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EVALUATION AND INTERVENTION IN THE EVENT OF A CROSS CHILD LATERALITY CASE. ONLY CASE

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Abstract. Laterality is one of the most complex neuropsychological processes to which human beings are subjected throughout their life cycle. Although this process can be developed correctly in most of the cases, it does not happen in all of them. 30% of the world population shows problems related to undefined laterality or cross dominance and therefore, they may present problems in learning to read and write, troubles with their body image, spatial and temporal awareness difficulties and problems with mental calculation. Thus, the aim of this single-case study is to analyse which are the components, that form laterality in children, identify which are the variables that modulate it and find out about the personal, family, social an educational consequences which have an effect on the subject's life from a clinical point of view.

Key words: Laterality, learning, cross laterality.

EVALUACIÓN E INTERVENCIÓN ANTE UN CASO DE LATERALIDAD CRUZADA INFANTIL. CASO ÚNICO

Resumen. La lateralidad es uno de los procesos neuropsicológicos más complejos a los que está sometido el ser humano a lo largo de su ciclo evolutivo. Este proceso se llega a desarrollar correctamente en la mayoría de los casos, pero no en todos. El 30% de la población mundial muestra problemas relacionados con la lateralidad no definida o lateralidad cruzada, presentando problemas en el aprendizaje de la lectura y escritura, dificultades con el esquema corporal y espacio-tiempo, así como en dificultades para el cálculo mental. Por tanto, el objetivo de este estudio de caso único es analizar cuáles son los componentes que forman parte de la lateralidad infantil,

identificar cuáles son las variables que la modulan y conocer en profundidad las consecuencias personales, familiares, sociales y educativas que repercuten en la vida del sujeto desde un punto de vista clínico.

Palabras clave: lateralidad, aprendizaje, lateralidad cruzada.

Introduction

The brain, like any of our organs, is formed throughout life development (Blakemore & Frith, 2007). During this period, it undergoes constant changes both quantitatively and qualitatively. At a quantitative level, the brain modulates its shape, as well as its volume, to accommodate the neural connections that are forged throughout development (Ferré, Catalán, Casaprima and Mombiela, 2004). These neural connections imply that it undergoes waves of brain reorganization (qualitative changes), where the function and organization of all brain structures is modified, from the most primitive to the most complex (Blakemore and Frith, 2007).

All these complex structures need a good organization that allows the brain to be able to act in a way adapted to the environment. Therefore, it (as well as our entire body) is organized in a binary way, in which all structures have their function based on their location (Ferré, Catalán, Casaprima, Mombiela, 2016): left hemisphere and right hemisphere.

Thus, each of the hemispheres is specialized in specific functions. In general, the left hemisphere is in charge of language (Gazzaniga, 2000) and information processing (Ferré et al, 2004), as well as the hemisphere in charge of writing, reading or numerical reasoning (Cumandá, 2012) and whose processing is sequential, that is, the one that analyzes the details step by step (Rivera, 2010). The right hemisphere would then be in charge of the most spatial part, with functions intended to process corporo-spatial information (Ferré et al, 2004), as well as the fact of being able to orient itself in space and prepare conceptual maps (Cumandá, 2012), being its most holistic and global processing (Rivera, 2010). This statement would lead us to think about the fact that each of the hemispheres has a specific functionality and that, therefore, depending on the task, one hemisphere will prevail over the other, thus marking a dominant and a sub-dominant hemisphere (Ostrosky, 1986).

Thus, it has been considered from the first theories that the left hemisphere is the dominant hemisphere, due to the linguistic function it is in charge of, in addition to being the hemisphere in charge of the dextrality of more than 90% of the world population (Romero, 2010).

However, although it is true that each of the hemispheres is preferably assigned to specific functions, it should be noted that neither of these acts “alone”, since it requires that both hemispheres participate in all the activities or tasks carried out for the correct development of the same (Ferré et al, 2004). Therefore, the concept of the dominant/non-dominant hemisphere is replaced by other more specific terminologies, in which the term cerebral reference is called in reference to the greater participation of one or the other in certain tasks or functions (Repila, 2014) or depending on the novelty of the task (Tirapu, 2018), but always bearing in mind that both participate as a globality not subject to dissociations (Ferré and Irabua, 2002).

This interhemispheric connection is produced by the corpus callosum. In the words of Quintero, Manaut, Rodríguez, Pérez and Gómez (2003), "the corpus callosum is the largest interhemispheric commissure and is in charge of connecting both hemispheres transversely", which is made up of more than 200 million fibers nervous (Romero 2010, Quintero et al, 2003). In other words, the corpus callosum is responsible for establishing relationships between the highest functions of the Nervous System, and thus being able to get the right side of the brain to know what the left does (Ferré et al, 2016).

However, at the moment when the hierarchical organization of functions fails and the cerebral hemispheres do not communicate through the corpus callosum in a successful way, the circuits designed to elaborate a response are not capable of carrying out the tasks that correspond, entering the bark scene. The cortex, which is in charge of higher functions, carries out the "resolution" of lower-level tasks, causing a blockage and saturation when it comes to performing its own tasks, such as planning, directing, or raising awareness (Ferré et al, 2004). This process causes subjects with learning problems linked to laterality to appear, presenting difficulties in developing correct learning adapted to the needs of the environment (Casado, Llamas & López, 2015).

Laterality has been a very studied aspect by different authors, and there is controversy regarding its etiology (Bilbao and Oña, 2000). According to several authors (Galin and Ornstein, 1972; Hicks and Kinsbourne, 1978 and Milner, 1964), laterality is considered an aspect linked to genetics, it being an intrinsic factor in the nature of the human being, and difficult to change. However, authors such as Dawson (1972) or Oña (1999), establish that lateral predominance is the result of learning and that it can be modulated.

As of today and taking into account the latest studies, it can be concluded that the functional distribution between the two hemispheres is predetermined by genetic information, but that it is the environment and learning that causes their modulation and subsequent development. In the words of Ferré et al (2004): "Genetics provides the basic design, but interaction with the environment is essential for synapses to be activated and circuits and connections to be built."

Laterality is defined as "the functional predominance of one side of the body over another, and is manifested in the preferential use of the hand, foot, eye and ear" (Portellano, 2008). It is what allows us to orient ourselves at a time-spatial level, which helps us to differentiate what is left and right (Rivera, 2010), showing a right or left-handed ability at the eye, foot, hand and ear level (Squadrone et al., nineteen ninety five). Thus, laterality is the fruit of the ordered distribution of functions between the two hemispheres, but without coming to suppose an absolute dominance of one hemisphere over another, but rather as a relative dominance depending on the task or activity (Repila, 2014; Tirapu, 2018).

Therefore, laterality is understood as a complex process that runs through the neuro-sensory-motor aspects throughout the entire cycle (Cumandá, 2012), and as such, goes through several phases. The first phase of the development of laterality is the prelateral stage, comprised between the zero and four years of the child. In this phase, what is intended to be achieved is that the subject has a proper domain of the sensory organs and the body itself, guarantee good contralateral automatic coordination and three-dimensional sensory function, as well as correct activation of the corpus callosum (Ferré et al, 2016).

This phase in turn is divided into three large blocks, in which aspects related to the development of sensory organization stand out, as well as the characteristic responses of the child after its achievement (Table 1, Ferré et al, 2016).

