

Children with ADHD in Contact with Nature: possible changes

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ABSTRACT – Children with ADHD in Contact with Nature: possible changes. ADHD is characterized by the occurrence of symptoms such as hyperactivity, impulsivity, and inattention, which have been treated with medications and psychological therapies. We here investigate how experiencing nature might aid in the treatment of ADHD symptoms. The present study is based on interventions and its participants are ADHD children, who were divided in two groups: Intervention Group and Control Group. Through a qualitative analysis, the present study concluded that ADHD symptoms were less intense after the experiences with and within nature although their respective ADHD subtypes still predominated.

Keywords: Attention Deficit and Hyperactivity Disorder. Psychological Therapies. Nature.

RESUMO – Crianças com TDAH em Contato com a Natureza: transformações possíveis. O TDAH caracteriza-se pela ocorrência de hiperatividade, impulsividade e desatenção, sintomas que têm sido tratados com medicamentos e terapia comportamental. Questiona-se como o contato regular com a natureza pode atuar de modo complementar no combate aos sintomas do TDAH. A pesquisa baseia-se em intervenções tendo como participantes crianças com TDAH separadas em dois grupos: Grupo Intervenção e Grupo Controle. Ao se analisar qualitativamente os impactos das vivências com a natureza nos sintomas do TDAH concluiu-se que, apesar dos respectivos tipos de TDAH ainda predominarem após as vivências, os sintomas foram menos intensos.

Palavras-chave: Transtorno de Déficit de Atenção e Hiperatividade. Terapias Psicológicas. Natureza.

Introduction

Attention Deficit and Hyperactivity Disorder (ADHD) is characterized by the significant impairment of cognitive aspects, and it might cause complications in several areas an individual's life: family, social, and academic. It is the most commonly diagnosed behavioral disorder in children, yet there is no consensus as to its prevalence.

Approximately 5% of Elementary students in France are estimated to exhibit this condition; in the United States, on the other hand, this percentage lies between 5% and 7% (Caci *et al.*, 2016). In Brazil, this rate varies between 3% and 6% (Bolfer, 2009). According to the Brazilian Association of Attention Deficit (ABDA), there are different statistics, and frequency among children ranges from 3% to 10%. Frequency is more common in boys than in girls, according to Cardoso, Sabbag, and Beltrame (2007) and it also occurs more often in early childhood, around 3 years old (Carvalho *et al.*, 2012). On the other hand, several studies indicate that more latent symptoms are mitigated in individuals that undergo early interventions on ADHD (Caci *et al.*, 2016).

ADHD categories might be defined according to the occurrence of hyperactivity, impulsivity, inattention, or whether there are two of these forms combined (Bonadio; Mori, 2013). Inattention provides symptoms such as reduced perception to details and neglect of professional activities, and it might occur during leisure periods and even when interacting with other people. It sometimes is expressed as disobedience to instructions provided, withdrawal from or forgetting activities, disorganization, difficulty in making a constant mental effort, losing objects, susceptible behavior to external factors, and sensitivity. Hyperactivity, on the other hand, refers to the tendency towards excessive agitation, difficulty in engaging in quiet activities, accelerated thinking, excessive speech, and difficulty in remaining silent. Impulsivity symptoms, in turn, might be identified by how much the individual meddles in other people's affair and interrupts when other people are speaking, answering questions before they are formulated and showing signs of impatience (Rohde *et al.*, 2000).

ADHD can be defined as a disorder due to the multiple damages it causes in different daily settings (Nussbaum, 2015). It is seen as a health issue that compromises school performance, generally causing psychological and social problems (Gomes *et al.*, 2007). When it affects children and young people, it might lead to negative social and affective reactions from peers and adults, which causes a degree of social exclusion. "Children might experience rejection in their social interactions because they are not adjusted to the ideals expected by their peers in the same age group" (Bertoldo; Feijó; Benetti, 2018, p. 430).

Although ADHD is not classified as a Learning Disorder, its characteristics do hamper learning, as ADHD children might also have difficulty in meeting school requirements due to behavioral issues and lack of attention. Moreover, due to its intrinsic characteristics, ADHD is also frequently associated to defiant events during school phase (Martins, Peres; Souza, 2019).

Regarding treatment, methylphenidate, known as Ritalin, is currently one of the medications frequently indicated and is still used at a large scale, as well as Concerta and Venvanse. Authors such as Rohde & Halpern (2004) and Andrade & Silva (2011) believe that stimulants are indicated as first options for ADHD treatment and are first-line medications for patients with no comorbidities. Psychological interventions e.g. Behavioral Cognitive Therapy (BCT), which helps develop strategies to deal with the symptoms (Oliveira; Dias, 2018) are also adopted as treatment.

Based on the considerations above, direct exposure to nature is understood to be a relevant factor in mitigating characteristics related to ADHD symptoms. The hypothesis of the present study is based on two elements: ADHD is related to a limited exposure of individuals to nature in their daily lives, and experiencing nature is associated to increased tranquility states of being and full attention. Authors such as Taylor & Kuo (2004, 2011); Louv (2015); and Godbey (2009) believe that exposure to nature might improve ADHD, cause attention and concentration to increase, and reduce stress and obesity. These authors agree that exposure to nature improves health by providing physiological, psychological, and social benefits.

