

DIPARTIMENTO DI PSICOLOGIA
DEI PROCESSI DI SVILUPPO
E SOCIALIZZAZIONE



SAPIENZA
UNIVERSITÀ DI ROMA

FACULTY OF MEDICINE AND PSYCHOLOGY

Department of Social and Developmental Psychology

PhD in Social Psychology, Developmental Psychology and Educational Research

Curriculum: Environmental Psychology

Ph.D. THESIS

**THE EFFECT OF CONTACT WITH NATURE ON ATTENTION AND
RESTORATION AMONG CHILDREN AND ADOLESCENTS AFFECTED BY
ATTENTION DEFICIT HYPERACTIVITY DISORDER**

Cycle XXXI - 2015/2019

PhD candidate: Francesca Di Carmine

Supervisors: Prof. Marino Bonaiuto (Sapienza University of Rome)

Prof. Silvia Collado (University of Zaragoza)

This dissertation was supported by a research scholarship for doctoral courses funded by Sapienza University of Rome. It is framed within the project Experiencia infantil de la naturaleza. Estudio de los efectos psicológicos y sociales del contacto con entornos naturales (PGC2018-095502-B-100).

ACKNOWLEDGEMENTS

Firstly, I would like to thank Prof. Marino Bonaiuto, for encouraging me to enrol for the PhD course. It was not among my projects however it has been one of my greatest and most inspiring experiences, surely very challenging yet it allowed me to reach important results, such as discovering Environmental Psychology. You helped me find what I was looking for as I was still in the Positive Psychology area... however I soon discovered that I wanted to be in the Environmental Psychology instead! I soon was able to give a name to something that was already happening in myself, such as place attachment for the Nature that surrounds my residence, connectedness with Nature and so forth. Thank you for introducing me to restorativeness studies and suggesting to focus my literature review on them, because this allowed me to enter into an unknown but very exciting world that highly impressed me. Now I realize that this was what I was looking for but back at the beginning of this journey I could not give it a name. I feel this is something very important to me since I believe in what I have been investigating! It is not only part of my work as it also relates to my personal values, such as the love for Nature. Thanks for trusting me and letting me conduct the studies I wanted to, in other words, thanks for letting me go, since in this way I was driven by passion and this helped me to cope with the big challenges of conducting field studies with clinical samples. Moreover, I feel extremely happy and satisfied with the hard work done during the PhD! Finally, I would like to let you know that I appreciated and still appreciate your being international, this was one of the things that led me to work with you!

Thank you very much Silvia Collado, or Silvia, my co-tutor. Thank you for becoming part of my PhD during one of the most difficult times in this journey. I loved working with you. You made me feel more than welcome, you listened to me, you were open to my ideas. Thank you for putting your great experience to my disposal, for encouraging me when I needed, for using nice words with me, for letting me know the good parts of my work and not only highlighting its shortcomings, and also for making me feel that I could do it when I thought I could not. Thank you for always explaining

how to do things, especially when I had no idea how to go about doing them. You have been much more than a supervisor to me and I really appreciate it. I am so proud you have been my supervisor because I know how hard you work but at the same time you showed that relations at work are important to you and I think this is the reason why you could maintain a relationship based on respect and esteem with me and people around you. I really hope that we can keep on working together in the future!

Thank you Prof. Gloria Scalisi, you helped me when I most needed and when I least believed in myself (the statistics!). You made me think I could do it! Thank you so much for this and for sharing important aspects of my studies!

I also wish to thank Rita Berto. Although I have not met you yet in person, I really hope that one day we could meet. I love your works, I see passion, intellect and great critical thought yet I also see simplicity which I believe as a part of great things. Your works inspired me so much! Whilst reviewing the literature, I used to find inspiring aspects in your works! They inspired me sooooo much during my PhD. Thanks for being available with suggestions every time we corresponded during these years. Please keep on working like this, you are an inspiration in the scientific community of Environmental Psychology.

Thank you Anna Maria Ardito and Rossella Lazzari for believing so much in me and for appreciating my enthusiasm and passion for work! Every time I met you in the TSMREE, in your eyes I could read appreciation and esteem for myself and my work and this allowed me to do better. Thanks for helping me in recruiting the ADHD children and for speaking to the parents about the studies. You are a great part of my PhD work and memories!

Thank you mum and dad! I know how much you love me and how proud you are of me. Thank you so much for helping me in the last and more challenging part of the PhD. I know you did a lot of sacrifices to hold my lovely baby but I know you did this because you really believe in me and are

inspired by my determination. I love you so much and I feel so grateful to you!!! Dad, you are wonderful! You are proud of me, I am so proud of you and your sweet heart. It was really funny every time you asked me what I was doing and what my work consisted in!!!! I love you because you are proud of me yet sometimes you do not even know what I am doing, this is unconditional love!

Thanks to my sister! I feel you have so much esteem for me. And I love it when you explicitly say it to me. I love the way you encourage me when I do not believe in myself. Thanks for always inspiring me and listening to my work details! You helped me very much.

Thanks to my husband. Thanks for supporting me during these challenging years and especially during the writing of this thesis, when I was not myself anymore. You always listened to me. I really appreciate it very much! I hope that we can reach other goals together in the future. I love you.

Finally, thanks to my lovely and sweet one-year baby!!!! Elias, I love you. Thanks for existing. Writing this thesis during your first year of life was challenging for me, and maybe for you as well. But I feel so happy you are with me in the last part of the PhD. I am so proud I can still breastfeed you, it does not matter how busy I am or if I keep on reading on the PC while I breastfeed you in bed (and sometimes you want the exclusiveness, no PC!). I cannot wait for the day when you can understand my explanations (maybe you already do!!!) on what I have been doing and how passionate I am for this work. I believe in this work, that is why I take you every day walking in the green, engaging with Nature with all your senses, I let you get dirty in the soil, caress the animals and pick up the fruits from the trees! I feel so happy when we are outside and I know you perceive it. I always remember the importance to keep on being passionate for what I do, in this way I can more probably be the mum you need to have, happy and satisfied. I hope you can have my same or even more passion in your life!

I also wish to thank Giulia Amicone for listening to me, understanding me, suggesting me how to work, and sharing with me the hardest parts of my PhD! Thank you Fleur for reading my entire thesis!

Finally, thanks to all the children, parents, teachers, professors, students and colleagues who worked with me and believed in what we were doing. Thanks to everyone who shared with me this exciting journey and to Sapienza University for giving me such opportunity!

ABSTRACT

Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001), with possible impairments in familial, cognitive, academic and occupational functioning. It is mainly characterised by chronic inattentiveness or attention inconsistency and, additionally but not necessarily, impulsive behaviour (hyperactivity-impulsivity).

Based on epidemiological data on developing age, international prevalence of the disease is around 5.29% (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014) whereas in Italy the range is between 0.4% and 3.6%, depending on geographical areas and, assuming the lowest value, the pathology would concern about thirty thousand children and adolescents. Moreover, the 88,5% of those affected is constituted by males (Maschietto et al., 2012). Current treatments are both behavioural and pharmacological, notwithstanding complementary interventions that might alleviate symptoms and improve quality of life are highly suggested. Attention Restoration Theory (ART; Kaplan & Kaplan, 1989), already widely empirically tested both among typical children and adults (Berto, 2014; Chawla, 2015; Collado & Staats, 2016; Franco, Shanahan, & Fuller, 2017) offers promising beneficial applications on ADHD as confirmed by published literature (Faber Taylor, Kuo & Sullivan, 2001, 2002; Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010).

By considering ART framework, the present research addresses innovative points. Infact, it investigates if and how ADHD symptoms are alleviated after passive exposure in different built and natural environments among children and adolescents (first central point). It also explores the relationship between mindfulness and psychological restoration or the also defined fascination-meditation hypothesis (Kaplan, 2001), among typical adolescents (second central point), with the wider and future objective to find (active) ways that may increase the benefits of passive exposure to Nature for ADHD children and adolescents. Such aims are reached by 1) evaluating the recovery effect of different types of outdoor environments (natural and built, yet built has two sub-types

historical-urban and standard-urban), (2) evaluating the recovery effect of two different types of natural environments that vary in terms of prospect – a clear field of vision on the surroundings – and refuge – the presence of (potential) hiding places that certain types of vegetation configuration might offer (Appleton, 1975; Gatersleben & Andrews, 2013; Luymes & Tamminga, 1995). Indeed, one is characterised by high prospect and low refuge and another one is characterised by low prospect and high refuge, (3) evaluating the recovery effect by considering the frequency of contact with Nature and the system of relations that involve the child, (4) testing a mediational model between mindfulness and reported restoration mediated by perceived restorativeness. In total, four experimental studies are presented, of which two are experimental. In line with previous findings, general outcomes of Study 1 and Study 2 show that a walk in a large open field characterised by high prospect promotes cognitive functioning, whereas two different natural environments of a botanical garden do not lead to recovery and are not even significantly perceived in different ways. In addition, findings of Study 3 reveal that child's contact with Nature and connection to Nature are related to a system of family relations that influence symptoms severity. Moreover, findings of Study 4 suggest that it is possible to increase benefits of Nature contact by being mindful during passive exposure to Nature, and this is a promising line of research among ADHD children and adolescents who need to enhance the restorative effect they might obtain from exposure to Nature. Implications relate to the implementation of environment-based behavioural treatments with a mindful approach in healthcares for ADHD, outdoor pedagogies and urban design that include nearby Nature.

