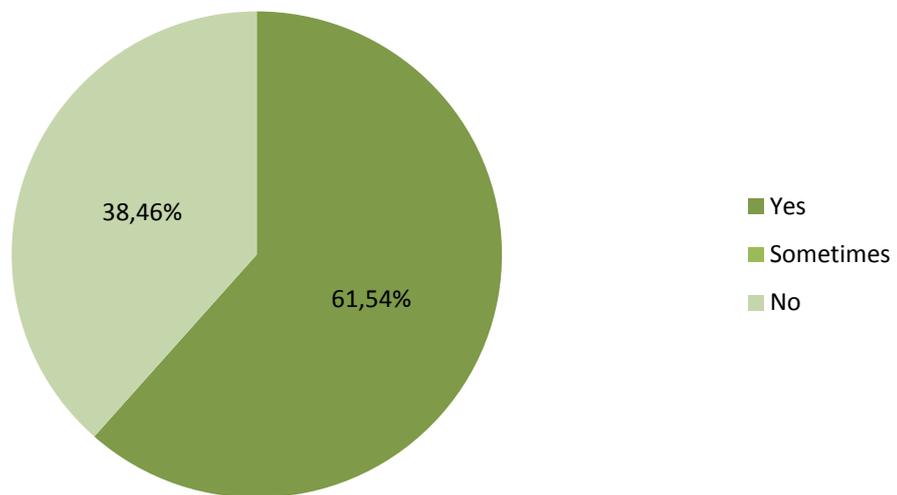
In this point are shown the answers that former coaches have given about how crossed Laterality players used to play.

FORMER COACHES INTERVIEW				
Players with crossed Laterality				
NAME	Q.1	Q.2	Q.3	Q.4
<b>Annau Crespo</b>	NO	YES	NO	NO
<b>Quim Fernandez</b>	YES	YES	NO	YES
<b>Miquel Oliva</b>	YES	YES	YES	YES
<b>Sergi Algué</b>	NO	NO	YES	YES
<b>Arnau Güell</b>	NO	NO	NO	YES
<b>Gerard Marsol</b>	YES	YES	YES	YES
<b>Guillem Lao</b>	YES	YES	NO	YES
<b>Robert Marsol</b>	YES	YES	YES	YES
<b>Eduard Mas</b>	NO	NO	50%	NO
<b>David Lopez</b>	NO	YES	NO	NO
<b>Miquel Aliaga</b>	YES	NO	YES	YES
<b>Arnau Marquez</b>	NO	YES	NO	YES
<b>Pau Martinez</b>	YES	NO	YES	NO

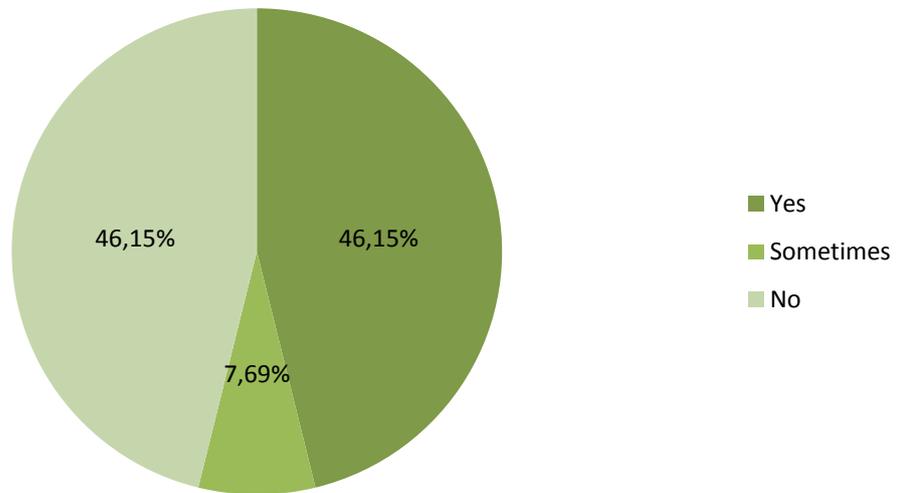
Q.1. Was it easier for the player to learn the new game actions that the coach introduced?