Therefore, the question is: can regular exposure to nature be considered another tool to prevent ADHD symptoms as a complement to drug therapies and behavioral approaches?

The present study is based on interventions and the participants are ADHD children. These children experienced activities with and within nature for six months, based on the Flow Learning Method, by Joseph Cornell, adapted for children who have been diagnosed with this disorder. There was a Control Group along with the Intervention Group.

The Flow Learning Method is a method that derives originally from the Environmental Education field, and it enables subjects to interact with nature as a learning tool to develop feelings that lead to social changes (Cornell, 2008). Through a set of individual and collective activities, which are carried out using natural elements, it allows subjects to be aware of themselves in several situations and contexts. Interaction experiences broaden the repertoire of emotions, perceptions, knowledges, and enhance the understanding of oneself, the other, and the environment, as they encourage sensitivity and loving through fun games.

Therefore, considering the impacts of ADHD symptoms on the daily lives of children and how important it is to seek alternatives to mitigate these symptoms, the aim of the present study was to analyze qualitatively the impact of Experiencing Nature on ADHD symptoms.

Method

The present research is qualitative and characterized as a descriptive-exploratory study. The study locus was the municipality of Crato in Ceará. Experiences with nature were performed in Floresta

Nacional do Araripe-Apodi (FLONA - National Forest of Araripe-Apodi), known as Chapada do Araripe, the first Conservation Unit (CU) of its category in Brazil (Figures 1, 2, and 3).

Figure 1 – Chapada do Araripe



Source: Augusto Pessoa (2016).

Figure 2 – ICMBIO/ICMBIO headquarters



Source: The authors (2018).

Figure 3 – Belmonte Trail



Source: The authors (2018).

The area was chosen due to the beauty of its preserved forest, for its several ecological trails, and its natural springs. Instituto Chico Mendes de Conservação da Biodiversidade (ICMBIO – Chico Mendes Institute for Biodiversity Conservation), under the Federal Government (ICMBIO, 2016), is the managing agency of CU-FLONA-Apodi. Experiences were also carried out in the municipality of Barbalha, where Riacho do Meio Ecological Park and Sítio Pinheiros are situated; these places provide suitable characteristics to develop activities for experiencing nature.

Field research followed the ethical research parameters ruled by Resolution 466/2012 of the National Health Council, which provides guidelines and regulatory norms for research that involves human beings. The project was explained to the participants and their parents, along with its objectives and technical procedures, ensuring the confidentiality of the participants, who provided a Free Informed Consent Term (TCLE)¹.

The study population was comprised of children from public system schools in the municipality of Crato, from both rural and urban areas, with ADHD symptoms. Regarding the participants directly involved in the research, 11 children were selected once they fulfilled the inclusion criteria, which were: a) being between 7 and 12 years old at the beginning of the study; b) having been previously diagnosed with ADHD (with a medical report for verification); c) being regularly enrolled in a municipal public school in Crato; and d) attending school in the urban zone. All children that had already been diagnosed with ADHD, CID-F.90.0 (currently, CID11-6A05), according to medical reports submitted by the city Education Department, were considered for this study.

The online Qminim software was used for randomization using minimization to select subjects that would comprise the Intervention Group. The names of the eleven study subjects were added for software processing, and six of them were selected to comprise the Intervention

Group, based on the increasing order shown by Qminim. The other individuals – five children – comprised the group designated as Control; they were informed that they would comprise this group and that, after the study was completed, they would also participate in the experiences.

After the two groups were selected, the required steps were carried out to meet the aim of the present study. According to Oliveira & Dias (2018), ADHD diagnosis is primarily clinical and requires information collected from several interlocutors and interviews in compliance with DSM-5 criteria, using information collected from the children's family members and identifying contexts in which nuclear symptoms appeared. Therefore, interviews were conducted with parents, teachers, and with the subjects themselves, which allowed for outlining a profile of subjects prior to performing the activities within nature.

Subsequently, the SNAP-IV test was applied to teachers, in order to comprise an initial profile for the subjects, identifying symptom predominance and intensity. It is worth noting that the interviews and the SNAP-IV tests were applied with children from either the Intervention or Control Groups. After a period of six months, interviews were re-conducted and the SNAP-IV questionnaire was performed again with both groups, to observe potential changes in symptoms in both groups: the one that participated in the experiences and the one that did not.

Intervention Using Experiences with and within Nature

Interventions occurred once a week and lasted four hours within nature, for a period of six months. The first stage lasted three months, as did the second stage, which consisted of re- applying the activities to compare each participant's resourcefulness prior to and after the experiences. Therefore, there was a total of sixteen meetings and one extra meeting with all children (Intervention Group and Control Group).

A guide was created with four activities for each meeting; the research team recorded their observations in this guide as they monitored the resourcefulness of each individual (Figure 4).