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SUMMARY

Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001). It is mainly characterised by chronic inattentiveness or attention inconsistency and, additionally but not necessarily, impulsive behaviour (hyperactivity-impulsivity). Epidemiological data show that the international prevalence of the disease in childhood is around 5.29% (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014), whereas in Italy the range is between 0.4% and 3.6%, depending on geographical areas and, assuming the lowest value, the pathology would concern about thirty thousand children and adolescents. Moreover, the 88,5% of those affected is constituted by males (Maschietto et al., 2012). Therefore, ADHD appears to be one of the most common diagnoses during developmental years nowadays. Based on Barkley (2003), 50% of children with ADHD will display symptoms during adulthood. This shows that ADHD is a chronic disorder, that could be manifested throughout the life-span, with serious impairments in familial, cognitive, academic and occupational functioning. The social consequences of ADHD could be the most detrimental side of this disorder, both in childhood and adulthood. Current interventions on ADHD are aimed at reducing symptoms and include behavioural and pharmacological treatments (i. e. methylphenidate, atomoxetine) on severe cases (Maschietto et al., 2012), the latter implicating possible side effects. Behavioural treatments address the relations the child has within family and school relations contexts. Nevertheless, the basis of human behavior are strongly influenced not only by the social environment yet also by the physical environment, which in turn effects health and well-being (Glanz, Rimer, & Viswanath, 2008). However, physical environment and human-environment transactions are barely or not at all investigated in the ADHD framework. Indeed, a consideration of ADHD in a wider holistic perspective shows that it urges to seek additional interventions addressing the importance of the physical environment that surrounds ADHD children. Indeed, the present

research aims at evaluating whether the natural environment used as an environment-based behavioural treatment yet with a mindful approach, could be considered a complementary way (combined with current treatments) to alleviate ADHD symptoms. The advantages of such a treatment refer to its potential absence of side effects (conversely to medications) and minimal costs.

Such overarching aim is reached by experimentally investigating if and how being exposed to certain types of outdoor environments leads to restoration, and whether being mindful during Nature contact, leads to even greater restoration. In cognitive terms, restoration means attention renewal, however this is not its only meaning and, as such, it is a much wider concept. Restoration is defined as “the renewal or recovery of adaptive resources or capabilities that have become depleted in meeting the demands of everyday life” (Collado, Staats, Corraliza & Hartig, 2017, p. 128; please see Hartig, 2004). The resources involved are physical, psychological and social, the ones that are used on a daily basis and, indeed, are depleted and in constant need to be renewed in order to cope with new challenges. These resources are more depleted in individuals affected by ADHD.

Literature based on Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) suggests that exposure to natural environments leads to restoration and other benefits both amongst adults (Franco, Shanahan, & Fuller, 2017) and children (Chawla, 2015), and that psychological restoration between both (typical) groups works in the same way (Berto, Pasini, & Barbiero, 2015). However, environmental psychology literature on the benefits amongst ADHD population is still at its infant stage. A few exceptions are presented by Faber Taylor and Kuo (2008) and Van den Berg and Van den Berg (2010) who experimentally demonstrated that exposure to natural environments improved cognitive functioning as well as symptomatic behaviours and elicited positive feelings. Nonetheless, findings from both studies and those deriving from other studies conducted amongst ADHD population (Donovan, Michael,

Gatziolis, Mannetje & Douwes, 2019; Faber Taylor & Kuo, 2011; Faber Taylor et al., 2001; Kuo & Faber Taylor, 2004) show that many theoretical and empirical gaps need to be investigated. Some of the gaps rely on the difference between built environments (for instance those of a modern town or an historical site) and natural environments (pristine or wild areas vs. gardens or urban parks), factors promoting the frequency of contact with Nature of children diagnosed with ADHD as well as factors that might potentially increase the restoration level during Nature exposure, amongst others.

As consequence, the thesis aims at giving insights to the following research questions: (a) what is the effect of a recovery experience in a natural setting such as a large open field on inattentiveness and other ADHD symptoms? (b) what is the effect of a recovery experience in a historical-urban setting and in a standard-urban setting on inattentiveness and other ADHD symptoms? (c) does a recovery experience in a natural setting help ADHD children focus on the Here and Now? (d) does a recovery experience in a variety of natural environments influence in different ways inattentiveness and other ADHD symptoms? (e) does the frequency of contact with Nature ameliorate symptoms severity? (f) is children's frequency of contact with Nature influenced by their parents' frequency of contact with Nature? (g) is children's connection to Nature influenced by their parents' connection to Nature? (h) is it possible to increase the benefits of a recovery experience in a natural setting by being more mindful or mentally present in the Here and Now?

Four studies are presented in this thesis with the aim of reaching two main objectives: the first object is investigating if and how symptoms are alleviated after walking in different built and natural environments. This is divided in three sub-objectives: (1) evaluating the recovery effect of different types of outdoor environments (natural and built, and the built is constituted by two environments - historical-urban and standard-urban), (2) evaluating the recovery effect of two different types of natural environments (one characterised by high prospect and low refuge

and another one characterised by low prospect and high refuge), (3) evaluating the recovery effect by considering the frequency of contact with Nature and the system of relations that involve the child. The first objective was developed through Studies 1, 2 and 3. The second main objective consists in exploring the relationship between mindfulness and restoration, the fascination-meditation hypothesis (Kaplan, 2001) with the wider and future objective to find (active) ways that may increase the benefits of passive exposure to Nature for ADHD children and adolescents.

Study 1 and 2 are experimental field studies. They are mainly aimed at gaining more insight into the emotions, attention, impulsivity and perceived restorativeness of children and adolescents affected by ADHD when exposed to natural as opposed to built environments. To achieve this, a twenty minute slow paced individually guided walk (Faber Taylor & Kuo, 2008), with a mindful approach, was performed in five different settings: two urban walks (standard vs. historical) and a walk in Nature (a high prospect large open green field) for Study 1 and a Mediterranean area of the Rome Botanical garden compared to a Palms area of the Rome Botanical garden for Study 2, areas differentiated in terms of the width of visual field (prospect) and possibility for hiding (refuge; Gatersleben & Andrews, 2013). Main outcomes of Study 1 show an improvement of attention only after walking in the natural condition and an improvement of impulsivity whereas main outcomes of Study 2 show no statistical differences between conditions and no recovery either.

Study 3 is a correlational study aimed at gaining more insight into being in contact and connected with Nature on family basis and the eventual relation with symptoms severity. Main findings suggest that frequency of contact with Nature is negatively correlated with symptoms severity, in accordance to previous literature (Faber Taylor et al., 2001; Kuo & Faber Taylor, 2004).

Although Studies 1, 2 and 3 show that Nature contact helps into reducing ADHD symptoms and tend to promote thoughts focused on the Here & Now by eliminating the cognitive

noise, the first level of restoration (Barbiero & Berto, 2016; Herzog, Black, Fountaine, & Knotts, 1997), it urges to find a way to increase the benefits that participants obtain. Infact, ADHD presupposes an incapacity to be in the Here and Now and a tendency to be distracted, impulsive, and hyperactive. Therefore, benefits deriving from contact with Nature could be hindered if the individual is not fully aware of the surroundings, in other words, “this ‘lack’ of awareness may affect the perception of the restorativeness associated with exposure to Nature” (Berto, Barbiero, Barbiero & Senes, 2018, p. 2). Conversely, being fully present during Nature contact would lead to experience the third level of restoration, a deeper state of engagement with self and Nature, an openness to reflection (Barbiero & Berto, 2016; Herzog et al., 1997; Kaplan, 2001). At this purpose, the aim of study 4 is to empirically address whether a relation exists between being mindful (a trait rather than a state) or having mindful abilities and (reported) restoration after contact with Nature through the mediation of perceived restorativeness (Berto, Pasini & Barbiero, 2015; Lymeus, Lundgren, & Hartig, 2017). The model is inspired to the Kaplan’s fascination-meditation hypothesis (2001) which basically states that fascination and meditation (a mean to cultivate the mindfulness) are crisscrossed. Study 4 is a field study conducted among healthy adolescents visiting the Rome Botanical Garden. Outcomes show that a relation exists between mindfulness abilities and reported restoration, mediated by perceived restorativeness. However, the wider and future purpose consists in applying mindfulness (through regular practice) to ADHD adolescents in order to increase the engagement – and the deriving benefits - they experience with Nature (see Zylowska et al., 2008).

