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Executive Functions Development and Playing Games

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The aim of this paper is to discuss executive functions and playing games, considering Piaget's work (1967) and the neuropsychological framework (Barkley, 1997, 2000; Cypel, 2007). Two questions guide the discussion: What are the intersections between playing games and the development of executive functions? Can we stimulate children with learning disabilities to build up skills related to executive functioning in a context of games and problem-solving situations? For the last 22 years, researchers from the Institute of Psychology, University of Sao Paulo have been studying children and proposing situations, in which they play games with rules, solve problems, and interact with others (Macedo, Petty & Passos, 1997, 2000, 2005; Souza, Petty, Carvalho, Passos, & Carracedo, 2002). Groups of children from 7 to 11 years old are supervised by professionals who challenge them to develop reasoning and autonomy, which also contribute to develop executive functions. The main point of the project is not to become a good player, but build up skills to surpass difficulties, such as attention, organization, and planning. Participants who were engaged, and did not have serious neurological damages in brain functioning, really became students with better resources to deal with school challenges and they developed more adequate attitudes.

Keywords: executive functions, neuropsychology, development, games, learning disabilities

Introduction

According to Piaget's theory (1962), games are classified into three main structures, considering the mental complexity inherent to each level of development: practice games, symbolic games, and games with rules. The practice play is elementary, and it occurs in the early childhood, beginning in the first month after a child is born. It is characterized by repetitions, and it is essentially sensory-motor. This is a continuous process and it gradually gives place to the symbolic games. The development of symbolic schemas can be observed when imitations and mental representations start, and it opposes to the mere motor play. This new structure of play is more complex than the former, and includes a crescent progress of representation, verbal communication, and interiorised actions. When the ludic symbol gradually becomes adapted representation, it is possible to consider the situation as a transition between the symbolic games to the games with rules. In this case, the rules define a very particular pattern of functioning that implies social or inter-individual relationship. Rules represent a necessity in the organization of the collective play: "Rules are a regulation imposed by the group and their violation carries sanction" (Piaget, 1962, pp. 112-113). In other words, rules are an external regulator that works in favour of the collective activities. Games with rules were defined by Piaget as "... games with sensory-motor combinations (races, marbles, ball games, etc.), or intellectual combinations (cards, chess, etc.), in which there is competition between individuals (otherwise rules would

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be useless) and which are regulated either by a code handed down from earlier generations, or by temporary agreement" (Piaget, 1962, p. 144). It is important to underline these three structures—practice, symbolic, and rule—that do not disappear as the child develops: One includes the other, being successive-inclusive stages, in addition to the former.

In the child development studies field, it is well known that the game with rules context represent a rich set to study children and their relations between rules and peers. Game is a very important social institution and can be considered a significant interference in the development of social relations. If a child plays and learns that respecting the rules means to act adequately, it implies in a great opportunity to grow in the descentration process and the autonomous behaviour. When Piaget (1932) studied the moral development, he described how children showed progress concerning the rules. There was a special interest to find out about how children practiced rules and also how they got more conscious about using them. As a contribution of his researches, we could learn that there are three types of attitudes or social behaviours: motor, self-centered, and cooperative. Each of them corresponds to three types of rules: motor, unilateral respect, and mutual respect.

Based and inspired by Piaget's results, in a very brief summary, we can affirm that our target is to achieve the intersection between cooperative attitudes, mutual respect, and reasoning, after we finalize the game-intervention project with our children at the laboratory. This result implies achieving a level of participation in the game context in which the child understands and respects the rules, builds up strategies that lead to a successful play and also create favourable attitudes towards learning and development processes.