Figure 4 – Loving contact with nature



Source: The authors (2018).

The observation guide was created by the researchers considering the objectives of each experience with nature defined by Cornell and according to SNAP-IV items (Chart 1).

Chart 1 – Individual observation guide of experiences with nature

				
NAME				
DATE				
EXPERIENCES WITH NATURE Stages of Cornell's Flow Learning Method	OBJECTIVE OF ACTIVITIES ACCORDING TO CORNELL	ADHD SYMPTOMS ACCORDING TO SNAP-IV	SNAP-IV FORM ITEMS	OBSERVATIONS OF CHARACTERISTICS OF DEVELOPMENT ASPECTS
Beginning: Loving contact with nature	To conduct a loving contact with nature, and increase it at each practice in order to create a foundation	Difficulty sustaining attention	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-affective () 3. Motor () Notes:
		Cannot perform the activity in silence	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-affective () 3. Motor () Notes:
ACTIVITY 1 Nature man-kind x (Stage 1 Awaken enthusiasm) –	Awaken enthusiasm; Stimulate auditory perception and attention; work concepts	Does not follow instructions	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-affective () 3. Motor () Notes:
		Does not like or does not engage in activities that require prolonged mental effort	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-affective () 3. Motor () Notes:
ACTIVITY 2 Walking barefoot (Stage 2 –		Cannot perform the activity in silence	() Not at all () Just a little () Quite a bit	1. Cognitive () 2. Socio-affective () 3. Motor ()

Focus attention)	Focus attention; observation and balance		() Very much	Notes:
		Difficulty in sustaining attention; Is distracted by foreign stimuli	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-afective () 3. Motor () Notes:
ACTIVITY 3 Travelling to nature's core (Stage 3 – Direct experience)	Concentration; exploration; reflection; sharing	Does not seem to be listening When talked to; Moves hands or feet or fiddles on the spot where is sitting	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-afective () 3. Motor () Notes:
		Having difficulty engaging in calm activities; Answer questions hastily before they are finished	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-afective () 3. Motor () Notes:
ACTIVITY 4 I am a painter! (Stage 4 – Share inspiration)	Sensory olfactory perception; concentration; new discoveries	Avoids, dislikes, or unwillingly Engages in activities that require prolonged mental effort;	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-afective () 3. Motor () Notes:
		Is distracted by foreign stimuli	() Not at all () Just a little () Quite a bit () Very much	1. Cognitive () 2. Socio-afective () 3. Motor () Notes:

Source: The authors (2018).

Each child was observed by a Scientific Initiation scholarship student attending the Physical Education course of Instituto Federal do Ceará (IFCE – Federal Institute of Ceará), who underwent a training course in order to apply the activities. While one student mediated the experiences, the other students, along with the researcher, took notes in the guides and filmed the activities.²

Aside from observations recorded in the guides, a Field Journal was used, in which feelings, movements, speeches, and other elements that were observed and considered to be relevant regarding the research objectives were recorded. In other words, everything that could be seen, heard, and felt was recorded, as suggested by Demo (2012, p. 33), who believes that “the qualitative analyst observes everything, what is said and what is not: gestures, glances, the sway, the waddle of the body, the swinging of hands, because everything might be impregnated with meaning [...]”

Experiences were selected according to their significance regarding the research goal, which was to mitigate ADHD symptoms. Each experience day started with a loving contact with nature, aiming at a free exploration of the space, allowing the subjects to submerge themselves

in the scents, colors, textures, and sounds provided by the environment. After that, four activities were performed prior to the meeting, each corresponding to one of the stages proposed by the Flow Learning Method: awaken enthusiasm, focus attention, offer direct experience, and share inspiration (Cornell, 2008).

Experiences consisted of four games or play activities, each one following a stage and with specific objectives. The experience “walking barefoot”, for instance, sought to provide children with better focus, enhancing observation and attaining balance. The purpose of working these characteristics was to mitigate some ADHD symptoms, such as difficulty in sustaining attention, not being able to perform activities quietly, and being easily distracted.

Results

Results were organized according to changes observed in the following aspects, which comprised emerging categories: a) ADHD symptoms; b) behaviors; c) social skills; d) interest in school activities and in learning.

Data obtained using the Snap-IV test completed by teachers and identified in monitoring guides are shown in Chart 1, where SI means subject from the Intervention Group and SC means subject from the Control Group. According to the SNAP-IV, inattention predominates if there are six or more “quite a bit or very much” answers for items 01 through 09 in the form. If there are at least six “quite a bit or very much” answers for items 10 through 18, there is predominance of impulsivity/hyperactivity (Chart 2).