Overall, the thesis suggests that Nature contact might benefit ADHD children and adolescents and that such benefits are likely to be increased by mindfully engaging with Nature (see Kaplan, 2001). Based on Faber Taylor and Kuo (2008), Nature doses offer potential benefits comparable to those deriving from medications yet without side effects. Indeed, this line of research has exciting implications for the management of ADHD. Daily doses of “green time”

might supplement medications and behavioural approaches to ADHD. These “doses” might take a variety of forms: choosing a greener route for the walk to school, doing class work or homework at a window with a relatively green view, or playing in a green yard or ball field at recess and after school (Kuo & Faber Taylor, 2004, p. 1585), inviting healthcares into implementing an environment-based behavioural treatment for ADHD, designing school and home environments inspired to Nature (Berto & Barbiero, 2017).

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001). Based on Barkley (2003), 50% of children with ADHD will display symptoms during adulthood. It is mainly characterised by chronic inattentiveness or attention inconsistency and, in some cases, by impulsive behaviour (hyperactivity-impulsivity). It can cause serious impairments in familial, cognitive, academic and occupational functioning. The social consequences of ADHD could be the most detrimental side of this disorder, both in childhood and adulthood. Based on epidemiological data of childhood, international prevalence of the disease is around 5.29% (Polanczyk et al., 2014) and, in Italy, the 88,5% of those affected is constituted by males (Maschietto et al., 2012). Indeed, ADHD appears to be one of the most common diagnoses during developmental years nowadays. Interventions on ADHD include behavioural and pharmacological treatments on severe cases (Maschietto et al., 2012). In particular, pharmacological treatments (i. e. methylphenidate, atomoxetine) are not tolerated by all children and those who tolerate them, need to deal with side effects. Here it comes the need to seek complementary treatments that could help into managing symptoms and improving the quality of life of individuals and families affected (Kuo & Faber Taylor, 2004).

In order to look for complementary treatments, it is worth considering that the basis of human behavior are strongly influenced both by the physical environment and social environment, effecting in turn health and well-being (Glanz, Rimer, & Viswanath, 2008). Although the social environment has received scientific attention by psychologists, the role that the physical environment plays in the human behavior has received scarce attention. Moreover, physical environment and human-environment transactions are barely or not at all investigated in the ADHD framework. Indeed, a consideration of ADHD in a wider holistic perspective shows that it urges to review current treatments

and combine them with complementary interventions that address the importance of the physical environment surrounding ADHD children.

The present research aims at finding complementary ways that, combined with current treatments, are able to alleviate ADHD symptoms. It aims to do so by experimentally investigating if and how being exposed to certain types of outdoor environments leads to restoration, and whether being mindful during Nature contact, leads to greater restoration. Exposure to outdoor environments as a potential treatment for ADHD appears to be without side effects, potentially with minimal costs and is able to offer additional benefits to human health and planet conservation (Collado, Corraliza, Staats & Ruiz, 2015). In cognitive terms, restoration means attention renewal yet is a much wider concept. Infact, Collado, Staats, Corraliza & Hartig, (2017) define it as “the renewal or recovery of adaptive resources or capabilities that have become depleted in meeting the demands of everyday life” (p. 128). The resources involved are physical, psychological and social, the ones that are used on a daily basis and, indeed, are depleted and in constant need to be renewed in order to cope with new challenges (please see Hartig, 2004). These resources are more depleted in individuals affected by ADHD. Implicitly this interchange occurs in relation to activities conducted in specific physical environments, that may or may not help the restoration process. In addition, if the interchange is efficient and supported by the environment, restoration occurs, with positive impacts on health. This definition encompasses the importance of subjective factors and processes shaped on individual levels (please see World Health Organization, 1996), such as the restoration (Collado et al., 2017).

Literature based on Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) suggests that exposure to natural environments leads to restoration and other benefits both amongst adults (Franco et al., 2017) and children (Chawla, 2015), and that psychological restoration between both (typical) groups works in the same way (Berto, Pasini, & Barbiero, 2015). However, environmental psychology literature on the benefits amongst ADHD population is still at its infant stage. A few exceptions are presented by Faber Taylor and Kuo (2008) and Van den Berg and Van den Berg (2010)

who experimentally demonstrated that exposure to natural environments improved cognitive functioning as well as symptomatic behaviours and positive feelings. Nonetheless, findings from both studies and those deriving from other studies conducted amongst ADHD population (Donovan, Michael, Gatziolis, Mannetje & Douwes, 2019; Faber Taylor et al., 2001; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004) show that many theoretical and empirical gaps need to be investigated such as the difference between built environments (for instance those of a modern town or an historical site) and natural environments (pristine or wild areas vs. gardens or urban parks), factors promoting the frequency of contact with Nature of children diagnosed with ADHD as well as factors that might potentially increase the restoration level during Nature exposure, amongst others.

Therefore, the present thesis aims at giving insights to the following research questions: (a) what is the effect of a recovery experience in a natural setting such as a large open field on inattentiveness and other ADHD symptoms? (b) what is the effect of a recovery experience in a historical-urban setting and in a standard-urban setting on inattentiveness and other ADHD symptoms? (c) does a recovery experience in a natural setting help ADHD children focus on the Here & Now? (d) does a recovery experience in a variety of natural environments influence in different ways inattentiveness and other ADHD symptoms? (e) does the frequency of contact with Nature ameliorate symptoms severity? (f) is children's frequency of contact with Nature influenced by their parents' frequency of contact with Nature? (g) is children's connection to Nature influenced by their parents' connection to Nature? (h) is it possible to increase the benefits of a recovery experience in a natural setting by being more mindful or mentally present in the Here&Now?

Four studies are presented in this thesis with the aim of reaching two main objectives: the first object is investigating if and how symptoms are alleviated after walking in different built and natural environments. The second main objective consists in exploring the relationship between mindfulness and restoration, the fascination-meditation hypothesis (Kaplan, 2001) with the wider and future objective to find (active) ways that may increase the benefits of passive exposure to Nature for ADHD

children and adolescents. Before going into the details of the studies, a theoretical review of attention and the potential of (natural) environment is presented.

1. ATTENTION AND NATURE: CONCEPTUAL FRAMEWORK

1.1 ATTENTION: AN INTEGRATIVE FRAMEWORK

Attention is one of the most complex cognitive processes and, in its theoretical cognitive framework, makes reference to the selection process, in other words, the selection of information to be processed. As such, the term attention is a wide term referring to an internal mechanism that manages information in a cognitive system. Its primary function is to help classify and organize incoming information in a prioritized order. Attention is guided by stimuli that based on Chun, Golomb, and Turk-Browne (2011) are both exogenous (in the external world context) and endogenous (personal goals and internal mental states). The relevance of the information has an impact on the processing. Saliency is the criteria for exogenous stimuli (Theeuwes, 1991; Theeuwes & Burger, 1998; Yantis & Jonides, 1984) whereas relevance is the criteria for endogenous stimuli (Hopfinger, Buonocore, & Mangun, 2000; Posner & Petersen, 1989) which is under the individual's control (personal goals etc.).

Information processing is the result of exogenous and endogenous stimuli interaction, in other words, the processing of a biologically salient stimulus depends on transient internal states of the individual (Folk, Remington, & Johnston, 1992; Folk, Remington, & Wright, 1994). Based on Lavadas and Berti (2009), some of the characteristics that make an exogenous stimulus salient enough to capture attention and though, activate selective mechanism, are *intensity* (a brilliant colour or a loud sound attracts more attention than a dull colour or a weak sound would), *dimensions* (a big object attracts more attention than a small one would), *duration* (a repeated or a continuous stimulus attracts more attention than a short one would), *emotional content* (a stimulus related to a positive or negative emotional content attracts more attention than a neutral one would), *novelty* (an unexpected stimulus during a familiar and maybe repetitive situation attracts more attention than a familiar one would);

James (1890) wrote that “attention is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness, are of its essence. It implies withdrawal from some things in order to deal effectively with others...”. (pp. 403-404). The author distinguished between active and passive attention. Attention is active when it follows a top-down process, this means that it is guided by the expectations of the person, whereas when it follows a bottom-up process it is guided by external stimuli such as sounds or other things in the environment. In this case it is a passive process. This important distinction is still in use by most of researchers (Please see Corbetta & Shulman, 2002; Yantis, 2008).

Although most of attention theories follow James’ thesis, other researchers found that attention has several dynamics which are not directly linked with what an individual is doing in the present moment. Indeed, mind-wandering is the process in which one’s thoughts drift away from what the person is currently doing. Some researchers agree in defining mind-wandering as task-unrelated thought (please see Christoff, 2012; McVay & Kane, 2009) and it is the process of drifting from one thought to another, probably consciously. Other two processes, mostly antithetical to mind-wandering, could be rumination and absorption, in which attention remains fixed on a single topic. These seem to be antithetical to mind-wandering. The difference between them is the stability versus instability of attention: in the process of mind-wandering attention is unstable whereas in rumination and absorption it is stable and thoughts remain fixed. Mind-wandering is also defined unguided attention, since “the focus of attention drifts unguided from one topic to the next” (Irving, 2015, p. 563).