From the moment children understand rules as a social regulator, they become more interested in improving their competences in order to succeed and win. To do so, they have to use different skills, such as attention, organization, and self-control. These are some of the skills that characterize the executive functioning (Barkley, 1997, 2000; Cypel, 2007). According to Cypel (2007), executive functions can be defined as:

> A group of functions responsible of the beginning and progress of an activity with a determined aim. This includes many cognitive processes, such as state of alert, sustained and selective attention, time of reaction, fluency and flexibility of thought, conditions that will favorable the possibility of finding solutions for new problems, interfering in the planning and the regulating of the behavior, in order to adapt and create a solution. (Cypel, 2007, p. 33)

The executive functions organize the perception and active capacities, which allow the person to: define a target and decide if should start it or not; plan and pay attention to each part of the project; analyze the results, maintaining or modifying the procedures in comparison to the defined target.

The attention function plays a very important role in the executive function system and can be analyzed in different perspectives. The inhibitory system, for example, is one of the important aspects of the attention system, because it works in favor of the inhibitory mechanisms that contribute to the exclusion of the stimulus that interfere negatively to achieve a good result in a task. Apart from being driven by wishes and wills, a child must be able to finalize a defined activity. This means that the use of many internal resources, such as the already mentioned and others, like acting with persistence and flexibility. The work memory is also a fundamental system to be developed. It is an essential mechanism to be put in use when a child is solving problems, dealing with all the information that must be retained and coordinated.

If a child does not develop adequately, he/she will face many problems at school and might be classified as one case of executive dysfunction. Nowadays, it is very common to find school teachers and parents worried about ADHD (attention deficit hyperactivity disorder) and ODD (oppositional defiant disorder), willing to find creative solutions.

Aiming to analyze the Piagetian view about child development and playing games in terms of operational thinking and moral judgment (Piaget, 1967), and also more recent contributions from the neuropsychological framework (Barkley, 1997, 2000; Cypel, 2007), we have selected a few questions that guide our discussion: What are the intersections between the act of playing games and the development of executive functions? Can we stimulate children with learning disabilities to build up skills related to executive functioning in a context of games and problem-solving situations? As a consequence, another question can be discussed: Do they learn easier and develop more adequate attitudes?

The Project

For the last 22 years, researchers from the Laboratory of Psychopedagogy and the Laboratory of Studies about Development and Learning (Institute of Psychology, University of Sao Paulo) have been interested in studying children with learning disabilities and proposing situations in which they are invited to play games with rules, solve problems, and interact with other children (Macedo, Petty, & Passos, 1997, 2000, 2005; Souza et al., 2002).

In the laboratory context, we use games, such as Mastermind, Pick up Sticks, Dominoes, Mancala (African game), Snakes, and Ladders among many others. They are proposed in a very particular mode, which we define as “Methodological Game Usage”. Every game is introduced as a material to be explored, before the rules are taught. This first moment implies observation, manipulation, and freedom to explore the components in different ways. After that, the rules are presented and the participants should play according to them. Doubts related to how-to-play are solved and they start trying to build up strategies that can lead to a successful result. Professionals avoid interfering in this moment, and act more as judges than as mediators. The third moment requires a change in the interfering process, so that professionals start questioning the participants’ actions and attitudes, aiming at making them be more aware of what is being produced. The next part of this process includes discussions and challenges, in which children should try to transfer the positive attitudes and favourable actions to their own lives, including the school environment. If we take the Dominoes as an example, firstly the pieces are observed and the children should count how many of them compose the game, notice the distribution of numbers in each piece, make different combinations of pieces and put them in order (for example, crescent). While playing a match, they could learn how to organize the pieces, pay attention to the opponent’s pieces that are disposed, plan a possible domination of a number, etc.. With the constant presence of a professional, this game context is very rich to inform how does a child play and it allows a high quality interfering and questioning process. As to finalize this game proposal, it is brought into discussion on how to become more motivated, how to use the pieces in a better combination, what to do when the situation is not bringing good results, and what questions one must learn to make to himself/herself to develop reasoning and help solve problems of different nature.