Chart 2 – ADHD Symptoms

PRIOR TO EXPERIENCES			AFTER EXPERIENCES		
INTERVENTION GROUP	TEACHERS	GUIDES	INTERVENTION GROUP	TEACHERS	GUIDES
SI1	09 Inattention	07 Inattention	SI1	08 Inattention	06 Inattention
SI2	09 Inattention	07 Inattention	SI2	06 Inattention	06 Inattention
SI3	09 Inattention and 10 Hyp/imp	08 Inattention And 08 Hyp/imp	SI3	08 Inattention and 09 Hyp/imp	06 Inattention and 07 Hyp/imp
SI4	07 Inattention	06 Inattention	SI4	Only two items from 01 through 10 scored “Very much”	04 Inattention
SI5	07 Inattention and 09 Hyp/imp	09 Inattention And 08 Hyp/imp	SI5	06 Inattention and 07 Hyp/imp	06 Inattention and 06 Hyp/imp
SI6	09 Inattention and 06 Hyp/imp	10 Inattention and 06 Hyp/imp	SI6	07 Inattention and 06 Hyp/imp	08 Inattention and 06 Hyp/imp

CONTROL GROUP	TEACHERS	GUIDES	CONTROL GROUP	TEACHERS	GUIDES
SC1	09 Inattention And 06 Hyp/imp	NOT AVAILABLE	SC1	09 Inattention And 05 Hyp/imp	NOT AVAILABLE
SC2	08 Inattention and 05 Hyp/imp		SC2	09 Inattention and 05 Hyp/imp	
SC3	08 Inattention and 05 Hyp/imp		SC3	08 Inattention and 05 Hyp/imp	
SC4	10 Inattention and 02 Hyp/imp		SC4	10 Inattention and 03 Hyp/imp	
SC5	05 Inattention and 09 Hyp/imp		SC5	07 Inattention and 10 Hyp/imp	

Source: The authors (2018).

In the chart above, it is clear that both teachers' answers and the results obtained from the guides indicate the same symptom predominance. It is also clear that after experiencing nature, the Intervention Group (IG) had similar and positive changes, which indicates that symptoms were indeed mitigated. The Control Group (CG) did not have guide results as they did not participate in the experiences; however, SNAP-IV results clearly show that there were no significant changes prior to and after the experiences.

It is noticeable that three children from the Intervention Group lay in the combined subtype; three other children were in the group characterized as predominantly inattentive according to the classification by Bonadio & Mori (2013). On the other hand, according to the SNAP-IV completed by teachers, all subjects of the Control Group had the combined type: inattention, hyperactivity, and impulsivity.

The results in the SNAP-IV questionnaires applied to teachers prior to and after the experiences showed changes in the Intervention Group. Even though they occurred at a small scale, small changes were observed in symptom perception, which indicates they were mitigated. This also applies to guide results, which were compatible with SNAP-IV, indicating that ADHD symptom intensity decreased in the IG.

Symptom predominance remained the same after the experiences; however, symptom intensity was lower, declining from "very much" to "quite a bit" in the SNAP-IV, and to "just a little" in some situations. This finding might be observed by cross-referencing the SNAP-IV results, guide notes, and Field Journal records.

No subject had less than six scores in SNAP-IV items prior to the experiences. Analyzing the guides, it is noticeable that SI4, for instance, had a

change in attention level, observed by the teachers. This change was positive, so much so that no item was marked as “very much” or “quite a bit”.

In the IG, the inattention symptoms that were the most positively affected correspond to items related to failure to pay attention to detail, difficulty in sustaining attention to tasks or games, not following instructions, and difficulty in responding to requests or following orders. Regarding hyperactivity and impulsivity symptoms, the following items stand out: indication of being “wired”, providing hasty answers, and having difficulty in waiting for their turn.

ADHD children usually find it difficult to interact with individuals of the same age group in games or in school activities and to sustain attention. However, according to Figueiredo (2015), international investigations suggest that green spaces allow access to intimacy, beauty, freedom, and challenge, and because of these characteristics, they instigate movement and exploration. Thus, children are allowed to develop, beyond their motor capabilities, self-confidence, autonomy, imagination, and creativity. The emergence of these behaviors was observed in the Intervention Group, as ADHD symptoms were mitigated throughout a continuous exposure of children to nature.

According to Maller et al. (2009), it is possible to confirm that nature improves health, including physiological, psychological, physical, and social benefits; it might even develop an environmental behavior. The results obtained provide enough evidence indicating that nature might also mitigate ADHD symptoms.

Changes were expressed mostly through social resourcefulness, autonomy, perception, self-confidence, among others. When ADHD symptoms were at higher levels prior to the experiences, these behaviors were not expressed satisfactorily. Some evidence regarding the above mentioned might be identified in the speeches of parents and teachers, as shown in Chart 3.

Chart 3 – Speeches about the behaviors observed by parents and teachers

Parents	Teachers
With this project he's doing with you, you know, SI6's behavior has improved, he's "calmer" and less "quarrelsome" (Parent 06).	Look, after... (pause) after he (SI6 started participating in the experience, his behavior had an excellent change, because he wouldn't stay in the classroom. Now he stays, he does some tasks, thank God. I liked the project very much, because it helped me a lot (Teacher 01)
He (SI5) seemed to me to become calmer as the Project developed. Yeah, he's changed a lot (gets thoughtful). But, you know, after he stopped the experiences he's been having more compulsive behaviors and has wanted to go outside more (Teacher 05).	Yeah, you know, he's (SI5) improved (pause), like, sometimes his behavior is really less aggressive. Sometimes, he's still aggressive, but that's what he experiences at home, you know? He's at home, his mother mistreats him, and the little guy just wants to lash it out, right? Because that's the language he's familiar with. But, you know, he's improved a lot overall (Teacher 03).