In general, attention relates to a complex cognitive process also because it requires other psychological activities, such as memory, perception, learning and executive functions (Miyake et al., 2000). For instance, problem-solving strategies (part of the executive functions) involve the capacity for selection under voluntary control, focus on a repertoire of thoughts and actions and an

inhibitory capacity, also essential to behave appropriately and effectively in each single situation. Indeed, authors have developed an executive functions model that considers three main subsystems: response inhibition, working memory and cognitive flexibility. Instead, regarding memory (Huizinga, Dolan & van der Molen, 2006), attention process is helped by the memory into developing a temporal field which can be integrated with the visuo-spatial field around the individual, making it a complex and dynamic attentional field. In other words, it is possible to combine elements from past visual fields into present visual fields (Chun & Turk-Brown, 2007).

Moreover, attention includes social, emotional and motivational components. For instance, motivation gives the necessary energy to the selection process. Even though individuals have the capacity of paying attention to a stimulus (selective attention), motivation makes this capacity weak or strong. Attention and motivation are two separate resources that work together (Brose, Schmiedek, Lövdén, & Lindenberger, 2012). Motivation works in particular with selective attention (please see next paragraph). The stronger the motivation is, the more attention is paid to the stimulus selected and unnecessary stimuli are ignored.

Finally, attention is a complex construct. Indeed, an impairment in its functioning may encompass several basic functions with consequences on the behavior and social interactions of the effected individuals. The next chapters will return to these aspects from other perspectives (clinical and environmental psychology, as well as field studies conducted within the present research).

1.1.1 Main types of attention

Several types of attention have been studied in the cognitive psychology framework. However, in this section, only a few of them are included since they are more related to the present research.

Selective Attention

Selective attention occurs when a choice between a peculiar stimulus and unrelated stimuli is made. Individuals can attend or ignore such stimuli. The sub-classification of selective attention is

divided and focused attention. The attention is *divided* when two or more stimuli are attended simultaneously whereas it is *focused* when a single stimulus is attended to and other stimuli are ignored at the same time (Sharma, Newcorn, Halperin, & Wolf, 1991). Selective attention is indeed aim-related and involves a resource consumption directly proportional with the activation level required by the task. The level of alert is different depending on which attention type is used by the subjects. Selective attention might require the highest level of alert, and a continuum from alert or vigilance (passive inertia) to full activation/activity can probably represent the attention levels (Lavie, 2005).

Sustained attention

This type of attention makes reference to the maintenance of attention during a prolonged period of time (Sarter, Givens, & Bruno, 2001) and to the psycho-physiological alert that subjects display during an ordinary situation of inactive waking with open eyes. Alert, or the also defined vigilance, is the condition in which subjects use the amount of resources needed in order to maintain an active calm situation, which is ready to be interrupted by unexpected stimuli. It is a form of automatic attention, mostly used in repetitive tasks (and though might require more than vigilance activation). The sustained attention does not require a high level of attention (alert or vigilance) but it requires a prolonged period of time. It is not a stable process or a linear progression. It is represented like a continuous alternation between increasing and decreasing of activation level (a cycle between “good” and “poor” concentration). Since time is prolonged, the task is usually not complex, nevertheless the performance level is subject to decrease (Sarter et al., 2001). If the activation keeps on increasing, the optimal level of performance will decrease (Robertson & O’Connell, 2010).

To sum up, attention performance can also be explained in terms of alert, vigilance and sustained attention and these conditions move on a continuum from low physiological activation, in alert, to high physiological activation, in sustained attention. Therefore, different kinds of tasks,

whether boring or interesting for the subject, and their duration might say a lot on the level of activation subjects will experience.

Joint attention

Joint attention makes reference to the joint processing of information about the self and others, related to the social cognition. Mundy and Newell (2007, p. 269) state that joint attention “is an expression of the exquisitely honed human capacity to coordinate attention with a social partner, which is fundamental to our aptitude for learning, language, and sophisticated social competencies throughout life” (see Baldwin, 1995; Farroni, Mansfield, Lai, Johnson, 2003; Markus, Mundy, Morales, Delgado, & Yale, 2000). Joint attention, part of the secondary intersubjectivity (Cohn & Tronick, 1987), is developed from around nine months and this developmental milestone is defined as a “miracle or revolution”, to use Tomasello’s (1995) interpretation.

At early stage, joint attention is manifested through the eye gaze (Mundy & Newell, 2007; see Rizzolatti, Riggio, Dascola & Umiltà, 1987). Afterwards, it evolves into more complex forms through the development yet remains vital to social competence during the lifespan. Indeed, individuals who cannot engage in exchanges of joint attention, i. e. those aimed to share interests or pleasurable experiences, may experience impairments in their ability for relationships and relatedness. In fact, joint attention in general is recognized as being a predictor of adult social competence, for instance it supports cultural learning, language acquisition, and theory-of-mind development in infants (Baron-Cohen, Campbell, Karmiloff-Smith, Grant, & Walker, 1995; Bruner, 1983; Marotta et al., 2013; Tipples, 2008). In addition, impairments in joint attention may lead to unsuccessful learning outcomes in pedagogical contexts.

1.1.2 Attention deficit: Attention Deficit Hyperactivity Disorder (ADHD)

Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001).

It is mainly characterised by chronic inattentiveness or attention inconsistency and, additionally but not necessarily, impulsive behaviour (hyperactivity-impulsivity). Based on the DSM V (American Psychiatric Association, 2013), diagnosis could be of three subtypes: combined (both inattentiveness and hyperactivity-impulsivity), predominantly inattentive, predominantly hyperactive-impulsive.

It is still hard to define which types of attention are impaired amongst children affected by ADHD. Some researchers consider the selective attention (Loge, Staton, & Beatty, 1990) whereas others consider the sustained attention as the most affected (Douglas, 1983; Douglas & Peters, 1979). Overall, among researchers there is more agreement on the latter since it is more impaired during repetitive and boring activities for which motivation deficit co-occur (Van der Meere, 2005). However, joint attention is impaired as well. Marotta et al. (2013) showed that ADHD children and adolescents showed evidence of reflexive orienting through eye gaze only to locations previously cued by non-social stimuli but could not show such orienting effect in response to social eye gaze cues. Such absence of reflexive orienting effect could reflect an attentional deficit in responding to socially relevant cues (see Tipples, 2008). Overall, researchers working with ADHD children, agree that the disease is manifested through impairments in the same forms of attention described in the environmental psychology framework (Kaplan, 1995) that includes an effortful and an effortless mechanism (Chiarenza, Bianchi & Marzocchi, 2004). For more details, please see the next paragraph.

ADHD symptoms are caused by functional alterations of some Central Nervous System areas which cerebral circuits are responsible for inhibition and self-regulation. There are several aetiological models. The multifactorial model considers different factors such as biochemical, environmental and genetical/cerebral dysfunctions. Overall, such models make reference to a neurobiological origin that interferes with the normal psychological development of children and the co-occurrence of environmental and educational triggering factors (Marzocchi, 2003; Marzocchi & Cornoldi, 2000; Sergeant, Oosterlaan, & van der Meere, 1999).

Diagnosis is usually established from age seven, once children access school and attentional demands are high, although symptoms arise even before that cut-off age. Main co-morbidities are constituted by oppositional-defiant disorder, language speech disease and learning disease. The following factors are considered as potential risks for ADHD: pre-academic skill deficits, less optimal environment in social terms (i. e. home and school), lower socio-economic status (Cunningham & Boyle, 2002; DuPaul, McGoey, Eckert, & VanBrakle, 2001; McGee, Partridge, Williams, & Silva, 1991; Pierce, Ewing, & Campbell, 1999).

Based on epidemiological data on developing age, international prevalence of the disease is around 5.29% (Polanczyk et al., 2014) whereas in Italy the range is between 0.4% and 3.6%, depending on geographical areas and, assuming the lowest value, the pathology would concern about thirty thousand children and adolescents. Moreover, the 88,5% of those affected is constituted by males. (Maschietto et al., 2012). Also indigenous children from the Brazilian amazon, as well as aboriginal children from Canada and Australia and Taiwan seem to be effected by the western concept of ADHD (Azevêdo, Caixeta, Andrade, & Bordin, 2010; Baydala, Sherman, Rasmussen, Wikmann & Janzen, 2006; Chan et al., 2016; Loh, Martin, & Piek, 2016).

Interventions on ADHD include behavioural and pharmacological treatments (i. e. methylphenidate, atomoxetine) in severe cases (Maschietto et al., 2012). However, the treatment of choice is multimodal and involves a combination of pharmacological, psychoeducational and psychotherapeutic interventions. To achieve lasting behavioral improvements, it is necessary to associate pharmacological treatment with a combination of cognitive and behavioural strategies that help children, parents and teachers understand and manage problematic behaviours. In other words, therapeutic strategies work on three levels: individual, familial and school (among teachers and typical peers). On the individual level, cognitive-behavioural therapy is implemented with the purpose of teaching impulsivity management through self-control techniques and cognitive procedures, useful to face challenging situations (Horn et al., 1991). For instance, the SOBER

technique, part of the Mindfulness based relapse prevention protocol (Bowen et al., 2009), is aimed at managing impulsive behaviours or behaviours driven by the so called “automatic pilot” (Kabat-Zinn, 1994; 2006). SOBER is for stop, observe, breathe, expand, react (or find alternative solutions and choose one of them). On family level, cognitive-behavioural therapy implements parent education and parent training as well as counselling whereas at school level, interventions are psychopedagogical and include teacher training as well as counselling. Nevertheless, such behavioural interventions seem to consider only the social environment, ignoring the potential of the physical environment. In the following paragraph, the importance of the physical environment will be introduced.