Table 1

Evolutionary sequence of laterality

	Postural Organization	Sensory Organization	Answers Characteristics that the baby should organize (identifiable)
Homolatera phase	Alternating single-sided	Monocular, monaural, monotactile alternating perception.	Asymmetric and symmetric cervical tonic reflex Face-up domain. Body Extension I turn on the ground. Face down domain. Circular crawling.
	Bilateral	Ocular, auditory, tactile duosensory perception.	Inexperienced and homolateral linear crawling.
Contralateral phase	Contralateral	Ocular, auditory, tactile bisensory perception.	Linear expert Sitting Crawl Mastery of double-density Ambulation Contralateral ambulation
Laterality	Laterality	Auditory, tactile, visual dominance	Single stand Lateralization

Note: Adapted from Ferré et al, 2016.

During these phases, and since laterality is a complex process that takes place throughout the evolutionary process and where factors such as genetics, environment and stimulation interact, difficulties may arise when defining lateralization or delays in same.

The laterality, therefore, can be of different types (Brusasca, Labiano and Portellano, 2011; Ferré et at, 2016; Repila, 2014):

- Defined laterality. Defined laterality is that by which the subject predominantly uses one side of his body in both hands, feet, ears and eyes. Thus, the one who predominantly uses his right part will be right-handed and the one who uses his left part will be left-handed.
- Disgruntled laterality. It is one that has been produced by changing the primarily manual preference due to social and educational influences. It can cause neuropsychological disorders such as dysfunction, obstruction or inhibition of brain function.
- Ambidextrism. It occurs when both sides of the body are used without preference. This phenomenon is rare in population incidence. It indicates poor neurological organization and interhemispheric functional organization
- Crossed laterality. It refers to a non-homogeneous lateral predominance, that is, the fact that the right side prevails in one limb and the left side in another limb. This usually occurs when there is a reason for crossing the eye and ear, the most frequent being that expressed with right-handed predominance of the hand and foot together with left-eye predominance.

Although it is true that the majority of the population develops their laterality successfully, there is a significant percentage of children who do not adequately develop it. Approximately a 30% of the population suffers from cross laterality, especially women due to their cerebral symmetry (Brusasca et al, 2011). In the words of Bernabéu (2014), "the development of laterality has repercussions on different facets of the evolutionary development of the child, such as motor development, motor coordination, capacity for orientation and spatial-temporal perception, as well as knowledge of body schema". Specifically, the fact of having crossed laterality leads directly to presenting problems when it comes to rotating figures, confusing the spatial representation of letters or numbers or to presenting difficulties related to the body schema itself, as well as motor and time relationship-space.

In short, learning-related processes such as language, literacy or mathematics would be directly affected by the lack of lateral predominance, since it is necessary to have a dominant segment that has greater strength, precision, proprioceptive quality, balance and coordination to carry out this type of learning (Mayolas, 2010). According to Bernabéu (2014), children with a defined laterality dominance have advantages when it comes to learning to read, write and do mathematical calculations with respect to those who have difficulties in predefining their laterality. For example, authors such as Mesonero (1994) mention that the difficulties that may appear during the learning process of reading can be caused to a great extent by the difficulty of discrimination between right and left, delayed nerve maturation and alterations in cross

laterality. Like reading, there are also dysgraphia and dysortography problems, as well as calculus problems. In addition, this author relates the problems of reading and writing due to alterations in psychomotricity, body schema and spatial structuring.

Although it must be borne in mind that the laterality process is evolutionary and whose predominance does not begin to be established around 4-6 years with the learning of codes (Ferré et al, 2016), it is true that these problems must be detected from the as efficiently and quickly as possible, in order to supply all those deficits in the shortest possible time. For this, manifestations such as the following must be taken into account (Bernabéu, 2014; Ferré et al, 2016):

- Difficulties in the automation of reading, writing and calculation.
- Organization problems in space and time.
- Personal and emotional instability.
- Disorder of body landmarks.
- Difficulty getting to the right and left of the body midline.
- Marked slowness of reflections.
- Graphic and/or reading investments.
- Slow reading speed and lack of reading comprehension.
- Loss of attention.
- Problems in relationships with peers.

Therefore, a complete and global exploration of the different aspects related to the laterality of the subject is essential, with the emphasis on exploring the contralateral base development, the symmetry of the body and functional architecture, the automation of the previously reached levels of organization and the type of hand-eye-foot-ear laterality. The objective of this more exhaustive exploration is none other than being able to detect the lateral predominance of the subject and see in which phases or aspects the underlying problem may exist, in order to make a good approach and to design a manual preference acquisition strategy that improves the quality of life of the child (Ferré et al, 2004, Mayolas Pi, 2010).

In short, this study aims to contribute to the updating of laterality disorders research and to know in depth what are the factors and components that affect its correct development. For this, a single case study is carried out in which all relevant data that may be clarifying in the controversy surrounding laterality can be collected, and thus be able to ensure the existence of

a literature together with the entire scientific community truthful and rigorous that can be applied and taught in educational centers, psychology centers and training centers.

Objectives and hypotheses

The general objective of this study is to analyze which are the components and variables that are part of child laterality from the perspective of a single case study. The specific objectives are:

- Evaluate the main causes of laterality from a clinical perspective.
- Know the different tests and evaluations related to laterality.
- To analyze techniques for treating laterality disorders.
- Carry out a complete treatment plan for the improvement of the subject.
- Explore in depth what consequences it entails on a personal, family, social and educational level.

Once the research objectives have been established, the following hypotheses will be established:

1. Crossed laterality will be positively associated with learning-related problems.
2. Having a correctly defined laterality will be associated with an improvement in reading ability, as well as in the writing of the subject.
3. A correct defined laterality will be positively related to an adequate psychomotor development.
4. An individualized and personalized treatment in the patient will be positively related to a greater probability of improvement in their academic results.

Method

Participants

Being a single case study, the sample used to achieve it was from a single subject. Said subject (hereafter J.S.C) is a male, 10 years old. He is currently in the 4th grade of elementary school, he has repeated a year on one occasion. J.S.C is the youngest son of three brothers, with parents separated since he was four years old, with the mother having custody. He has two older brothers, aged fifteen and seventeen. The family has a medium socioeconomic and

educational level. J.S.C does not present any relevant disease or apparent neurological problems, as well as any psychological diagnosis detected to date. There is no family history.

The therapeutic demand comes from the parents of J.S.C, who express concern about its academic problems. They refer to the lack of motivation and the slowness of the subject to carry out academic tasks, since it presents problems when writing (both in form and in time) and also when reading. In relation to his psychomotricity, he presents slowness in alternating movements and movements that need more concrete and fine skills. It also presents difficulties to discriminate right-left. On an emotional and social level, he is a child with great concerns and curiosities, a lover of music and rock culture. Socially, he is an extroverted and amusing boy, reason why he does not present apparent problems in the relation with his equals.

Instruments

For the present study, different sources of evaluation have been used to determine what is the real problem underlying the reason for consultation. It should be noted that the specific evaluation for this single case study has been in the form of a funnel, that is, it has started with more general techniques and has ended with more specific tests and questionnaires depending on the results obtained.

Firstly, an interview was carried out both with the subject and with the parents, with the aim of obtaining all the relevant information that may be useful for therapeutic follow-up. Specifically, the interview used has been based on Silva (1998), where it is postulated that the semi-structured interview should be understood as a Gestalt, in which all aspects, situations and participants interact with each other, considering themselves as a whole. This interview has specific objectives and on which the interview was based (Silva, 1998):

- Perceive the complete behavior of the patient and their parents.
- Listen, experience, observe.
- Stimulate verbal expression.
- Operational definition of the problem.
- Identify antecedents and consequences thereof.
- Know solution attempts.
- Develop hypotheses.
- Plan the diagnostic process.
- Develop an integrative concept map.