Since he (SI3) started participating in the Project, he's been quite polite (thoughtful). Now I'm doing my best to change my children, too (Parent 03).	Today he (SI3) is really better as to staying in the classroom, especially with his classmates, because he wouldn't before. The only interaction he was capable of was those games o involving punching, these things. But not anymore nowadays (Teacher 02).
Regarding restlessness, SI1's restlessness has improved a lot. Because, woman, he wouldn't even do his homework. Now, he's doing it, he's trying more, even at home, he's making much more of an effort. He's improved a lot (Parent 01).	SI1 has been more relaxed, calmer lately. Like, he comes to class and is very pro-active, he wants to do the activities, and this is something I've already noticed (Teacher 04).

Source: The authors (2018).

Parents and teachers mentioned that new behavioral elements appeared, such as introspection, tolerance, quiet, good manners, commitment, lower impulsivity, persistence, and pro-activity. Parent 05 mentioned that they miss having nature in their daily lives, since their child was more focused and less impulsive during the experiences.

This result confirms the study by Taylor & Kuo (2009), who indicate that children exposed to nature have higher levels of concentration and exhibit a calmer behavior. The speeches, both from parents and from teachers, indicate changes in the behavior of subjects, either in their relationship with other children and with teachers, or in the intensity of their impulses. It is worth noting that a restless behavior and sometimes aggressiveness and movement in the classroom confirm the manifestation of ADHD symptoms. One scholarship student, who monitored SI3, made the following comment regarding his behavior:

I can't say that SI3's behavior was linear because SI3 is definitely not linear, there were highs and lows. There were times when he regressed regarding a given behavior, but if I compare all the meetings we held, I saw more of an evolution than regression in most of them. I believe all declines he had were explained by his home environment and they didn't occur when he was in a natural setting with us and the other children (Field Journal, B3).

Regarding changes in behavior observation in IG subjects after they experienced nature, the above opinion was unanimous in the speeches of parents, teachers, scholarship students, and researchers. The following speeches should be highlighted:

The first contacts with SI5 were permeated by fear, insecurity, and aggressive behavior. After two months of intervention, what I observe is a child who still has intense behaviors yet the level of aggression has changed considerably, as has the will to perform the experiences (Researcher).

During the experience "Where animals live", SI5 showed changes in his behavior: he followed instructions, was not always "wired", didn't find it difficult to sustain attention, and waited for his turn (Notes from B02).

It was very good to see her (SI1) participating in something that she could not do previously. We didn't see any irritation and we noticed that she was quite keen on getting it right (Notes from B01).

My son (SI6) is very different, before the project he would fight anything, today he is calmer (Parent 06).

(SI1) has been more relaxed to perform classroom activities (Teacher 04).

Therefore, an analysis of the changes that occurred in the subjects shows that the setting in which the individual is included in their daily lives must be taken into consideration, as well as the influence of activities with nature. The factors present in this environment might have been either positive or negative. Notwithstanding, positive stimuli they received experiencing nature must be considered relevant. However, exposure to nature alone is not remedial to mitigate problems intrinsic to ADHD. It does, however, enable a mitigation of aspects related to the lack of love that these children frequently experience. This circumstance corroborates the study by Benczik (2002, p.91), who believes that interventions based on cognitive-behavioral strategies are psychotherapeutic and provide better results in controlling ADHD symptoms.

Therefore, based on the results provided by parents, teachers, and scholarship students, experiences with nature might also become an ancillary strategy to mitigate ADHD symptoms. Comparing the subjects' way of being prior to and after their direct exposure to nature, it is clear that the natural environment affected social-affective development, improving social relationships and helping to trigger a process of inner ecology, which is related to transformation in subjectivity.

According to Guattari (2005), subjectivity, social relationships, and the environment work as communicating vases, ecosystems in interaction. In his opinion, however, these three ecological dimensions have been increasingly deteriorating. Experiencing nature enables to recover dimensions of these three ecologies, allowing the creation of existential territories by re-singularizing children as subjects. Regarding social skills, teacher and parent reports are organized in Chart 4 – Social Skills observed by parents and teachers.

Chart 4 – Social Skills observed by parents and teachers

Parents	Teachers
Well, regarding the entire process he (SI2) went through with you, he improved, in my opinion he improved a lot. At school, I believe so, with his friends, too. He said he made friends there in nature (Parent 02).	I've followed SI2 since first grade, and like, socially speaking, he's grown, like, considerably. Since he didn't socialize with anybody, he had this barrier that kept him from approaching people, chatting with someone, playing, he loves to play with these cards, and he needs a partner to play with these cards. Now, he wants to have company to play, right, he doesn't just play alone anymore (Teacher 06).
At home, she (SI5) used to only fight with his brother and even with me; now he is more talkative and fighting less (Parent 05).	Look, what I've noticed is that nobody wanted to play with her (SI5) before, because they said she picked too many fights (Teacher 04).