Based on the relation that Piaget has established between games with rules and the construction of knowledge, it is possible to state that mental and motor actions are fundamental conditions for both of them to

occur. Participants act according to the rules and are committed to its final objective, they also learn about themselves, strategies, and opponent's behavior. If the player is challenged to pay attention to these aspects and can develop a wider observation of his/her actions, questioning and analyzing what is being done, the consequence is a superior understanding of the situation as a whole. Becoming self-conscious of what is necessary to be done and/or changed is very important to surpass difficulties in any field of knowledge, and it is easier to develop this competence with children in contexts such as playing games.

When games with rules are proposed, the main question that guides the choice is not which of them to pick, but how it can be explored in order to achieve interesting results with a certain group of children. This means that regardless of the game used, the action of playing that we are concerned about must be committed to and coordinated by previous and future actions, also corresponding to actions that are intentional and integrated in the whole system. In this case, playing games is not just a matter of fun, and winning is not a matter of luck.

The activities held at the laboratory are always supervised by a professional, who mediates and challenges children to develop reasoning and build up favorable attitudes towards the problem-solving situations. In this rich and diverse environment, it is possible to identify many of the mentioned skills being put in use and the consequent difficulties when the child is not capable to do so.

It is well known that children have great interest in activities that involve games. So, we aim at relating the act of playing with important aspects of developing and learning, such as observing, criticizing, investigating, and relating.

For children with some sort of difficulty, the main contributions are to identify within the game context what is the problem, how he/she can deal with it, and which are the most adequate interventions to help he/she surpass it. Since we consider that the action of playing games promotes different kinds of developing and learning, we intend to help children to break the vicious circle in which they are submitted in their lives and at school, so that they can establish different relations with new information and contents, adults and children, challenges and activities.

To be agent of his/her actions allows the child to build up inner conditions to deal with all sorts of different situations. Observing, discussing, interpreting, and finding solutions are examples of what one has to go through during a match. When the child plays and there is professional intervention, he/she is lead to find out about the importance of anticipating and thinking before acting. Because he/she has been challenged to win, he/she learns to persist and improve the performance, not only because there is outer demand, but also because there is a wish for self-improvement.

From our experience, we notice that most of the problems children face are related to what characterizes the executive dysfunction, that is, inattention, disorganization, lack of motivation, excessive motion, lack of planning, and/or low interest in widening up knowledge. The project held at the laboratory aims at collecting information and interfering in favor of development and learning, taking into consideration how children play games with rules (in terms of procedures).

In practical terms, the project can be described as follows: groups of 12 children from 7 to 11 years of age are seen at the laboratory for one hour every week, and it takes about three semesters for them to complete a cycle that includes the sequence game-intervention-game. These three semesters are necessary to consolidate internal changes.

Participant Observation: The First Step

At first, games are proposed, so that children should learn the rules and enjoy the moment. Meanwhile, professionals observe them in action (playing, talking, and exchanging ideas with peers), discuss rules or procedures, and challenge them to explain their actions aiming at developing better strategies. Four important aspects are taken into consideration, as to enlarge the professional point of view of the diagnosis related to each child that takes part in the game context. They are: motor and space organization, emotional reactions, cognitive development, and social relations. There are always some guiding questions, such as: How does the child react to challenges? What competences does he/she show? In what cases does a mistake appear and whether is it noticed (or not)? Is he/she organized and focused enough to play the game? Are there any planning and coordinating actions? Are the rules being followed? Is there respect and mutual consideration? What strategies are used?

Interventions: Solving Problems

The second step of the project development demands from the professional the creation of different situations of intervention that contribute to each child to become more conscious of the actions and proceedings that were favorable (or not) to solve problems and answer some questions. Children are invited to use all their resources and skills, they are teased to build up new competences, and they also must learn and exchange experiences with partners. As a consequence, gradually he/she can intentionally act in pro of achieving better results, getting more aware of the process as a whole, changing what is unfavorable to win. It is mostly valued to pay attention, become more autonomous and develop reasoning.