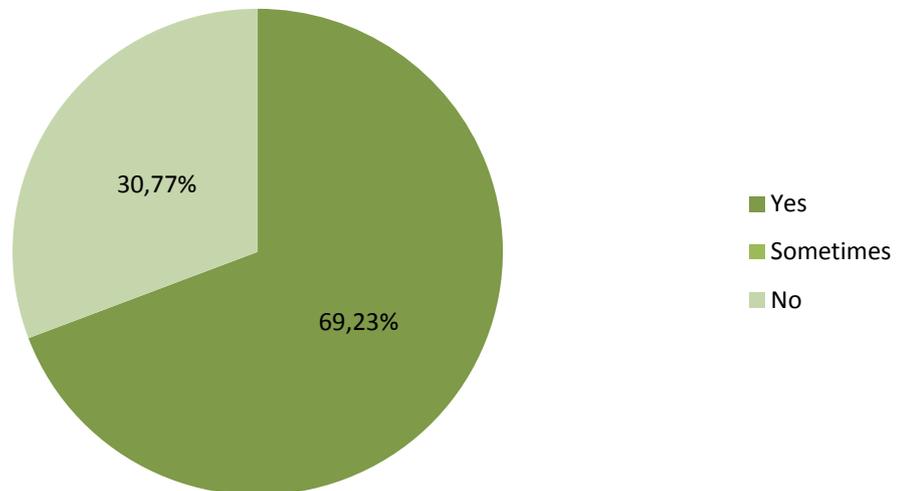
Q.2. Was it easier for the player to improve his individual technique?



Q.3. Did he read the passes better than other players in the team?



Q.4. Was it easier for the player to do the action learned in the trainings in the game?



## **11. DISCUSSION**

In this point it is shown shown the information that the results of the surveys, tests and interviews have given.

### **11.1. DISCUSSION ABOUT HARRIS TEST**

The results of these tests show that more than a third part of the basketball players (36,67%) have crossed Laterality, which means that not more than a half of the basketball players have a crossed Laterality, nevertheless a 36,67% is a very important percentage of players with crossed Laterality.

### **11.2. DISCUSSION ABOUT PLAYERS SURVEY**

The results of this survey may not be very significant, because the percentage of difficulty, considering that 1 and 2 are easy and 3, 4 and 5 are difficult, are very similar, so maybe this survey will not provide any conclusions.

This happens mainly for two reasons, the first one is that most of the players have a very good confidence in them, and for this reason there are a lot of actions which the players think that their difficulty is only about grade 1 or 2. The second reason why the difference between the players with crossed Laterality and the players with homogeneous Laterality is not significant is because these tests and surveys have been done in a club of a very good level, and all the players who play in that club should have a very good level, so the differences between the players are minimum, and they depend on the confidence of each player.

### **11.3. DISCUSSION ABOUT PRESENT DAY COACHES INTERVIEW**

The results of these interviews give us very important information, because of the fact that the results of the survey are not significant; the results of these interviews are the ones on which the conclusion will be based on.

In the first question it is shown that more than a half of the players with crossed Laterality have an easiness when doing layups from both sides.

In the second question it is shown that a little percentage of players have a higher percentage when shooting with a defender in front of them, for the other players, who do not have an advantage, it does not mean that they have it more difficult than other players in the team, it only means that they are not better than the others in this part of the game.

In the third question it is shown that for more than a half of the players with crossed Laterality it is easier to create advantages in 1on1, this is maybe one of the most important questions, because to create advantages in 1on1 it is very important to score points, and it is also a very good tool for the team, because when a player creates an advantage in 1on1 it gives more space to the other players, and this benefits the team.

In question number four it is shown that only a little percentage of crossed players have a wider range of vision than other players in the team, but it is also important information, because, usually in a team there are not a lot of players who have a wide range of vision, and if some players with crossed Laterality have a wider range of vision than other players in the team this means that most of the players with this higher range of vision could be the ones with crossed Laterality.

In question number five are shown the different things that players with crossed Laterality give to the team and it is important that of the 22 players 12 have a contribution to the team which is very close to having crossed Laterality; they give the team advantage in offense.

In question number six it is shown that for almost a half of the players with crossed Laterality it is easier to play in both sides of the court, left or right, and this also gives an advantage to the team, so it is better for the player.

#### **11.4. DISCUSSION ABOUT FORMER COACHES INTERVIEW**

This interview has the same importance as the previous one, because it gives the information about if it was difficult for the players to learn how to play basketball. The problem in these interviews is that it could not be done about all the players with crossed Laterality, because some of them were not in the club the previous years, and it was not possible to find their former coaches.