He (SI6) is very quiet and doesn't like to talk much, only when he's angry, then he goes berserk. I think he is like that because his father used to beat him a lot and told him to shut up (looks up and sighs), but now he's better! Yeah... (pause) he is better (Parent 06)	SI6 is much better nowadays. Because it's like, he would keep to himself before. He would stay in a corner, and now he's interacting with his classmates, he is (Teacher 05).
There's no issue of, like, only wanting to play with his siblings, she (SI4) has made friends, you know? And this is very good. And it happened after this nature project, you know? (Parent 02).	She (SI4) was always a quiet, calm girl. But what she improved a lot was her interaction with people. So she was never a trouble in the classroom, her problem was that she liked to keep to herself, didn't make friends, and there was a great change in that regard (Teacher 01).

Source: The authors (2018).

The aspects highlighted by teachers and parents refer to the creation of friendship bonds, extroversion, tolerance, and interaction.

At the beginning of the intervention, subjects SI3 and SI5 did not get along well; they even had physical altercations more than once. However, as the research progressed, they became very close, thus indicating changes in their social and affective behavior (Researcher).

Another aspect that changed greatly was his (SI3) relationship with his peers; he started to interact without being aggressive and even helps them when he notices someone is not doing the activity as he thinks it should be done (Teacher 03).

Monquinho, I love you, and love that I am here. I asked: here where? And he answered with a huge smile: c'mon! In nature... (SI3).

(SI1) says he really likes you (researcher) and the other people who go there to nature (Responsible SI1)..

Therefore, it is clear that the subjects' behavioral problems, as well as their social skills and affective issues, indicated by the parents, teachers, researcher, scholarship students, and the subjects themselves, are related with ADHD symptoms. However, they might also refer to emotional issues, derived from a troubled family background. The family setting affects motivation, the ability to concentrate, and social relationships of children. Sociability in a natural, affectionate setting that has limits, as was the one provided during the study period, aided in mitigating the ADHD symptoms, which reflected in changes in the development aspects of the children involved, which in turn directly affected the way they interact socially.

While these activities were performed, we identified the emergence and/or improvement of social and educational skills also indicated by Del Prette & Del Prette (2005): performing activities; establishing limits and discipline; generating positive reciprocity; expressing their opinions and responding positively to instructions. Likewise, we identified that exposure to nature helped build a suitable social behavior, and it helped the subjects in the Intervention Group regarding their cognitive aspect.

Inattention to details, evading exercises that require an extensive mental effort, or making mistakes because of neglect directly affect the learning process. In the first interview conducted with parents and teachers, this was quite evident. However, the reports by the same informers after the intervention signaled that children showed greater interest in school activities and their learning process had been showing improvements. Reports also indicate that the children started to show more motivation to go to school, as is shown in Chart 5.

Chart 5 – Interest in school activities and in learning

Parents	Teachers
I've noticed that all this process of SI5 going to nature is really good, it was really good to him, even for his head, for him to understand a little better about school things (Parent SI5)	He (SI5) is more willing to perform the activities. Before, he would do them, but very briefly and he would get tired, didn't want to do it, yeah... (pause) he only wanted to play and today I notice he is more interested (Teacher 03).
SI4 would put up a fight not to go to school, but when we said that we would go to the walk, with field class, she would wake up early, with no help, and was excited to go. Sometimes, it was even difficult for her to sleep, getting her things ready to go to field class (Parent 04).	Because, you know, she (SI4) didn't want to come to school at the beginning of the year. Her mother had already changed her schedule twice to see if he'd get interested, and after the experiences, she hasn't been missing classes lately (Teacher 02).
That's my son, before, SI2 complained he didn't do anything. It seems he doesn't learn much from other boys! But now he's willing to go to school and learn (Parent 02).	SI2 can't read, it is very hard for him. Before, he didn't want to be in the classroom because he used to say that he didn't know anything. Now he stays and says that if he doesn't come to school, Monica won't take him to nature (Teacher 06). SI2 always found it very difficult to learn. But, like, his issue... his wish to learn has increased a lot, you know? (Teacher 01).
SI4 only does the activities whenever he wants, you know? He starts doing them, but that way of his. But after this treatment, he improved a lot, quite a lot (Parent 06).	I notice that SI4 is more motivated to come to school and is participating much more in the activities suggested (Teacher 02).
SI1 stopped being inattentive a little. Sometimes, when starts doing chores at home, whenever he likes, then, she says "No, mom, I'm not doing it, right, because Mônica might arrive" (Parent 02).	Regarding her learning, it's still very difficult, but she (SI1) is improving a little, he is progressing. My work with her is more one-to-one, you know? Because, her learning is really slow (Teacher 04).

Source: The authors (2018).