When conducting the interview with the minor, it is necessary to emphasize that the process of the same changes, emphasizing other aspects that can provide more information, such as their verbal and non-verbal behavior, the forms of interaction with the therapist himself, verbalizations about the problem or the evolutionary variables themselves such as age. That is why the therapist must have deep knowledge about how to conduct interviews with children and adolescents, as well as have knowledge of child or evolutionary psychology (Maganto, 1998).

Once all the data has been collected (mainly by the parents), the case is recorded. The anamnesis at this time would act as a summary of all the relevant data mentioned so far, from a passive perspective, where they will be organized by aspects or dimensions of the subject: family, school, friends, etc. (Pujol, 1982).

In summary, the purpose of the anamnesis is to collect information on the subject from the prenatal, perinatal and postnatal moments up to the present time, taking into account those relevant factors that explain the reason for the consultation, in an objective and dynamic way. However, the purpose of the interview is to study and understand the behavior of the subject at a global level, with the information provided being more subjective and profound (Bleger, 1964).

Specifically, during the interview, special emphasis has been placed on knowing all those data related to the laterality process in the J.S.C family, as well as in the subject himself from his birth to the present day. In this way, the data on the lateral dominance of the family, possible functional or sensory alterations and possible associated pathologies have been studied in depth (Ferré et al, 2016), since, although the etiology of manual laterality is unknown, they have been attributed genetic influences among others (Galán and Del Río, 2012).

Secondly, it is necessary to emphasize that a good evaluation process cannot be achieved without a good observation process (Fernández Ballesteros, 1992a). That is why observation has been used throughout the therapeutic process, since it provides information from the first interviews to the end of the intervention with the subject. In the words of this author, three main factors related to observation must be taken into account:

- Observing subject, since it can be an external observer (therapist or co-therapist, family) or internal observer, that is, through self-observation.
- Observation site, which can be natural (in its own context) or artificial (in consultation).

- Time in which the observation is made, current or past.

Be that as it may, observation allows determining the patterns or behaviors that the subject develops in different environments or contexts, with different people or at different times, thus causing the therapist to carry out a much more detailed analysis of what the therapeutic objectives should be to work (Fernández Ballesteros, 2014). Specifically, the observation of the laterality process can be done easily both at home and in therapy, taking into account what are the main tendencies of the child when it comes to moving, taking things with the most common hand, looking through a hole, etc. However, it must be borne in mind that these types of movements and actions must come out spontaneously and automatically in the child so that the information is as truthful as possible (Ferré et al, 2016).

Regarding more specific scales, a search was carried out for all those tests relevant to the case at hand, trying to evaluate all those areas of the subject that can provide relevant information for the future diagnosis. Firstly, the Weschler intelligence scale for children has been used (WISC-V, Flanagan & Alfonso, 2017).

This test assesses overall intellectual performance in children ages six through sixteen. It is made up of fifteen specific tests grouped into two major indices, primary (verbal comprehension, visuo-spatial dimension, fluid reasoning, working memory and processing speed) and secondary (quantitative reasoning and auditory working memory). It is a standardized test for individual use with a completion time of about fifty minutes (Huguet, 2018). The reliability of this test is divided into two halves. The reliability of the primary indices ranges from 0.88 to 0.93 and the reliability of the secondary indices ranges from 0.92 to 0.95. The reliability of Total IQ or CIT is 0.95. Furthermore, the scale shows high internal validity (Amador and Forns, 2019).

On the other hand, the CREA Test has also been used, a test that evaluates the creative capacities of all those subjects from six years of age until adulthood. From a statistical point of view, the CREA test presents high reliability (0.8756), as well as significant validity (Martínez Zaragoza, 2003). It is a quick and objective test that consists of writing all those possible questions that are generated from the visualization of an image. In addition, evaluating creativity in such an objective way offers the therapist the possibility of knowing more in depth aspects to take into account of the subject and her future intervention (Corbalán & Limiñana, 2010).

Another of the batteries used is the PROESC writing process battery that evaluates the processes involved in writing and error detection (Cuetos, Ramos & Ruano, 2002). The battery has a high internal validity both at the factorial level and at the criterion level, as well as a reliability of 0.82 (Cayhualla and Mendoza, 2012). It is a battery that can be administered individually or collectively, with ages between eight and fifteen years of age. It consists of five subtests, of which only two have been used to evaluate the writing of J.S.C: dictation of words and dictation of sentences.

In addition and closely linked to said battery, the battery for the PROLEC-R reading processes has been made (Cuetos et al, 2014), a battery that analyzes the reading processes and all the possible cognitive processes involved in it. This battery is made up of nine tests divided into four processes in which the following stand out: letter identification processes, through the letter name or sounds test and the same-different test; lexical processes or visual recognition of words, through the test of reading words and pseudowords; syntactic processes through grammatical structures and punctuation marks, and finally semantic processes through the understanding of sentences, texts and orally. The test shows a significant content validity, as well as a reliability of 0.687 (Salvador-Cruz, Cuetos and Aguillón, 2016).

Regarding the emotional aspect, a cross-sectional evaluation has been carried out, that is, throughout the sessions (both evaluation and intervention) emotional aspects of the subject have been analyzed through open questions about their interests, thoughts about the "problem", concerns and other aspects for the correct interpretation of it. However, standardized tests have also been used to complete the information.

The test chosen for this purpose has been the list of adjectives for the evaluation of the self-concept or LAEA. This test evaluates a series of aspects related to the physical, social, emotional and intellectual self-concept (Garaigordobil, 2011). This presents an adequate factor validity above 0.90 and a reliability that shows the stability of the LAEA test.

Finally, an evaluation focused on spatial orientation, psychomotor aspects and corporality in the subject was carried out. Thus, an exhaustive analysis of spatial orientation has been made, evaluating, as Gonzato, Fernández Blanco and Díaz Godino (2011) cite "the description of the subject's situation with the near space, the displacement in relation to himself and the use of the concepts of left-right, front-back, up-down, near-far and near-far". Therefore, and as the authors themselves indicate, "this criterion aims to evaluate the orientation and

spatial representation capabilities, taking into account both the language used in the description and the representation in the plane of objects and situations."

On the other hand, the Harris Test was used to assess the lateral predominance of the subject ((Harris, 1977). This test consists of evaluating the lateral predominance of each body segment of the subject using twenty-six tests that evaluate the lateral mastery of the hand, foot, ear and eye (Ferradas, 2015).

Furthermore, following the Harris Test line (Harris, 1977), each of the body lines involved in laterality (hand, foot, eye, ear) has been evaluated in a more comprehensive and concrete way. In this way, the entire evaluation has been carried out through different activities and procedures that can analyze in depth the different lateral predominance of the subject.

Procedure

This work has been carried out through the ITIPA practice center, a center dedicated to comprehensive psychology and trauma therapy, where patients with all kinds of problems are received. In this way, the case of J.S.C was evaluated by the internship tutors and subsequently assigned to carry out the final master's work, previously accepted by the ethics committee of the European University of the Atlantic in Santander (Spain).

Once the case was assigned, a meeting was held with the family in which they explained the purpose of the project, what the objectives were and what the procedure to be followed would be, as well as the aspects of confidentiality and ethics. In this way, and with all the data from the study on paper, the informed consent was signed (Annex 1) by the family for their minor parent to participate in the study.

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The way of working with J.S.C has been through fifty-minute sessions, established weekly within the ITIPA center and taught by the internship student. Each session had the objective of something different and essential depending on the times of therapy (see Table 2), although in all of them there has always been a common objective and that of establishing good

rapport with the patient, emphasizing establish a game dynamic that should occur in all cases in which an infant is involved.