1.2 ATTENTION ACCORDING TO ENVIRONMENTAL PSYCHOLOGY AND ATTENTION RESTORATION THEORY

Although most psychological theories on human functioning are individual-oriented (e.g. clinical psychology), it is now widely accepted that the basis of human behavior are strongly influenced by the physical-social environment. This, in turn, effects health and well-being (Glanz et al., 2008). Interestingly, Environmental Psychology follows a place-specific approach to human health and behavior (Bonnes & Bonaiuto, 2002) and investigates the individual-environment relationship, how this can lead to pro-social and pro-environmental behaviors among individuals and groups. For instance, Gifford indicates that “every aspect of human existence occurs in one environment or another, and the transactions with and within them have important consequences both for people and their natural and built worlds. Environmental psychology matters” (Gifford, 2014, p. 541).

Environmental label makes reference both to built and natural settings although in the present research programme the word environment indicates the setting or the context, and a natural area,

unless otherwise indicated. It is mainly based on the individual-natural environment relationship. Before delving in the theory, it is worth mentioning several definitions of term “Nature”.

1.2.1 Towards a definition of Nature

Nature is a wide label to define natural environments and it is still hard finding an overall and complex definition. Most of environmental researchers implicitly define Nature as environments of nonhuman origins, from plants to non-built landscapes (Capaldi, Passmore, Nisbet, Zelenski, & Dopko, 2015). Frumkin (2001) describes Nature as wilderness, landscapes, plants and also includes animals (nonhuman animals).

A definition of Nature is the following: In an objective sense, “nature” as used here refers to physical features and processes of nonhuman origin that people ordinarily can perceive, including the “living nature” of flora and fauna, together with still and running water, qualities of air and weather, and the landscapes that comprise these and show the influence of geological processes. As such, “nature” overlaps substantially with “natural environment”, an environment with little or no apparent evidence of human presence or intervention, and the two terms have been used interchangeably (Hartig, Mitchell, De Vries, & Frumkin, 2014, p. 208).

These above-mentioned definitions make reference to physical features of an environment, processes and living beings and do not include human beings. Indeed, some people see themselves as separate from Nature and this is reflected in the regulations they propose. For instance, the U.S. Wilderness Act describes Nature as something pristine and free of any human intervention. This seems to be typical in Western countries but less common in traditional cultures (more details on traditional cultures will be mentioned further on). The Enlightenment conveyed the ideas of separation and domination therefore humans were supposed to dominate the natural world. The processes of industrialization and urbanization contributed to make such separation possible. The alienation also combines with the sacredness, since if Nature is sacred it cannot be touched by humans

and it becomes a cycle of separate entities (Cronon, 1995; Franklin, 1999; Vining, Merrick, & Price, 2008). The domination concept is related with the anthro-centric concept which makes reference to an ethical state of men above nature (Lamb, 1996), opposed to the biocentric idea which places individuals and the rest of the living world in the same hierarchical position. Schultz (2000; 2001) posits that a biospheric environmental orientation is based on connectedness with Nature and promotes pro-environmental behavior. Hartig (1993), following a holistic perspective, posits that humans and environment are interconnected.

It emerges that there are still difficulties in finding the role of humans into the ecosystem and the relationship between humans and Nature (if they can be considered two separate entities). However, this relation is fundamental because it makes a difference when deciding to act in favor or not of the environment (Vining et al., 2008). Researchers agree that connectedness to Nature is a predictor of pro-environmental behavior, which is just one of the positive outcomes resulting from connection with Nature (Zelenski & Nisbet, 2014). For instance, Vining et al. (2008) asked people to describe their connectedness to Nature and whether they think there is a separateness between humans and Nature. People described what being part of Nature meant for them and overall it emerged that most of participants felt part of Nature. Nevertheless, although most of participants felt such a connection, their general perception of Nature excluded any human involvement, whereas what is not natural included human involvement. It seems that most of the participants had the idea that “nature involved pristine preserved land that is uninhabited and unaltered by human beings” (Vining et al., 2008, p. 8) and maybe this seems also to be what most of researchers define into the framework of what Nature is. Therefore, according to Hartig et al. (2014), the study conducted by Vining et al. (2008) suggests that a sense of belonging or onness with Nature is related to pristine Nature rather than Nature with human touch, such as gardens, urban parks etc. This is an important point to be considered when aiming to obtain restoration after Nature exposure and it will be mentioned further on.

Indeed, Nature tag also includes urban nature or, in other words, the presence of Nature in urban settings such as street trees and indoor plants or gardens and parks that appear to be natural but are based on a human design and regulation. Viewing a natural scene on a picture or a movie is also considered an experience in nature, even if it requires an artificial manipulation (Vining et al., 2008).

To sum up, it is still hard to find a unique definition of what Nature is in Environmental Psychology literature. However, in the present research, the term Nature refers to the broader sense of natural environment.

1.2.2 Attention Restoration Theory

Kaplan (1995) aimed to create an integrative framework into the topic of the restorative benefits of the natural environments, which is suggested to be particularly useful for restorative experiences in regards of attention. Based on this author, the effects of restorative environments on people may constitute opportunities for reducing the psychological resources depletion, or the fatigue of directed attention (the top-down mechanism). Such concept is consistent with people's trends: people believe that natural environments are both natural and restorative, though they prefer them to urban environments (e.g. Ulrich, 1984; Walker et al., 1983).

Kaplan (1995) attempted to integrate the psycho-evolutionary theory of stress reduction (Ulrich, 1983), which explains attention depletion in terms of effects of stress and the concept of directed attention studied by James (1892). Based on James theory (1892), humans use two different kinds of attention: directed and undirected (then named as voluntary and involuntary). Directed attention is a key psychological resource and is used when something itself "does not attract attention but is important to attend nonetheless" (Kaplan, 1995, p. 169) and it suggests the functioning of the will. The will itself is compared to a weak intention which does not necessarily lead to an action. In order to finalise an action it is essential to protect the will from competing thoughts (in other words it makes reference to the inhibition process). In James' theory what has real importance is effort,

voluntary control, inhibition and focus orientation. Based on Chapter 1 of the present thesis, the concept of attention studied by James would probably refer to the topical common definition of selective and sustained attention. Actually, researchers working with ADHD children, agree with the same concept of attention that includes an effortful and an effortless mechanism (Chiarenza et al., 2004).

What misses in James' theory is the concept of fatigue: because it requires effort, the attention mechanism is also susceptible to fatigue. Directed attention is mainly involved in the daily life human effectiveness, from school to workplace, and helps in coping with challenges (Kaplan, 1995). The author mentions that, to implement problem solving strategies in daily life, a type of attention that requires effort is needed, whereas the type of attention that is activated in routine behavior does not help in finding new solutions. Indeed, he suggests that effort means fatigue (Kaplan, 1995; Moray, 1987).

In terms of exogenous stimuli, since directed attention is susceptible to fatigue and this would lead to less effectiveness and performance decline, Kaplan (1995), on the basis of James' work (1892), wondered whether there could be recovery or restoration when using undirected attention, since it requires no efforts. This would depend on the exogenous stimuli present in the physical context. The process involved is passive.

Kaplan (1995) renamed the undirected attention, or the also defined involuntary attention, as fascination: when a subject is fascinated by something in the environment, he can pay attention to it with no efforts. Therefore, he is likely to be resistant to fatigue. The power of the natural environment is described in terms of soft fascination because it "has a special advantage in terms of providing an opportunity for reflection, which can further enhance the benefits of recovering from directed attention fatigue" (Kaplan, 1995, p. 172). Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) is based on four main components, named restorative factors, that combined together, each one on its intensity, make an environment restorative. As mentioned, the first one is *fascination*, the key

factor. The other three components are: *being away*, *extent* and *compatibility*. *Being away* refers to a conceptual transformation, an eye gaze changing of direction in order to feel free from mental activity.

Although a subject is fascinated by something in the environment, and feels away, he/she still needs to *extent* to a whole other world. It means that the environment needs to be of enough scope to guarantee the mind engagement, “it must provide enough to see, experience, and think about so that it takes up a substantial portion of the available room in one’s head” (Kaplan, 1995, p. 173).

Compatibility, as last component, restores attention when the environment is compatible with one’s purposes and inclinations. Therefore, it takes less selectivity, in other words less directed attention, less effort. In this kind of environment, people’s ability to carry out their activities without struggling may be better, this because they feel supported by the environment in which they are located.

Several places could be considered restorative, but based on Kaplan’s theory, in general natural environments seem to be the best ones in promoting attention and recovery because each of the four restorative factors is highly present.

In summary, ART states that being exposed to highly restorative environments (such as the natural ones) reduces cognitive noise or mental fatigue, leading the individual to experience the first level of restoration. Then, the exposition to a highly restorative environment promotes directed attention recovery, the second level of restoration. Next, openness to reflection is the third level of restoration (Barbiero & Berto, 2016; Herzog, Black, Fountaine, & Knotts, 1997). These aspects of restoration on a continuum level, from a superficial to a deep degree, are related to mindfulness or the concept of mental presence (Kabat-Zinn, 2006). A detailed description of such aspects is presented in the next paragraph.