Behaviors identified by parents and teachers at the beginning of the research were altered, and ADHD symptoms were mitigated. Children showed higher motivation, persistence, understanding, attendance, and interest in participating in the activities, as highlighted by parents and teachers.

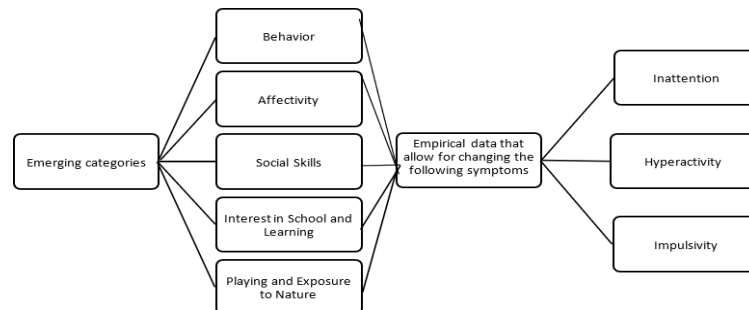
SI2 found it more difficult to learn, according to Parent 02 and Teachers 06 and 01. However, among the participants of activities with nature, he was the keenest on learning. He tried hard and whenever he was able to perform some activity, it was as if the entire world was opening to him.

In ADHD people, the ability to respond well to new situations, in an adaptive manner, is compromised, which leads to a low motivation pattern, which causes the child to become irritated and upset. These aspects might be related to the expectation of people with whom the subjects interact, whether they are friends or people from school (Bolfer, 2009). However, in the period during which the experiences with green spaces were conducted, children diagnosed with ADHD were observed to adjust well to the new situation and managed to perform the activities throughout the project, with no major difficulties, and they were pleased, as well. Fjørtoft (2001) believes that outdoor environments are considered essential to learning and for child development.

Cross-Reference Between Data, as a Summarizing Exercise

After the individual analysis of each category, it was necessary to cross-check the SNAP-IV questionnaire results and interviews with study informers regarding ADHD symptoms, behaviors, social skills, and interest in school activities and learning. Figure 5 shows a summary of this cross-reference (Figure 5).

Figure 5 – Cross-reference between empirical data and ADHD Symptoms



Source: The authors (2019).

Considering the categories that emerged from the speeches of the informers, it is clear that children from the Intervention Group had higher adjustment in each one of them, having benefited from direct exposure to nature, which thus directly affected each ADHD symptom, by mitigating them.

Regarding ADHD symptoms such as inattention, which might appear in SNAP-IV as “difficulty in sustaining attention” or “seems to not be listening when talked to”, we observed that, the children who first had this symptom at a strong level were able to develop better attention and focus while performing the activities. There were also improvements in the following aspects: “is easily distracted by stimuli that are

foreign to the task”, “does not follow through with instructions”, “does not complete school tasks”, “avoids prolonged mental effort”. There is evidence that they acquired higher focus and interest, and were able to finish tasks with higher focus.

The symptoms “hyperactivity” and “impulsivity”, “runs from one side to the other”, “has difficulty in playing or engaging in quiet activities”, and “speaks excessively” also had positive changes; there was evidence of access to peace of mind, higher participation, and sustaining moments of silence/focus.

In the Control Group, the changes observed indicate a positive shift in SNAP-IV scoring, changing from “very” to “only a little” regarding “Seems not to listen when directly spoken to”. Conversely, the inattention symptom increased in another subject, changing from “a little” to “a lot” in the items “Difficulty in sustaining attention to tasks or games” and “Distracted by external stimuli. Regarding hyperactivity, only one change occurred with a subject that went from “quite a bit” to “a little” in SNAP-IV scoring in the item corresponding to being wired.

Activities with nature affected the development process of subjects from the Intervention Group. There was a positive impact on each ADHD symptom, and a new aspect that was unveiled right in front of the parents', teachers', and the subjects' eyes. Therefore, the relevance of the interaction between children and the natural environment for mitigating ADHD symptoms is evident. ADHD symptoms shown by the study subjects compromise and hamper their activities and relationships; however, as the symptoms were mitigated, there were improvements in their life quality, which was evident in the present study.

It can be inferred that the fact that children from the Intervention Group actively participated in the experiences with and within nature, which provides engaging settings, led to considerable changes in the ways they expressed themselves concerning several aspects. Bonadio & Mori (2013, p. 43) state that ADHD symptoms are mitigated when children are engaged in interesting activities. On the other hand, in less compelling settings or with less compelling activities, symptom frequency tends to increase.

Cross-Referencing with Other Studies as a Validation Exercise

There are few studies published specifically on the relationship between nature and ADHD people. Among those, nine papers have been identified through an integrative analysis conducted in the period ranging from 2003 to 2019, and their results indicate that outdoor activities reduce attention deficit/hyperactivity (ADHD) symptoms and help cognitive and social-affective development. They also point out that higher levels of green spaces have been associated with lower chances of having ADHD symptoms and they suggest a link between disconnection of children and nature and the recent outbreak of childhood disorders, such as ADHD (Taylor; Kuo, 2004, 2009, 2011; Godbey, 2009; Van Den Berg; Van Den Berg, 2011; Arns et al., 2013; Yang et al., 2019; Donovan et al. 2019; Damasceno, 2019)³.