Being a unique case, the sessions will focus first on the correct evaluation and consequent possible diagnosis, followed by the subject's intervention and treatment plan. Being younger, the treatment will also be focused on the family and, if possible, on school.

Table 2

Procedure of sessions

Nº of sessions	Procedure	Phases
1st session	First contact. Interview with J.S.C and parents. Reason for consultation.	Establish good rapport. Data collection. Case history.
2nd session	WISC-V + TEST CREA.	Evaluation J.S.C.
3rd session	PROLEC and PROESC.	Evaluation J.S.C.
4th session	LAEA and Test Harris.	Evaluation J.S.C.
5th session	Laterality Assessment.	Evaluation J.S.C.
6th session	Return of information to parents and school. Preparation of reports.	Diagnosis and intervention objectives.
7th session	Improve body schema and body dominance.	Intervention J.S.C.
8th session	Activities and games Consolidation of manual and foot preference.	Intervention J.S.C.
9th session	Manual preferential consolidation. I work in writing. Return advances to the family.	Intervention J.S.C. Information to parents and school.
10th session	I work in writing. Visual and auditory consolidation.	Intervention J.S.C.
11th session	Consolidation of visual preference. I work in writing. Return advances to the family.	Intervention J.S.C. Information to parents and school.
12th session	Spatial and temporal organization.	Intervention J.S.C

13th session	Eye-hand-foot-ear integration. Gymkana. End of treatment.	laterality	Intervention J.S.C. End of treatment.

Note: Author's creation.

Results

Once the resolution of all those pertinent tests has been carried out and the evaluation of the subject has been completed, all relevant results that may clarify the case in question must be revealed. Being such a complex and exhaustive evaluation, the results of each test will be specified in the same order that they have been presented in the Method section.

The results obtained on the Weschler Intelligence Scale for children WISC-V show significant results. As can be seen in Table 3, the scalar scores and the equivalent age of the tests performed show that subtests such as matrices, digits, keys, drawing span and symbol search are below the standardized mean for the subject's age. Specifically, the Matrices score (with an age equivalent to 6 years 10 months), shows possible alterations in the subject's ability to reason abstractly, as well as to process visual information. As for the Digits subscale (with an equivalent age below 6 years), it shows that the subject presents possible deficits in immediate auditory memory, as well as in working and attention memory. On the Claves scale (with an equivalent age below 8 years) the results show possible difficulties in the subject's speed and visuomotor skills, as well as problems in associative learning and pencil and paper handling. Regarding the Span scale of Drawings (with an equivalent age below 6 years), the results show that the subject has possible problems with the ability to memorize visually, as well as in working memory. Finally, the results in the Symbol Search subscale (with an equivalent age below 8 years), show that the subject has serious difficulties with perceptual precision and speed, as well as speed difficulties in processing simple visual information.

Table 3

WISC-V scale result

TEST	Direct scoring	Scalar Score	Equivalent age
Cubes	30	11	10 years and 10 months
Similarities	33	13	12 years and 10 months
Arrays	13	7	6 years and 10 months
Digits	14	4	< 6 years and 2 months
Keys	24	5	< 8 years and 2 months
Vocabulary	27	9	9 years and 10 months
Balances	18	9	9 years and 2 months
Visual Puzzles	20	14	> 16 years and 10 months
Spam Drawings	13	4	< 6 years and 2 months
Search symbols	17	7	< 8 years and 2 months
Arithmetic	18	9	9 years and 2 months

Note: Adaptation of Weschler's version, 2015

In addition, as can be seen in Table 4 (primary indices), the results show conclusive results, with the most affected indices being working memory and processing speed. The 1st percentile in working memory seems to indicate that the subject has serious difficulties in temporarily retaining auditory and visual information for a certain time.

Lastly, the 9th percentile in processing speed seems to indicate alterations in the subject's ability to explore, order and discriminate simple visual information quickly. These first results already show encouraging and relevant data to understand what the subject's functioning is and in which aspects there are deficits.

Table 4

Primary indices

Indice	Sum scalar scores	Composite score	Percentage	95% Confidence interval
Verbal understanding	22	ICV 106	66	97-119
Visospatial	25	IVE 114	82	104-121
Fluid reasoning	16	IRF 88	21	82-96
Work memory	8	IMT 67	1	62
Processing speed	13	IVP 80	9	73-91
CI TOTAL	58	CIT 87	19	81-94

Note: Adapted from the Weschler version, 2015

Regarding the results from the CREA version C Test, a direct score of 13 has been obtained. This corresponds to an 80th percentile, so we can affirm that J.S.C has high creativity. It is relevant to note that, due to the slow writing, JS.C completes the questionnaire orally instead of writing the questions himself.

In tune with the previous test, the Battery for Writing Processes (PROESC-R) has been carried out, specifically the test dictated by a newsroom. In dictation it is observed that J.S.C has a very slow writing speed, taking five minutes to complete 32 words. Furthermore, it states that the dictation is very long. The letter is large and has an irregular line. There are errors in the letters that imply curvature and union of words, with little clarity being observed in the b, l, j and q. There are also misspellings such as the little use of capital letters in proper names (Parakeet) and beginning of sentences after periods, lack of accentuation (birds) and confusion between b / v (liked). (Appendix 2)

Regarding the writing process, the results obtained in the Battery for the PROLEC-R Reading Processes are as follows (Table 5):

Table 5
Results of the PROLEC-R scales

Scales	Direct scoring	Precision	Speed	Reading Skill
Reading letters	20	Normal	Normal	Average
Same-Different	20	Normal	Normal	Average
Word reading	39	Normal	Very slow	Low
Pseudoword reading	38	Normal	Very slow	Low
Gramatical structures	13	-	Normal	Average
Punctuation marks	12	Normal	-	Average
Understanding sentences	15	Doubts	-	Average
Text c comprehension	13	-	-	Average
Oral comprehension	5	-	-	Average

Note: Adapted from the PROLEC-R scale

The PROLEC-R Battery is organized through processes. The first process is the initial process of letter identification, evaluated through the subscript "letter name" and "equal-different". The results obtained in this process have been normal both in precision and speed, as well as in reading ability, showing that J.S.C knows how to identify letters and discriminate them, an essential aspect to read correctly.

However, in the second process called "lexical process", the scores show problems both in the "word list" and "pseudoword list" subscale, showing problems mainly in the speed to read them. Specifically, presenting problems in this process may be for reasons related to the non-preference of the recovery path of the reading processes (lexical or sub-lexical), but also with other problems derived from the difficulty of integrating information. The third process studies the grammatical aspect, through the subscales "grammatical structures" and "punctuation marks", showing adequate and standard results. Finally there is the semantic process, formed by the understanding of sentences, texts and oral comprehension. The results

show doubts in the precision in the level of sentences, as well as a very low direct score in oral comprehension. This shows the possible difficulties of the child to extract the meaning of the sentences, as well as difficulties in the correct information of the information.

When evaluating J.S.C, the emotional aspect has also been taken into account, evaluated through the different interviews but also through the List of Adjectives for Self-Concept (LAEA). The percentile obtained through the direct score has been 90, so it is concluded that J.S.C has a good emotional, physical, social and intellectual self-concept.

On the other hand, the results obtained in the evaluation in spatial orientation have been decisive in determining the deficit in the subject. J.S.C shows orientation problems, showing difficulties to differentiate left, right, up, down, front, behind. Thus, in activities such as pointing to objects with different hands, saying what position these objects are in relation to others, or placing himself in a certain specific position, the difficulties were obvious. It also presents difficulties in the speed to carry out simple exercises, since it takes a lot of time to think about what is indicated, showing deficits in the automation of these processes.