1.2.3 Attention, mindfulness and restoration

Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) states that exposure to natural environments leads to restoration. In order to experience restoration, a person needs to be engaged with the environment and perceive its several characteristics. This is partially due to the soft fascination process in which attention is attracted effortlessly and people can softly engage with the surroundings by being still able to reflect, supporting meditative states. (Herzog et al., 1997). It is highly resistant to distractions therefore automatic thoughts are deleted. For instance, a sunset and the sound of the wind among the leaves are soft stimuli able to activate the undirected attention. Softly engaging with the environment and being resistant to distractions at the same time, allows people to be in the Here and Now, a condition for a healthy brain (Siegel, 2007; 2009). Consequently, the individual feels restored. Conversely, although also hard fascination automatically captures attention, reflection is not possible because this process does not leave space for it. Both soft and hard fascination involve a passive process.

However, it is arguable that if people get in contact with Nature while attention engages with unrelated contents, or while a mind-wandering process is active (please see paragraph 1.1), then the engagement with Nature is not full and it is not possible to perceive the several characteristics of the physical context, as Berto et al. (2018, p. 2) state, “this ‘lack’ of awareness may affect the perception of the restorativeness associated with exposure to Nature”. This suggests that people need to actively put an effort into keeping in contact with Here and Now otherwise experience in Nature loses its restorative potential.

Based on Kaplan (2001), an active process would also be able to lead to recovery (and deactivate automatic thoughts): mindfulness. Mindfulness is the capacity of being present to oneself, in the Here and Now. It works on the same neural correlates related to attention (Lazar, 2005; please see Kabat-Zinn, 2006).

Mindfulness implies the ability to get in touch, moment by moment, both with internal experiences (emotions, thoughts and physical sensations) and with the surrounding physical environment. Furthermore, it implies observing both internal and external stimuli with openness and curiosity, without giving a judgement and without an automatic reaction to them (Baer, 2003). Thompson and Gauntlett-Gilbert (2008) mention an example to clear how mindfulness is applied to daily activities: a boy walking to school in a mindful way is aware of his feet touching the ground and any tension concerned with school gate. Conversely, walking mindlessly would mean being lost in his thoughts regarding school activities, such as future questions, or summer holidays.

Recently, Mindfulness-based psychotherapeutic approaches (Didonna, 2012) have been developed and implemented in clinical contexts both among adults and children, ADHD included (Baer, 2005; Burke, 2010; Fabbro & Muratori, 2012; Greenberg & Harris, 2012; Keng, Smoski, & Robins, 2011; Swain, Hancock, Dixon, & Bowman, 2015). For instance, the well-known Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1990), and the Acceptance and Commitment Therapy (ACT; Hayes, Stroschal, & Wilson, 1999). In addition, mindfulness-based approaches were used to improve socio-emotional competences (Semple, Lee, Rosa, & Miller, 2010), attention (Napoli, Krech, & Holley, 2005), and executive functions (Flook et al., 2010).

Moreover, Environmental Psychology literature has recently focused on mindfulness approaches (Berto et al., 2015; Hartig et al., 2011; Kaplan, 2001). In particular, Lymeus, Lundgren, and Hartig, (2017) showed that healthy adults viewing Nature images while practising mindfulness could offset the attentional fatigue (related to beginners), suggesting that natural environments can activate the effortless attention and lead the individual to fuller experience the present moment, and vice-versa. Moreover, Berto et al. (2015) conducted a study on typical children in a school context. Children's activities included the practice of mindful silence in an indoor setting (a classroom) of the school context. By applying the Kaplan's fascination-meditation hypothesis (2001), findings revealed

that restoration was evoked by the practice of Mindful silence (and not only by the exposure to the natural environment).

To sum up, restorative environments and mindfulness both aim to break automatic thoughts respectively in a passive and an active process (Barbiero & Berto, 2016) and lead to restoration. Indeed, a mindfulness-based contact with Nature would be likely to increase the benefits of restoration (Lymeus et al., 2017). The literature reviewed on mindfulness studies shows that scarce attention has been paid by environmental psychologists. It takes an environmental approach to mindfulness studies in order to increase the benefits of Nature contact or obtaining them when Nature is temporarily unavailable.

1.2.4 Benefits of Nature contact among adults

Approximately half of the global population live in cities, and it is calculated that by 2030, 60% of people will live in urban areas worldwide, characterized by increased levels of pollution, built environments and fewer green spaces (Dadvand et al., 2015).

There are a number of researchers showing the benefits in physical and mental health and overall wellbeing of getting in contact with Nature both among adults and children, from physiological measurements to self-reports, observations, correlations and experimental or quasi-experimental studies (Berto, 2014; Capaldi et al., 2015; Franco et al., 2017; Gill, 2014; Weinstein, Przybylski, & Ryan, 2009). In this section some of the studies conducted on adults are briefly reviewed. In the next section, studies exploring the children-Nature relationship will be described.

For example, Hansmann, Hug, and Seeland (2007) observed reductions in self-reported stress levels and headaches associated with increases in well-being significantly positively related to duration of the green space visit of park and forest visitors. Similarly, beyond aesthetics effects of contemplating its beauty, Nature contact also leads to stress recovery (Frumkin, 2001). Moreover, some researchers investigated how being connected to Nature leads to pro-environmental and pro-

social behavior. Happiness is another positive outcome that derives from Nature contact. Hence, a sense of connectedness helps in feeling happy and not only connected. Zelenski et al. (2014, p. 46) indicate that “it is a strong sense of trait connection with nature, and perhaps the moments of nature contact” to promote well-being. According to O’Brien (2008), the Nature-relatedness construct (or connection with Nature) might be related to a “sustainable happiness” theory or a “happy path to sustainability” (Nisbet & Zelenski, 2011) since it would contribute to human wellbeing as well as environmental sustainability. Furthermore, Frumkin (2001) revealed that people tend to experience vigor, comfort, humility and feelings of awe, renewal, wonder, together with an increased appreciation of others when they are in front of natural landscapes and wilderness. These outcomes are the reasons why Nature is used in the context of the wilderness therapy for psychiatric patients and other clinical contexts. Moreover, a reduction of crime and aggression has been related with Nature contact (Kuo et al., 2001a, 2001b)

1.2.5 Benefits of Nature contact among children

There is growing evidence of the benefits that derive from Nature contact. However, nowadays children have lost most of the contact with Nature and this has wide ranging of implications in their development, their future and planet conservation (Collado, Corraliza, Staats & Ruiz, 2015). In 2005, Louv published his bestseller *Last Child in the Woods* showing that there is a huge difference in the childhood features between his generation and the topical one. Nowadays, children spend most of the time indoors on sedentary activities that involve computers and television screens, the so called “videophilia” (Zaradic & Pergarms, 2007) rather than being in contact with Nature by stimulating their biophilia, an innate instinct based on a set of genetically-determined learning rules (Wilson, 1984). Some of the reasons might be attributed to crime and safety issues (Clements, 2004).

Using Louv’s term, nowadays children are experiencing the “nature-deficit disorder”, a phenomenon, not a clinical issue, to describe the human cost that alienation from Nature provokes, such as less use of senses as well as physical and psychological disorders. Although technology and

cities have some advantages, these children lack basic experience in Nature. Accordingly, the U. S. Department of Agriculture stated in 1977, almost 40 years ago, that urban children become increasingly divorced from the natural environment. In addition to this, urban environments' psychological effects seem to be more effective on children than adults, since core cognitive abilities are developed during infancy and childhood.

Conversely, children living out of cities and in traditional societies seem to have much more contact with nature than western children do. A recent study on aboriginal children in rural Australia (Kreutz, 2015) showed that children are still given a great license to roam, even though the forced relocation and assimilation into European culture that weakens the bond with the land (maybe a sense of place attachment) of which they were renowned for. These aboriginal children could face the fear of some social or physical risks of entering a bush or a forest, and this was beneficial. For example, they could learn to build forts, explore rocks and caves, swim and fish in the crick, climb trees and so on. These places were not only for adventures but also for reflection, privacy and peace, indeed adapted for restorative experiences that led into developing place attachment and several useful skills for everyday and upcoming life.

Considering the Gardner's Multiple Intelligences Theory (2011), being in contact with Nature helps developing the naturalistic intelligence, which is the ability to get into a profound connection with the living world and to appreciate the effect that this connection has on us and on the environment. Children who strongly develop this kind of intelligence show communion with Nature, sensitivity toward flora and fauna, love for animals and plants, care and interaction with living creatures, appreciation of the Nature impact on humans, self and viceversa, love for outdoor activities, recognition and classification of natural objects. Other benefits suggested by literature on children refers to the psychological well-being. Indeed, Chawla (2015) showed that creative play is one of the factors related to the psychological wellbeing amongst children. Similarly, Korpela, Kyttä, & Hartig, (2002) interviewed fifty-five Finnish children asking information about their favorite places. Children

mentioned that their favorite places were in natural environments, which in turn allowed them to forget troubles, reflect on personal matters, feel free and relaxed, clear their mind, in other words it all meant psychological well-being. Accordingly, Wells et al. (2003) found that Nature acted as a buffer when children experienced stressful events by reducing distress and promoting a sense of self-worth, without the influence of family-income. As consequence, Nature contact might be considered as a protective factor for children (please see Dadvand et al., 2015; Martensson et al., 2009; Tapsell, 1997).