Studies on the presence of nature inside school environments indicate that outdoor learning spaces lead to higher social interaction, communication, cooperation, thus improving social behaviors, emotional intelligence, and academic performance, and broadening inclusion, as well (Mannion, 2003; Dymont, 2005; Dymont; Bell, 2006; Mirrahimi et al. 2011).

Other studies have provided evidence that the landscape has a beneficial effect on physical activities and motor development of children, which reflects on their physical and mental health (Fjørtoft, 2004; Mccurdy et al. 2010). Aside from the physiological benefits provided to children, derived from exposure to nature, psychological, spiritual, and social benefits are also evident (Wells; Evans, 2003; Maller et al. 2009; Godbey, 2009; Corraliza; Collado, 2011). Overall, aesthetic experiences derived from exposure to natural settings affect life quality, as well as peoples' way of being and living, reassigning meaning to relationships one has with the world, representing an essential element for child development, and for their health and well-being (Kellert, 2006; Marin; Kasper, 2009; Chawla, 2015).

The cognitive, emotional, and physical aspects of children benefit from higher exposure to nature, when they engage in socio-affective and ecological learning processes, which increase their ability to deal with adverse situations and enable restoring psychological experiences. Additionally, exposure to nature leads to involvement and awareness, providing new meaning to their relationships with the natural environment (Strife; Downey, 2009; Lima-Guimarães, 2010; Corraliza; Collado, 2011; Cheng; Monroe, 2012; Collado; Corraliza, 2015; Assis; Mazzarino, 2016). Exposure to Nature also increases attention and enhances memory quality in children (Schutte; Torquati; Beattie, 2015).

Therefore, both wide studies on the relationship between people and nature, on one hand, and specific studies with ADHD children, on the other, claim that multiple dimensions of human existence benefit from this setting, even the very biological aspect of the being, sometimes forgotten by present-day society. In summary, experiencing nature leads to the development of physical, psychological, emotional, spiritual, mental, cognitive, learning, attention, and memory aspects, which reflects in life quality, in a more sensitive way of being and living. It increases the possibilities of communicating, cooperating, including, and this has an impact on affection experiences, which extend beyond social relationships and into the relationship with the world and its beings. Symptoms are mitigated specifically in ADHD children, as is confirmed by this and other studies. Hence, according to Kellert (2006), it is possible to state that nature remains an indispensable and irreplaceable element for human development. Aside from Kellert, other authors, such as Louv (2015), Tiriba (2006), and Godbey (2009) have proven that the absence of exposure to nature is harmful to human beings, and Kellert (2006), who compared different age groups, shows that children suffer disproportionately when this type of contact is limited; according to the author, this affects their long-term development.

Final Considerations

During the intervention period, it was evident that experiences with and within Nature stimulated creativity, exploration of freedom, and autonomy. It is worth noting that activities were chosen because they were interesting and riveting, but particularly because they were related to the minimization of ADHD symptoms.

The experiences of ADHD children exposed to nature allowed them to feel more confident, more capable of relating to themselves and to others, and of developing a conscious way of being within and caring for the environment. According to teachers' and parents' perceptions, experiencing nature impacted the social, affective and cognitive aspects of these children.

The analysis of the intervention process with nature, considering the changes observed in the biopsychosocial development of the involved in the research, allows us to conclude that contact with natural environments provides a powerful life experience for children with ADHD. The study concluded that ADHD symptoms were less intense after the experiences with and within nature although their respective ADHD subtypes still predominated. The proposal of the present study was developed by the researchers and is summarized in the observation guide, which poses a contribution for further studies on ADHD children and nature.

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Notes

¹ Additionally, and following the aforementioned Resolution, the research project was submitted to the Committee of Ethics and Research – (COEPE), and obtained a Coepe Report, number 2.504.020. This project is identified as number 11197612.1.00005310 on Plataforma Brasil (Brazil Platform), a Federal Government agency that manages these issues. Aside from COEPE authorization, an authorization was requested to IC-MBIO to perform the study inside a CU.

² Recordings and photographs were authorized by parents in the TCLE

³ The bases for searching were Portal de Periódicos da CAPES; Periódicos Eletrônicos de Psicologia (PEPSIC); Biblioteca Virtual em Saúde (BVS); Science Direct; Scientific Electronic Library Online (SCIELO). The following were used as descriptors: Vivências com a Natureza (Experiences with nature) AND Necessidades Educacionais Específicas (Specific Educational Needs); Meio ambiente (Environment) AND Aprendizagem (Learning); Transtornos e Dificuldades de Aprendizagem (Learning Disorders and Difficulties) AND Vivências (Experiences). During the search, we observed that by using the descriptors combined, no related papers were being found. Therefore, we chose to use the descriptors separately and other were included, namely: TDAH; ADHD; Nature; Natureza; Health.

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