Regarding the Harris Test, the results show that the subject apparently presents a crossed laterality (in acronyms of the DIDI questionnaire), since he shows dextral preferences in hand, foot and ear (although with slow actions) and dextral or sinistral lateral alternation in the eye domain. This issue has been evaluated in more detail through the detailed evaluation of each of the lateral domains: manual, foot, visual and auditory laterality. The results show similar results to those already mentioned in the Harris Test, showing preferences in the right hand, foot and ear, but finding doubts in the ocular preference.

Diagnostics

In conclusion, once all the results obtained throughout the evaluation have been analyzed, it can be concluded that J.S.C presents learning problems derived from difficulties in written expression. This could be due to a base problem related to a possible cross laterality with visual crossing. This causes difficulties in one's own corporeality and body schema, difficulties in writing and reading, as well as in spatial and temporal organization. Therefore, the intervention will be focused on improving all these aspects in particular, and on improving its quality of life.

Intervention

Once the diagnosis is made, the intervention and treatment plan is carried out. The treatment chosen for this case has been mainly therapeutic and individually. It is important to note that although the treatment of cross laterality has common guidelines and objectives, there are no equal cases. This is because each person presents different aspects, characteristics and pathological situations, so the treatment should be focused only on the subject in question with whom they are going to work, adjusting the intervention objectives to their needs (Ferré et al, 2016). In addition, it should be noted that this study has been integrated into the multidisciplinary approach of the center, making game dynamics the central axis of the therapy and also, taking into account the systemic therapy of the center in which the family and educational environment count as main factor for the development of the subject and its problems.

In this way, once all those individual variables of the subject and the problem in question have been taken into account, the conclusion is reached that a neuro-psycho-educational intervention will be the most appropriate choice for the case and the context. This is because the problem of cross laterality may have a neurological origin, but also at a psychological level or due to contextual and educational experiences. Thus, taking into account the aforementioned and based on the book by Ferré et al (2016), the specific treatment objectives for J.S.C have been:

- Improve the corporality and the corporal scheme.
- Consolidate laterality at manual, foot, visual and auditory levels.
- Train graphomotor skills to improve writing.
- Improve spatial and temporal organizational.

Corporeality and body scheme

The development of the body schema must be considered as a necessary objective within the intervention for the correct achievement of the overall development of the subject, in order to ensure that the subject is aware of their own perception and that of their environment (Fontana, Pereira and Rojas, 2006). In this way, the training of the corporeality of the subject and the enhancement of knowledge in the body schema itself has been carried out through different activities:

- Middle line. Exercises related to the body midline consist of drawing the midline on the body, in drawings or in front of a mirror. Then parts of the body that are in the midline are named (Annex 3).
- Point out, recognize and name body parts.
- "Sí, mi capitán" ("Yes my captain"). This game consists of giving an order to the partner (in this case patient-therapist) to carry out a series of instructions related to the body (Annex 3)
- Integration exercises of the two hemicibodies. Dividing the body through the midline causes us to have "two halves of the body." This means that the child must first know how to differentiate what is her right and left, and then how to integrate both. To achieve this integration, a color is assigned to each part of the body (blue-right / yellow-left). Once assigned, a series of exercises related to color and body part are requested. Once this objective has been achieved, the midline is "crossed" and exercises will be carried out focused on achieving the integration of the two half-bodies.

These exercises stimulate the child's proprioception and give him the opportunity to get to know those parts of his body necessary to perform certain tasks of a bodily nature, providing the overall development of the subject in the environment around him.

Consolidation of laterality at manual, foot, visual and auditory levels

Although it is true that laterality is considered a superior process at a global level, it should not be forgotten that a good lateral eye-hand-leg-ear organization is necessary for good subsequent development (Ferré et al, 2004). For this reason, one of the primary objectives of the intervention has been to consolidate laterality at each of these levels, emphasizing visual dominance, since it is the most affected aspect.

Manual laterality

Taking into account the results obtained in the evaluation of the subject, right-handed manual dominance was consolidated, although both gross and fine psychomotor processes were affected in terms of procedure and execution time. For this reason, the proposed activities have aimed to improve dominant manual integration as well as facilitate general and bodily harmonization (Cumandá, 2012; Ferré et al, 2004).

- "Hot Potato". The game consists of throwing and catching objects between the therapist and the subject with the desired hand for a timed time. Whoever has the object in hand loses. The goal of this game is global body timing.
- Shoot a target. The game consists of making balls in a bucket with the dominant hand and then changing to the non-dominant hand.
- Make small constructions (Lego type).
- Hold object in balance in one hand while performing another action.
- Slap a balloon with the desired hand. The exercise consists of keeping the balloon inserting which hand to use (once right, next left).

All these exercises have the common objective of stimulating the dominant hand, integrating manual laterality as an automatic and effective process, coordinating the hand with other parts of the body (eg, hand-eye), as well as stimulating other higher processes such as working memory. , inhibition processes, etc.

Foot laterality

In the words of Repila (2014), the predominant foot laterality does not form part of one of the main objectives in terms of diagnostic criteria and lateral intervention, since this has the function of supporting and balancing higher functions. However, it is important to note that the correct functionality of the same interferes with the consequent laterality of sensory and manual dominance. Therefore, the exercises chosen for this purpose have been:

- "To the lame leg". Keep the balance to the lame leg making a circuit.
- Kick a ball by inserting the feet.
- Jumps triggered with a hopscotch.
- Lame, lame I am. Go to the wrong leg for a while while doing activities. Thus, foot dominance and working memory are stimulated.

Visual laterality

The results obtained from the evaluation show a poorly defined laterality at a visual level in J.S.C. Therefore, it is important to delve into this aspect, since a poorly defined laterality in the visual field can cause interferences in the overall processing and, therefore, a longer task completion time. The objective of intervention in visual laterality is therefore to enhance the interhemispheric relationship of the passage of information from one hemisphere

to another through the corpus callosum (Tirapu, 2018), since it is one of the structures with the highest number of nerve fibers in the brain (Van, Mori, Wakana, Nagae, 2005)

Thus, during the intervention at J.S.C, a series of activities and exercises based on visual interhemispheric empowerment have been carried out. Specifically, the activities chosen are based on the aforementioned book by Ferré et al (2004), they are as follows:

- Activities with separator. This activity consists of dividing the two visual fields through a cardboard located in the middle of the nose, with the aim that each eye looks at its corresponding part (right eye-right part). Once divided, a series of activities are carried out such as seeing drawings on one side and drawing them on the other, reading text on one side and writing it on the other, joining sentences, etc. (Annex 4)

It is important to note that J.S.C presents a right-handed lateral predominance, with visual interference. Therefore, it is recommended to enhance right-handed visual dominance so that its overall laterality is well defined from the left. In this way, all exercises or activities are carried out in this case by strengthening the right eye and always covering the left eye. Following the guidelines of Cumandá (2012) and Ferré (2004), some examples of this are:

- Bounce a ball through a circuit with your left eye covered.
- Palming a balloon without it falling and without losing sight of it.
- Craft with the left eye covered.
- Puzzles and board games with a covered left eye.
- Read with a covered left eye.

Auditory laterality

The laterality at the auditory level in J.S.C was well defined, so the intervention in this aspect had as its objective only the enhancement of right-handed auditory dominance. The activities proposed for this purpose have consisted of listening through the right ear to walls, the floor, certain sounds, etc. Specifically, based on Cumandá (2012), the activities carried out have been:

- "Doctor Doctor". This activity consists of playing to listen to the different organs of our body through a tube. For this J.S.C has to choose a predominant ear and exchange them.
- "Messages from a glass". This activity consists of making a “phone” with two glasses and a string and saying words that must be heard by the other through their predominant ear.