For this purpose, in The United States, a program named “park prescription” (Seltenrich, 2015) involved health cares and pediatricians in promoting parks use among patients. The program aims to obtain the following benefits from Nature contact: spread reduction of air pollutants through protective vegetation, shade and natural cooling, reprieve from noise, cognitive benefits such as attention restoration, better vision (reduction of myopia risk), socialization and physical activity. A wide range of parks into and around cities such as Los Angeles and Washington DC had been listed as natural areas. Hundreds of patients among adults and children visit them in order to experience health positive outcomes such as better physical state and emotional well-being like above mentioned (see Swinburn, Walter, Arroll, Tilyard, & Russell, 1998).

This short literature review shows the advantages that Nature contact has on typical children at present and on their future development therefore it suggests the importance to promote their individual’s inclinations to get in contact with Nature. Although most of the evidence of the benefits deriving from Nature contact is among typical children, some studies are also conducted amongst atypical children, in particular those affected by ADHD. In the next section I will be referring to existing literature on the topic which has been taken into consideration whilst working on this research project.

1.2.6 Benefits of Nature contact among children affected by ADHD

As mentioned in the previous paragraphs, the basis of human behavior are strongly influenced by the physical-social environment which affects health and well-being (Glanz et al., 2008). Moreover, “every aspect of human existence occurs in one environment or another, and the transactions with and within them have important consequences both for people and their natural and built worlds” (Gifford, 2014, p. 541). This concept indirectly suggests that clinical issues, especially those occurring in developing age, need to be reframed by integrating aspects deriving from the physical environments in which people daily interact since they hide a potential to improving or worsening their health state. Infact, current interventions of ADHD include behavioural treatments aimed at working on the social environment of the affected child. For instance, the parent and teacher training or the cognitive technique to improve self-control. It takes a lot of efforts to reframe current ADHD treatments by taking into consideration the physical environment potential and a few studies conducted on ADHD children in the Environmental Psychology background are worth mentioning since they basically reveal that transactions with and within environments “have important consequences both for people and their natural and built worlds” (Gifford, 2014, p. 541).

For instance, a study conducted in New Zealand among 49.923 children born in 1998 showed that rurality and increased minimum greenness are related to a lower risk of ADHD (Donovan et al., 2019). Similarly, Faber Taylor et al. (2002) showed that green views from apartment windows reduced both symptoms of Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). Subsequently, the same authors tried to differentiate environments between ADD and ADHD groups. It resulted that hyperactive children improved only after playing on open grass whereas children diagnosed with attention deficits disorder improved after playing both in grassy areas with big trees and grass open lawns (Faber Taylor et al., 2001; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004). In concordance with these results, Markevych et al. (2014) found that as the distance from home to green areas decreased, so did the probabilities of the child to present symptoms

of inattention and hyperactivity, in a sample of children in Germany. Similar effects were obtained in a study conducted in the United States by Wells (2000) on an Attention Deficit Disorder (without hyperactivity) children sample. Outcomes revealed that symptoms reduced after moving to a greener area, measured in terms of grass yards and green views, no matters of low income. With regard to this, a study conducted in Spain (Amoly et al., 2014) showed that, following parents and teachers' assessment of children's ADHD symptoms, greenness around residential areas was related to less inattention and hyperactivity and this result was not dependent on family income.

Regarding experimental studies in the Environmental psychology framework including ADHD children, to our knowledge, there are only two examples: one conducted in the USA by Faber Taylor and Kuo (2008); and a second one conducted by Van den Berg and Van den Berg (2010) in The Netherlands.

The first study (Faber Taylor & Kuo, 2008) examined the impact of three different environments – a park, an urban residential area and a downtown area - on attention and impulse control among ADHD children. The sample was constituted by seventeen children aged 7-12, usually medicated yet not on the testing days. Ten of them with hyperactivity and six without. Experimenters took the children out for an individually guided low pace walk of twenty minutes and afterwards attention was measured by using four objective tests. Outcomes showed that children concentrated better after walking in the park than in the two other conditions and authors suggest that improvement was comparable to methylphenidate peak effect of extended release. These findings show that Nature “might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms” (Faber Taylor & Kuo, 2008, p. 402).

The second study (Van den Berg & Van den Berg, 2010) compared the behaviour and the emotional and cognitive functioning of twelve medicated children aged 9-17 affected by ADHD in a natural setting and a built setting – a wooded area and a small town. Results showed that children had less difficulties to concentrate in the woods than in the town, and that woods were perceived as more

restorative than the town. Their behaviour was less impulsive and inattentive in the woods and children reported somewhat more positive feelings in the woods than in the town. In general, authors demonstrated that children with ADHD functioned at a constant high level in the natural area, whereas their behaviour was more variable and cognitive functioning was generally poor in the built condition.

Overall, this literature shows that natural environments have a restorative potential also among ADHD children. Considering that ADHD causes impairments in several aspects of everyday life, at present and with future consequences especially when this occurs in developing age, it is important to find complementary interventions that can alleviate the symptomatology without causing side effects (for instance those related to medication use), or at least by enhancing the benefits of current treatments. At this purpose, Nature appears to be a promising line of research. In addition, Nature contact leads to several additional benefits such as pro-environmental behaviour, fundamental for planet conservation (Collado, Staats & Sorrel, 2016). Indeed, the (behavioural) treatment implemented in the present thesis among ADHD children and adolescents addresses the exposure to the natural environment through a simple twenty minutes walk. This topic will be better described in the Study 1 and 2.

1.3 AIMS AND RESEARCH QUESTIONS

In general, this dissertation aims at obtaining a deeper understanding of ADHD symptoms severity while children are experiencing Nature, which is considered a complementary behavioural treatment based on the assumption that the physical environment, rather than only the social environment, affects our existence (Gifford, 2014), and it aims to achieve this general goal through two main objectives or central points. The first one, which covers the major part of the research project, consists in investigating if and how symptoms are alleviated after walking in different built and natural environments.

It is important to address this first point because, as described in the theoretical introduction, attention is a construct that encompasses several psychological activities such as memory, perception, learning and executive functions (Miyake et al., 2000). For instance, the problem-solving strategies (part of the executive functions) involve the capacity for selection under voluntary control, a focus on one's repertoire of thoughts and actions and an inhibitory capacity, also essential to behave appropriately and effectively in each single situation. Unfortunately, ADHD involves a deficit in the problem-solving strategies and, the lack of cognitive flexibility that it implicates, reduces the adaptive functioning of the child in his/her daily contexts. Indeed, finding alternative and complementary ways to recover without side effects is worthy and Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) offers promising beneficial applications on ADHD as confirmed by existing literature (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010).

The first aim is divided in three sub-objectives: (1) evaluating the recovery effect of different types of outdoor environments (natural and built, the latter historical-urban and standard-urban), (2) evaluating the recovery effect of two different types of natural environments (one characterised by high prospect and low refuge and another one characterised by low prospect and high refuge), (3) evaluating the recovery effect by considering the frequency of contact with Nature and the system of relations that involve the child. The first objective will be developed through the Studies 1, 2 and 3.

The second main objective or central point consists in exploring the relationship between mindfulness and restoration or the also defined fascination-meditation hypothesis (Kaplan, 2001) with the wider and future objective to find (active) ways that may increase the benefits of passive exposure to Nature for ADHD children and adolescents.

Mindfulness implies the ability to get in touch, moment by moment, both with one's own internal experiences (emotions, thoughts and physical sensations) and with the surrounding physical environment, observing both sources of stimuli with openness and curiosity, without giving a judgement and without an automatic reaction to them (Baer, 2003). Mindfulness-based approaches

are used to improve socio-emotional competences (Semple et al., 2010), attention (Napoli et al., 2005), and executive functions (Flook et al., 2010), which are impaired areas in the ADHD. This point is worth to be addressed because being fully aware of the natural surroundings (or being mindful while being in Nature), combined with the benefits of simple Nature (passive) exposure, might enhance the deriving benefits, with positive impacts on attention recovery and restoration. Conversely, if a person gets in contact with Nature while attention engages with unrelated contents, or while a mind-wandering process is active (please see paragraph 1.1), then the engagement with Nature is not full and it is not possible to perceive the several characteristics of the physical context. As Berto et al. (2018, p. 2) state, “this ‘lack’ of awareness may affect the perception of the restorativeness associated with exposure to Nature”, suggesting that the person needs to actively put an effort into keeping in contact with the Here and Now otherwise experiencing Nature loses its restorative potential.