When playing and discussing about the games, many concepts can be reconsidered, and different aspects of knowledge are amplified and deepened. Games with rules are used by the laboratory's professionals as instruments to instigate children to observe all executed actions and analyze their consequences. This favors the awareness of what must be intentionally maintained (because it leads to victory) or modified (because it is bad for the system). This is done through the creation of problem-solving situations, activities that happen after the match is over, in which the child is invited to reconsider fragments of it that are previously selected by the professional due to their relevance for learning. These activities present meaningful challenges for the child. They create a conflict or disequilibrium that, when solved, may show the child's level of development. At the same time, it may be used as a reference to define qualitatively some next steps to continue the intervention process. For example, let's consider that the mastermind game is being played with only three pieces: B (Blue)-R (Red)-G (Green). As a consequence, there is only one challenge: The child has to discover the sequence of colours. If he/she has zero as score to B-R-G, what does it mean? That B is not first, R is not middle, and G is not last. If the next trial does not consider this information, a good interference would be to ask questions about what did the child understand when getting the zero score and what could be a good trial in this case. If there are more colours, then it might be very helpful to alert the child that, when picking a sequence, it should be considered as a hypothesis, not as the correct one. This means to work with attention, memory, making decisions, and coordinating information, in a complex and coordinated system.

Evaluation: The Effect of Interventions

The third semester corresponds to the last part of the project. The meetings continue to occur as they have been set, but with a new view from the professional's perspective. Actually, there is an important question that

has to be answered: Is the child prepared to stop participating at the laboratory project? To be so, it is necessary to affirm that he/she has developed better attitudes towards the problem-solving situations, demonstrating attention, organization, and self-control to deal with many different challenges. The activities consist in proposing and observing new situations in which the child will be invited to use the developed skills and/or competences. In this way, it is checked if he/she has gained more consistent and autonomous procedures to play games and solve logical problems.

It is also checked whether the mentioned four aspects—motor and space organization, emotional reactions, cognitive development, and social relations—showed improvements.

It is important to underline that the main point of the project is not to become a good player, but develop skills in order to surpass difficulties that are not exclusive of the game context, such as attention, organization and planning, no matter what has to be done or how long the player must remain concentrated. In this sense, playing games in a context of professional intervention, contributes to develop executive functions. We all know that it is also essential to conquer these ways of proceeding and behaving at school, in order to achieve the targets for going ahead in the school degrees.

To sum up, we can state that the participants who were engaged in the project and also who did not have serious neurological damages in brain functioning, really became students with better resources to deal with different challenges and developed more adequate attitudes.

Remediation and/or Prevention

At the moment, the project held at the laboratory aims at seeing children who already need great help and who face many difficulties at home and school. However, we are absolutely convicted that prevention projects would contribute immensely to avoid this situation, or at least, diminish the dramatic unsuccessful results that many students produce due to growing in a school environment that takes too long to realize their needs. The learning difficulties vary a lot from children to children and have different natures. Many of them are hidden by the child, who learns very fast how to copy and disguise mistakes. On the other hand, there are cases in which the child is considered stupid, because he/she does not follow what is taught, but he/she does not hear very well or has attention deficit and has made no evaluation to find out what the problem was. There are also situations in which he/her is constantly excluded from the classroom due to inadequate behavior, and nothing is done to analyze the context, that sometimes is also inadequate to that child. To sum up, it is urgent to establish a wider view of the children's needs in order to help them surpass, and better, avoid early learning failure. Growing confident and in a more comprehensive environment is their right and our challenge.

Recent researches show that it is possible to early identify many indicators of learning disabilities. This can help parents and teachers to stimulate children, preventing failure and associated problems that affect self-esteem and emotional well-being. One important contribution is found in the *Encyclopedia on Early Childhood Development*, situated at the Centre of Excellence for Early Childhood Development, Canada. This encyclopedia, is published on the Internet, and covers 47 topics related to the psychosocial development of the child, from conception to the age of five. For each topic, a synthesis is provided that addresses three questions: How important is it? What do we know? What can be done? It is regularly updated, presenting articles based on scientific knowledge, and promotes interesting discussion about many subjects related to child development, interventions, and new information collected with researchers all over the world. It is considered as an important and relevant means of information.

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