Graphomotor skill training for writing improvement

Specifically, in the case of J.S.C there is a difficulty in writing both in form and at runtime, so it is necessary to delve into what are the aspects to improve.

Following the guidelines of Cumandá (2012); Ferré et al (2004) and Mayolas Pi, (2010), writing has been mainly worked through a series of exercises organized by phases in which the subject has had to carry out certain activities using different resources:

- Carry out works on blackboard. The activity has consisted of making different shapes and strokes with the greatest possible precision. One of the most used exercises has been to make a lattice with vertical and horizontal lines, spirals, wavy lines, etc. The objective of these activities is none other than to gradually exercise the different muscular actions of the stroke.
- Works on large paper without guidelines. Activities similar to the previous ones are carried out, with the difference of carrying them out on large paper, introducing the calligraphy of letters and numbers, with the aim of establishing the correct left and right directionality (Annex 5)
- Paper works with guidelines. Letter and number calligraphies are performed with a standard guideline, with the aim of standardizing the normal writing process. In addition, activities have been carried out that consisted of putting the letters in their correct position, with the aim of also working on orientation (Annex 5)
- Color. The activity of coloring the different letters and numbers is also used to work precision and resistance.
- Dictations: Finally, short and simple dictations begin to be carried out, increasing depending on the progression.

It is important to note that the J.S.C scribe tweezer was correct, so it was not necessary to rectify or modify any aspect related to how to take the pen.

Improve spatial and temporal organization

This fourth and final objective has been accomplished due to J.S.C's spatial orientation difficulties regarding right, left, up or down. In this regard, it is important to have previously worked on the knowledge of the body schema itself, since it is essential to have a spatially organized idea of how our own body is organized based on the right-left coordinates

A series of exercises have been carried out to improve spatial organization (Ferré et al, 2004; Gonzato et al, 2011):

- Place elements of the environment. This activity consists of naming objects from the near environment (of the room) and placing them in the right / left, up / down, front / back coordinates. Once achieved, it is done with the eyes closed in a different position.
- Place elements on paper. A drawing is put as a reference (pg .: a house), and objects and elements are placed around it. The subject must say what position each one is in. (Annex 6)
- Paint arrows. Paint arrows of a certain color depending on their orientation. (Annex 6)

Discussion

The present work was carried out with the aim of analyzing the different components and variables that make up the laterality, and to know those factors that are related to it. To do this, a single case study was carried out, in which a subject with apparent psychomotor problems and learning difficulties was evaluated. The results obtained during the complete evaluation have led to a diagnosis of undefined laterality, specifically crossed laterality at the visual level.

The results obtained from the evaluation and subsequent intervention show conclusive data. Although it is true that the etiology associated with laterality is not clear, studies such as that of Oña (1999) or Ferré (2004) conclude that although there is a large part of genetic influence, laterality is a neuropsychological aspect that can be manipulated environmental form, where stimulation plays a crucial role. Therefore, this study has focused on the idea of the possibility of change and improvement of the laterality of the subject through the correct learning and stimulation of those members with difficulties in lateral predominance. The results obtained through this treatment perspective have been evident, since there has been an overall improvement in the subject, as well as significant advances in aspects such as reading, writing, psychomotricity or physicality, thus supporting the aforementioned studies.

This in turn is related to the statement by Bernabéu (2014), in which he exposes in his study that a defined lateral dominance could lead to great advances in learning to read, write or perform mathematical calculations.

Furthermore, the results also provide relevant information about the influence of laterality on academic performance. The results obtained from the evaluation of the subject are in line with the research carried out by Repila (2014), where a relationship was found between a problem in the consolidation of laterality and low academic performance, specifically with problems in reading, writing and calculations. mathematicians. Likewise, although this study cannot be extrapolated due to its individualized nature, it does have the possibility of providing relevant information on the main manifestations of academic performance problems linked to difficulties in laterality. Thus, during the evaluation, manifestations such as difficulties in the automation of reading, writing and calculation, organization problems in space and time, or marked slowness of reflexes have been detected; considering all of them own manifestations also detected by studies such as that of Bernabéu (2014) or Ferré (2016).

On the other hand, the results of the evaluation of the subject's spatial and body orientation showed that there was an apparent affectation in aspects such as fine and gross psychomotricity, corporeality, time-space orientation or difficulties in locating left-right, etc. This, on the one hand, produces relevant information, since it is assumed that, as mentioned by Godino, Fernández Blanco and Díaz-Godino (2011), difficulties or delay in lateral predominance can cause problems related to psychomotricity, coming into consonance with said study

This in turn causes the detection of the problems in psychomotricity to entail a subsequent treatment in it. The results after the treatment focused on this purpose yielded optimal results, in which the subject substantially improved their psychomotor coordination, as well as their corporeality and time-space orientation, showing, as Gonzato et al (2011) and Ferré et had concluded. al (2004), direct relationship between the improvement of lateral dominance and the improvement of the psychomotor factor.

Lastly, it is important to highlight that the treatment chosen for said study has shown substantial improvements in the difficulties of J.S.C. These results are in line with the studies by Ferré et al (2016), since both studies have used the same intervention objectives and, therefore, have obtained similar results.

However, although the progress of the subject in all aspects is undoubtedly evident, it is also subjective. Laterality is not yet considered a problem worthy of attention by professionals and scientists, and as such is not a study center. This implies that the study has a series of limitations:

- Carrying out a single case study entails difficulties for the study to be considered significant and relevant. Not having a significant sample, the study is considered descriptive.
- Only one laterality test was used, due to the limited time of sessions and execution time. Likewise, the need to develop more reliable evaluation tests for the correct objective diagnosis of an ill-defined laterality, without giving rise to errors, is noted.
- The study shows difficulties when carrying out a specific treatment, since there is no scientific literature that specifies which protocols to follow in cases of poorly defined laterality.
- Laterality, being considered an evolutionary process, can cause confusion about its "resolution". It is difficult to know if the improvement in lateral predominance is due to the stimulation imparted by the therapist or due to the neuropsychological maturation of brain evolution.
- Disorders of laterality present controversy regarding their diagnosis. There are authors such as Ferré (2016) who ponder poorly defined laterality as the basis of learning disorders, ADHD, etc., and yet authors who do not relate laterality problems with said disorders, being totally independent. Be that as it may. This shows the need for training and information on the part of teachers, health professionals and families to help understand that an undefined basic laterality marks a very difficult journey for the minor, impacting on all aspects that make up their life and that if it is detected early, the probability of improvement is, in most cases, complete and effective.

Regarding the possible future lines of research, the need to investigate the evolution of the evolutionary process of laterality a few months later in the minor arises to carry out a pre-post study, since it can yield very significant information. It would also be interesting to extrapolate this study to a study of child laterality and academic performance in a school with minors of different ages.

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Annexes

Annex 1

INFORMED CONSENT

Before proceeding to sign this informed consent, carefully read the information provided below and, if necessary, you can consult any questions you have on the phone or address at the bottom of this page.

Nature of study

A study will be carried out which title is "**Evaluation and Intervention in the Event of a Cross Child Laterality Case. Only Case**". The objective of this study is none other than to evaluate and investigate the different processes and areas of laterality from the perspective of the subject to be evaluated (J.S.C).

The study is part of the Master's Thesis of the Master of General Health Psychology of the European University of the Atlantic in Santander (Cantabria).

Specifically, this study will be carried out by the student Isabel Mª Medina Amate, under the supervision of the Doctor and Professor of Child Psychology and director of the master Juan Luis Martín Ayala.