Nevertheless it was done about 13 of the 22 players with crossed Laterality, and it consisted on 4 different questions which gave different information.

In the first question it is shown that for more than half of the players it was easier to learn new actions that the coach introduced.

In the second question, one of the most important, because in basketball it is very important the improvement of the individual technique, it is shown that almost two thirds of the players improved easily their individual technique.

In the third question it is shown that almost half of the players read better the passes than other players, and like the fourth question of the previous interview, this percentage is very representative, because the ability to read the passes is one that a reduced number of players have.

In the fourth question it is shown that for almost 70% of the players it was easier to do the actions learned in the training in the games, this means that it was easier for them to learn these new abilities.

## 12. CONCLUSIONS

This research project has been done around five objectives and two hypotheses, and in this point it is going to be analysed if the hypotheses have been confirmed and if the objectives have been assumed. The objectives are which are going to be analysed first.

The first objective which was to **know how Laterality is determined and the different types that exist**, it was achieved and it was discovered that there is not only one classification for Laterality, we can distinguish two big different types of classification, including the best known, which distinguishes between Homogeneous Laterality (right and left) and Heterogeneous Laterality (forced, inversed, crossed and ambidextrous).

The second objective which was to **discover the different stages in the evolution of Laterality**, has been also achieved, it really was difficult to find a common classification of the different stages of the evolution of Laterality. However there were two that seemed to be more important than the others. These two are the Le Boulch classification and the one which appeared in a study. Both are explained in point number four.

The third objective which was to **dominate the different methods to determine Laterality** has also been achieved, but what it has been reached it was not a definitive method to determine the Laterality, instead of this it has been a big number of different question which will help determining someone Laterality, the one of their eye, ear, hand or feet.

The fourth objective which was to **know the relation between cerebral dominance and Laterality**, has been achieved too, actually it was not achieved at a hundred per cent, because even the scientists have not found a definitive relation between cerebral dominance and Laterality, despite of this, it has been found more than one relation between these two parts of the body, which are told in point number 2.

The fifth objective which was to **discover the importance of Laterality in sport**, was not really achieved, because the number of studies which relate Laterality and sports are few, and also most of the studies that have been done are private, so the access to them was impossible. Instead of showing the relation between basketball and sports,

the relation between Laterality and basketball has been explained, which has also been completed with the practical part. Apart from this, there is also the work of a very famous physiotherapist who investigated a lot in Laterality, and he discovered a method to give the weak hand or leg the same ability as the dominant hand or leg when doing a specific game action, and this physiotherapist is Paul Dorochenko.

Despite of achieving most of these objectives some of interesting knowledge, for example I came up with my own definition of Laterality, after reading and searching a lot it has been found that there did not exist a unique or better definition of it, so after this I decided to come create my own definition according to my beliefs about the topic and what most of the experts say about it. So, the definition is the following one: **Laterality is the preference to use one side of the body or the brain against the other side.**

On the other hand the hypotheses have not had the same success as the objectives, because one has been rejected and the other one has been confirmed. First of all I am going to explain the hypothesis which has been rejected.

The second hypothesis is the one which has been rejected; it exposed the idea that **most basketball players have crossed Laterality**. This hypothesis was rejected because the results show that **a 36,67% of the players have crossed Laterality** while a 60% of the players have homogeneous right Laterality, which is the dominant one in basketball players, because only a 3,33% of the players have an homogeneous left Laterality. Despite the fact that the hypothesis is not confirmed it can be said that the essence, the idea of it, has been confirmed. Because the idea was that a lot of players have crossed Laterality, that this kind of Laterality is the dominant one in basketball players, despite that this does not happen, the people with crossed Laterality are overrepresented in basketball, because in society, in general, it is not very common to have crossed Laterality at least it is not common that more than a two thirds parts of the population have crossed Laterality, despite it was impossible to find the exactly %.

The first hypothesis, in contrast with the second one, has been confirmed, because of different aspects.

First of all a difficulty has been found in the results of the players survey, because the results among the players with crossed Laterality and the players with homogeneous Laterality have been very similar, and this can have happened basically for two reasons. The first reason is that all the players normally have a good self-confidence and are very competitive, so when they were being asked questions, they could have answered with better results than the ones they really had, because they did not want to see that they were worse players than others in the teams, so because of that they thought that if they answered what they really are, they would be less good players than the others, which is not true, but these things usually happen in the teams with very good level and competitiveness among the players. The second reason could be that because the survey has been carried out in a very good level club, all the players, who are chosen, have a very high and similar level, so the difference between them is very little. For these two reasons it has been decided that the results of this survey, will not be taken into account, the conclusions will be focused basically in the two interviews to the coaches (present day and former).