The administration of the questionnaires and the subsequent achievement of the intervention will be carried out in the practice center "*Center for Integral Psychology and Trauma Therapy ITIPA*" and attended by J.S.C on a weekly basis. Said procedure will be tutored by the tutor Noemí Álvarez Boyero.

Implications for the participant:

- Participation is completely voluntary.
- The participant can withdraw from the study when he or she says so, without giving explanations and without this entailing any repercussion for him.
- All personal data obtained in this study is confidential and will be treated in accordance with the Organic Law on Protection of Personal Data 15/99.
- The information obtained will be used exclusively for the specific purposes of this study.
- Participant risks: None

If you require additional information you can contact Isabel María Medina Amate by phone 696518684 or by email imedinaamate@gmail.com.

INFORMED CONSENT

"Evaluation and Intervention in the Event of a Cross Child Laterality Case"

I (First and Last Name):……., father or mother of subject:…….....……
…….

- I have read the information document that accompanies this consent.
- I have been able to resolve the doubts that have been raised.
- I understand that my child's participation is voluntary and I am free to participate or not in the study.
- I have been informed that all the data obtained in this study will be confidential and will be treated in accordance with the Organic Law on Protection of Character Data Staff 15/99.
- I have been informed that the information obtained will only be used for academic and scientific purposes.

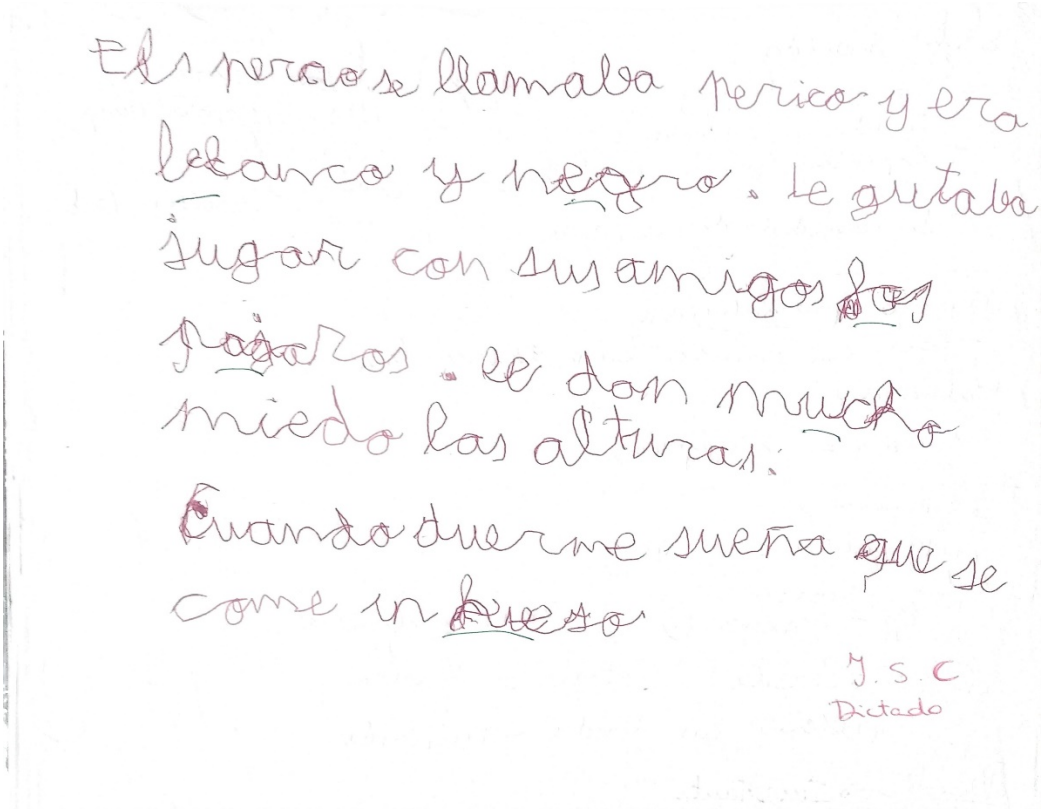
I understand that I may withdraw from the study:

- Whenever you want.
- Without having to explain.
- Without this having any impact on my son.

I freely agree to my son participating in the study on "Evaluation and intervention in a case of childhood laterality".

Signature of the father or mother (or legal representative if applicable)
Mr./Mrs./Ms.:……..…….……..
Date: ……..……

Annex 2: PROESC dictation


El perro se llamaba perico y era blanco y negro. le gustaba jugar con sus amigos los pajaros. le dan mucho miedo las alturas. Cuando duerme sueña que se come un hueso.

J. S. C
Dictado

Annex 3. Corporeity work and body schema

Annex 4. Visual dominance works with separator

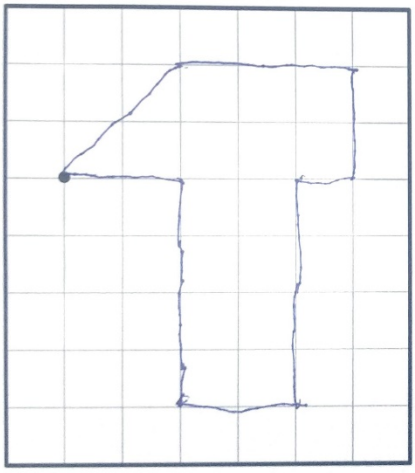
J.S.C 30/01/2020

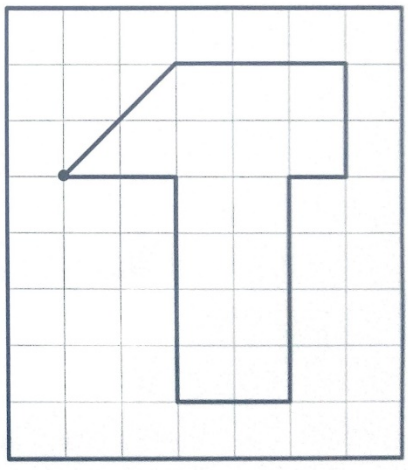
1

Los perros de mi vecina ladran todas las noches.	Los perros de mi tecina
Pilar y Vicente se han comprado dos patinetes.	Pilar y Vicente se han
Julia siempre lleva un sombrero azul en la cabeza. .	Julia siempre lleva un
La semana pasada fue el cumpleaños de mi abuelo.	La semana pasada fue el
A la catedral de Málaga la llaman "la manquita".	cumpleaños de mi abuelo
Mi profesor dice que hay que leer 2 libros a la semana.	

DICTADOS GRÁFICOS 3' 58"

2↗ 3→ 2↓ 1← 4↓ 2← 4↑ 2←





30/9/20

[redacted]

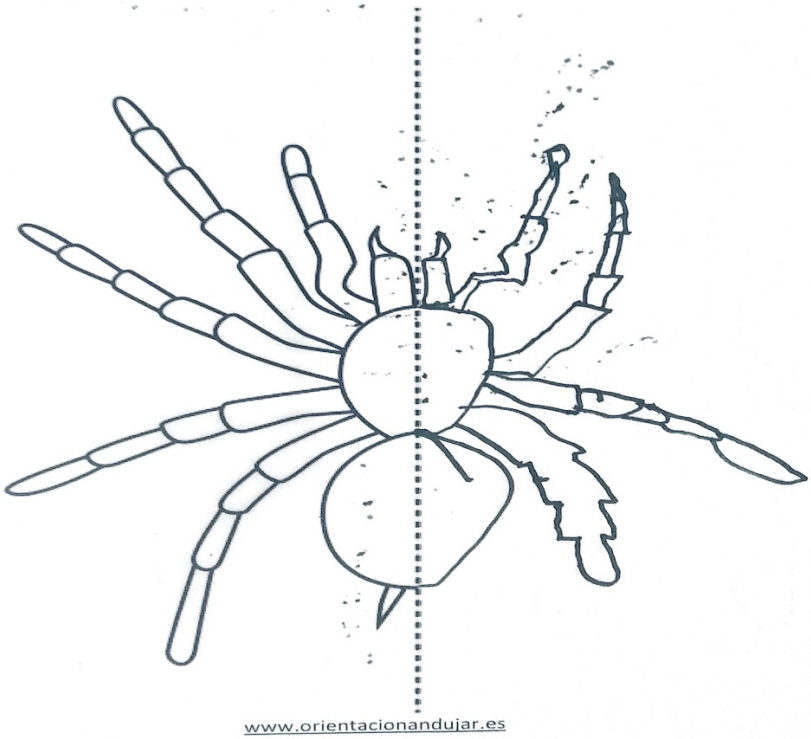
2

Juan y Paloma quieren casarse	en la iglesia de las afueras de la ciudad.
Mi ordenador	con su familia a visitar París.
Manuel irá de viaje	el rock, aunque también me gusta el flamenco.
El libro de matemáticas	está viejo, necesito comprarme uno nuevo.
Mi estilo de música favorito es	contiene muchos problemas y cuentas difíciles.
El plato favorito de Isabel es el	siendo dos de ellas gemelas.
Carlos tiene tres hermanas	pastel de queso con mermelada.

Maribel Martínez y Ginés Ciudad-Real — Fichas para mejorar la atención

LOS INSECTOS SIMÉTRICOS

Dibuja el insecto completando la parte que falta sabiendo que estos animales son simétricos



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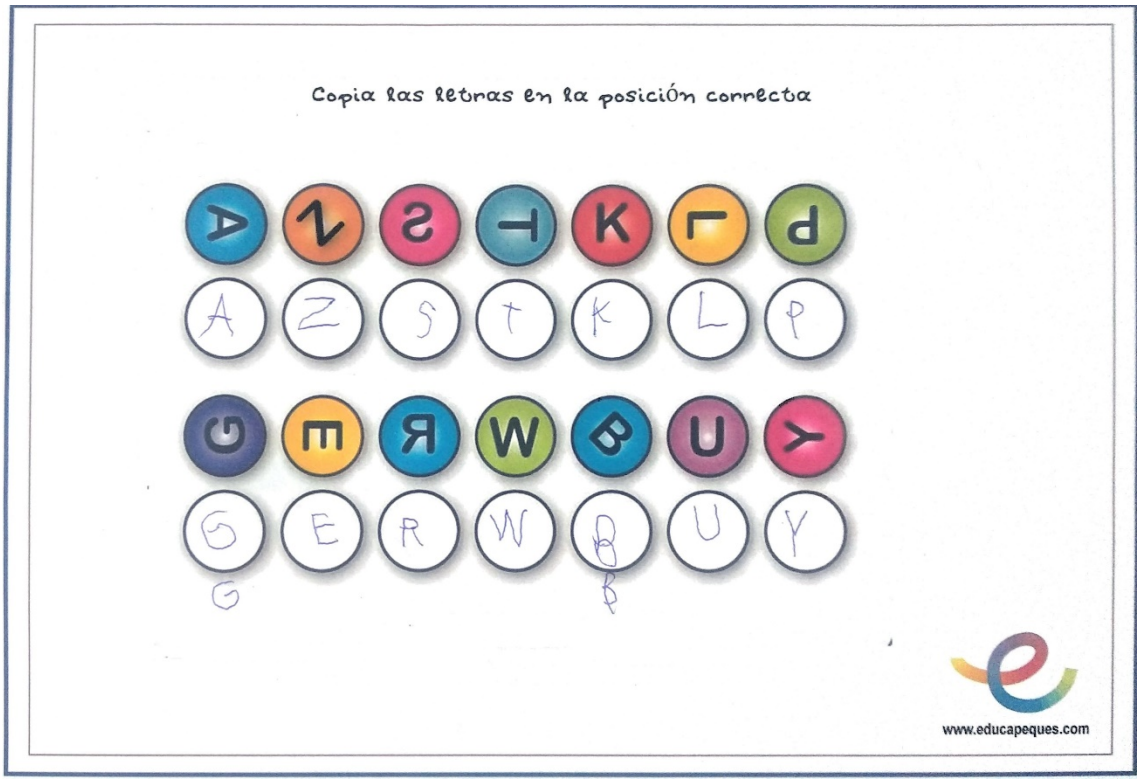
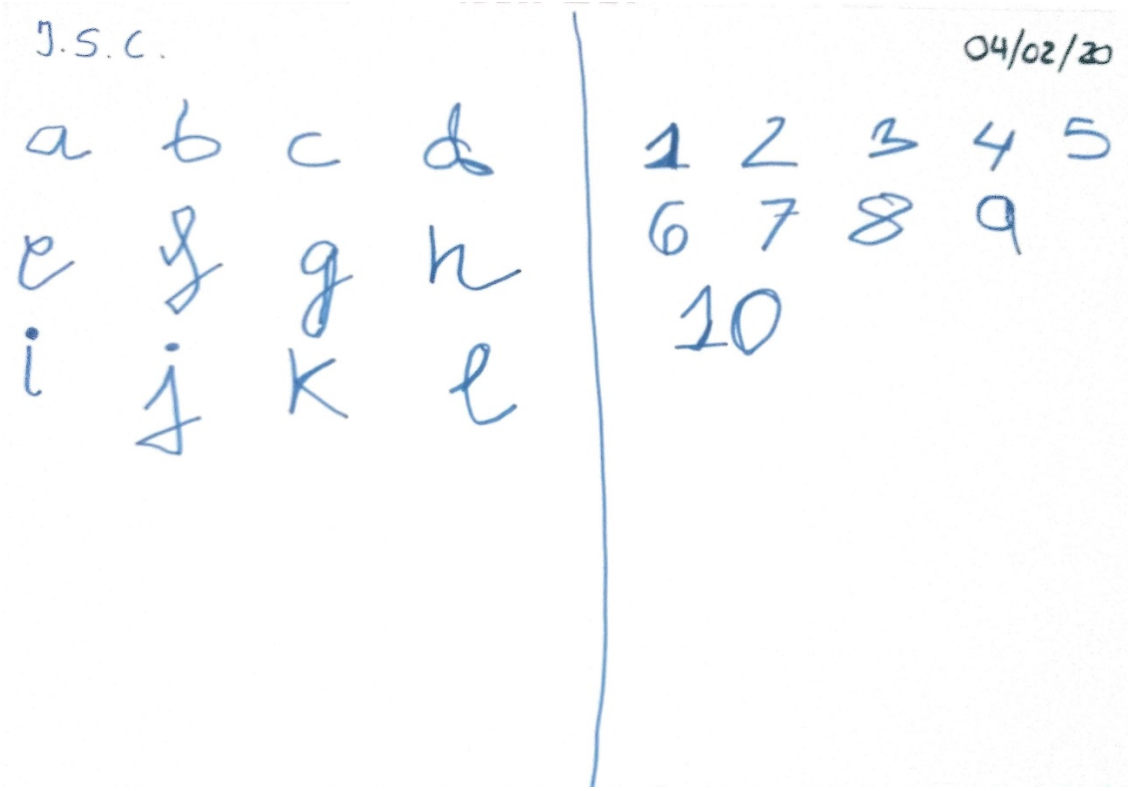
Annex 5. Work of graphomotor skill training





Annex 6. Work in spatial orientation