So focusing in the interviews it has been found that in most of the actions at least a 25% of the players have or had an easiness when doing a basketball action, so this helps to confirm that **crossed Laterality is advantageous to play basketball**. If you take a closer look, question by question.

In the interview of the present day coaches it is found that in the first question, which asks if it is easier for the player to do layups from both sides, it is found that more than half of the players have an easiness when doing that, which is really an advantage when playing basketball, because this way it is more difficult for the defender to predict where his player will go. In the second question the coaches say that about one fourth of the players have a better percentage when shooting with a defender in front of them, however it is a high percentage, because normally, a very reduced number of players have a good percentage when shooting defended. In the third question almost two thirds of the players have an easiness when creating advantages on 1on1, which gives the player an advantage to score or to pass to another player who is open because their player has to do a help, so this is an advantage, and it is also very related with the answer of question number 1. In the fourth question, like the second, less

than a fourth part of the players have a wider range of vision, and this is a very rare ability, so like at the second question, that one is a high percentage, because we have to remember that the players who do not have an advantage do not have it more difficult than other players. In the fifth question it is shown that most of the players give the team something related to the 1on1 or the vision of the game, so having a player with crossed Laterality would definitely help the team to play better. And the last question, number 6, shows that for almost half of the players it is easier to play in both sides of the court, so like the first question this will make it more difficult for the defender to defend that specific player. So, certainly, in this interview it is shown so clear that crossed Laterality gives an advantage to the players with crossed Laterality.

Following the same topic, in the interviews of the former coaches, it is shown that it was easier for the player to learn and do new things when they were younger, so it is another clue that crossed Laterality is advantageous to play basketball. If we take a look to each question, we will see that clue clearly. In question number one it is shown that for more than half of the players with crossed Laterality it was easier to learn new game actions, so this would help to their improvement and it would make it easier for them to play this game. In the second question it is shown that for more or less two thirds of the players improved their individual technique easily than other players, so like in question number one this would help their improvement in basketball skills. In question number three it is shown that almost half of the players saw better the passes to other players in the team, and in this kind of action, this percentage could be considered a huge one, and this ability would make it easier for the player to play basketball, because they would do better passes and they would help the team to play better. And finally in question number four it is shown that a little more than two third of the players with crossed Laterality, did the actions learned in the trainings during a game, so this will help the player have more advantages during a game, what will lead to do more 1on1 or better passes, and this all help them to become better players. From my point of view in this interview it is clearly shown that having a crossed Laterality gives an advantage to a basketball player.

So according to the results, mainly, of the two interviews the **hypothesis which said that crossed Laterality is advantageous to play basketball has been confirmed.**

Despite the results, this would not say that a player with crossed Laterality is better than a player without crossed Laterality, because there are a lot of other factors that affect the performance of the players, like the motivation when learning and play, the height, the hours of training or the physical abilities of a player, this hypothesis only says that a crossed Laterality gives an advantage to the player, and maybe if there existed two players with exactly the same conditions, motivation, etc. the player with crossed Laterality would be the best one.

Another fact that occurred during the research is that most of the players when they were told what they are going to answer, all of them, did not know or had never heard of Laterality, this shows that people in general know almost nothing about this fact, which from my point of view is very important.

The same happened with almost all the coaches, and this shows, apart from the lack of information about this topic, that there was no coach who prepared their trainings according to how many players have crossed Laterality or he did not even have a plan to work specifically with players with crossed Laterality or potentiate their advantages, so I think that it would be very interesting, in the future, to do a project which would **explain different methods to work with these players, and potentiate their advantages**, like Paul Dorochenko does with tennis players.

Finally I have to say that when doing this research project had also appeared some questions that would be interesting to solve in a future, but were not solved in this project because they did not enter in its previous planning and time was limited, so there was not enough time to investigate a lot more about some of these things. Some of those questions are for example if it the same would have happened in feminine basketball? (The main one), and another like how many professionals have crossed Laterality? (Which is very difficult to investigate, because it is very difficult to access those players), or other questions. So I think that in a future these questions could be answered and would help establish a closer relation between two of my passions,

Laterality and basketball, and this way could be better understood the things that happen in this beautiful sport.

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