Infact, ART states that, in order to experience restoration, a person needs to be engaged with the environment and perceive its several characteristics. Therefore, engagement depends on being fully aware of the Here and Now (Kabat-Zinn, 1994) and being mindful means being aware of the Here and Now, in other words what is happening in this place, in this moment. This suggests that mindful people are more aware and better engaged with their surroundings than non-mindful people (Bodner & Langer, 2001; Langer, 1989). Objective two will be developed by Study 4 (and some aspects of Study 1 and 2). However, Study 4 is conducted through healthy adolescents, rather than ADHD, because the aim of the present research programme is to first explore whether such relation exists from a theoretical point of view.

The research questions that guided the studies of this dissertation are the following: (a) what is the effect of a recovery experience in a natural setting such as a large open field on inattentiveness and other ADHD symptoms? (b) what is the effect of a recovery experience in a historical-urban setting and in a standard-urban setting on inattentiveness and other ADHD symptoms? (c) does a

recovery experience in a natural setting help ADHD children into focusing in the Here and Now? (d) does a recovery experience in different types of natural environments influence in different ways inattentiveness and other ADHD symptoms? (e) does the frequency of contact with Nature alleviate symptoms severity? (f) is the child's frequency of contact with Nature influenced by the parents' frequency of contact with Nature? (g) is the child's connection to Nature influenced by parents' connection to Nature? (h) is it possible to increase the benefits of a recovery experience in a natural setting by being more mindful or mentally present in the Here and Now?

The assumption underlying these research questions is that the physical outdoor environment influences health and the quality of life (Gifford, 2014), also of people affected by a mental disease such as ADHD children. In addition, current behavioural treatments focus on (cognitive) interventions which are only on individual or social basis (family and school) yet ignore the physical environment potential. Therefore, the treatment implemented in the present research programme is an environment-based behavioural intervention that consists into being exposed to the natural environment through a simple twenty minutes walk. A description of the treatment will be presented in Study 1 and 2.

Finally, the brief literature review mentioned in the previous section shows that the research questions that underly the present research programme have not been addressed yet. Everyday Nature is generally available to families therefore it urges more research investigating how to promote Nature contact in a society oriented to the videophilia (Zaradic & Pergarms, 2007) rather than the biophilia (Wilson, 1984), with the purpose to find alternative and complementary ways to alleviate ADHD symptoms and improve the quality of life of affected children.

STUDY 1

**EFFECTS OF NATURAL, HISTORICAL-URBAN AND STANDARD URBAN
ENVIRONMENTS ON ADHD SYMPTOMS, PERCEIVED RESTORATIVENESS AND
“HERE AND NOW” REPORTED THOUGHTS**

2.1 Introduction

The overarching aim of this study is to ascertain whether an environment-based behavioural treatment that consists in a twenty-minute walk in a natural environment could help children and adolescents affected by Attention Deficit Hyperactivity Disorder (ADHD) into alleviating their symptoms. In the past few years, there has been an increased interest and research on the restorative potential of Nature for typical children across places and cultures that showed great physical and psychological benefits, such as motor development, subjective well-being, pro-environmental attitudes, stress coping and cognitive functioning etc. (Adams, Savahl, & Casas, 2016; Chawla, 2015; Collado et al., 2015; Hordyk, Dulude, & Shem, 2015; Kuo & Faber Taylor, 2004). However, literature related to the effects of exposure to a natural environment on children and adolescents affected by ADHD is still scarce. In order to understand the reasons why Nature contact could have a positive influence into alleviating ADHD symptoms it is worth considering in detail what Attention Restoration Theory explains (ART; Kaplan, 1995; Kaplan & Kaplan, 1989) and which are the main characteristics of ADHD. Afterwards a link between the two will be presented.

Here is a brief explanation of the key features of ART. It posits that there are two modes of attention: directed attention which is effortful, and involuntary attention which is effortless. The first one requires the inhibitory system to protect from distractions. A prolonged use of directed attention leads to “*directed attention fatigue*” or mental fatigue (Kaplan, 1995, p. 170). However, “directed attention can be recovered when a person can engage in activities that draw primarily on involuntary attention” (Collado et al., 2017, p. 130), the also defined fascination by Kaplan and Kaplan (1989). Indeed, involuntary attention is automatically captured, that is effortlessly, in a natural environment. Of interest to this study, is the possible link between mental fatigue characteristics described in the ART framework (Kaplan, 1995) and ADHD symptoms. Kaplan (1995, p. 171) described what attention fatigue means: becoming “highly distractible, resulting in impaired perception of material that is not inherently engrossing” and feeling exhausted and irritable. In terms of behavior, the author

states that fatigue leads to “a greater inclination to be impulsive” (Kaplan, 1995, p. 172). Overall, mental fatigue concerns more than just lack of attention from a cognitive point of view. It includes being easily distractible and having difficulty in staying focused on unappealing tasks, in completing tasks, and listening and following directions. Mental fatigue also relates to the cognitive noise of the mind: thoughts that constantly crowd it and un-relate to the Here and Now.

Furthermore, as mentioned above, in the fascination process, attention is attracted with no mental effort and the mechanism underlying directed attention is temporarily unused indeed it can be at rest. Recovery is a consequence of this process. Hard fascination automatically captures the whole attention, without leaving space for reflection. Soft fascination allows the person to softly engage with the surroundings by being still able to reflect (Herzog et al., 1997). It is highly resistant to distractions. For instance, a sunset, the sound of the wind among the leaves are soft stimuli able to activate undirected attention. Softly engaging with the environment and being resistant to distractions at the same time, allows the person to be in the Here and Now, which relates to the concept of mental presence, a condition of a healthy brain (Kabat-Zinn, 1994, 2006; Siegel, 2007, 2009). Consequently, people feel restored. The process involved is passive, conversely to the active process of mindfulness. (Please see Kaplan, 2001; Kaplan & Kaplan, 2011; Langer, 1989; Lazar, 2005; Zylowska et al., 2007). In other words, ART states that being exposed to highly restorative environments (such as the natural ones) reduces cognitive noise or mental fatigue, which is the first level of restoration. Then, it promotes directed attention recovery, the second level of restoration and allows reflection, the third level of restoration (Barbiero & Berto, 2016; Herzog et al., 1997). Although fascination is a key factor of restorative environments, ART considers other three restorative factors: being away, extent (scope and coherence) and compatibility. Each environment varies the degree of each factor but most literature shows that natural environments display the four factors at a high level (Berto, 2014).

In order to understand the reason why Nature contact (explained by ART) could have a positive influence in alleviating ADHD symptoms, it is worthy to also consider ADHD

characteristics. ADHD is a childhood-onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001). It is mainly characterised by chronic inattentiveness or attention inconsistency and, additionally but not necessarily, impulsive behaviour (hyperactivity). For instance, on impulsivity tasks, ADHD children show impairments in flexible regulation of speed and accuracy. In other words, because they are hasty, they tend to increase speed and decrease accuracy (Vallesi, D'Agati, Pasini, Pitzianti, & Curatolo, 2013). According to Marzocchi, Re and Cornoldi, (2010), children and adolescents effected by ADHD show a certain developmental trajectory of their symptoms. For instance, inattentiveness, explained in terms of accuracy and response time latency, tends to remain stable from infancy to adolescence. Conversely, overall impulsivity tends to improve from infancy to adolescence both in terms of accuracy and response time latency. Overall, attention performance and impulsivity change depending on the age range (Marzocchi et al., 2010).

ADHD symptoms are caused by functional alterations of some Central Nervous System areas which cerebral circuits are responsible for inhibition and self-regulation. Although the onset of the disease is widely considered as neurobiological, psychological factors play an important role in the maintenance of the disease (Fabio, 2001). Many researchers agree on considering the ADHD aetiology related to a multi-factored hypothesis, in which predisposing factors are strictly associated to stressors such as those regarding environmental and educational aspects (Marzocchi, 2003) of family and school settings. More specifically, a multi-factored approach takes into consideration cognitive, motivational, behavioural, genetics components and self-regulation deficits (Fabio, 2001). Diagnosis is usually established from age seven, once children access school and attentional demands are high, although symptoms arise even before that cut-off age. Main co-morbidities may be present, such as oppositional-defiant disorder, language speech disease and learning disease. The following factors are considered as potential risks for ADHD: pre-academic skill deficits, less optimal

environment, lower socio-economic status (Cunningham & Boyle, 2002; DuPaul et al., 2001; McGee et al., 1991; Pierce et al., 1999).

Based on epidemiological data on developing age, international prevalence of the disease is around 5.29% (Polanczyk et al., 2014) whereas in Italy the range is between 0.4% and 3.6%, depending on geographical areas and, assuming the lowest value, the pathology would concern about thirty thousand children and adolescents. Furthermore, the 88,5% of those affected is constituted by males (Maschietto et al., 2012).

Interventions on ADHD include cognitive-behavioural and pharmacological treatments (e. i. methylphenidate, atomoxetine) on severe cases (Maschietto et al., 2012). However, the treatment of choice is multimodal and involves a combination of pharmacological, psychoeducational and psychotherapeutic interventions. Nevertheless, such behavioural interventions seem to consider only the social environment, ignoring the potential of the physical environment. As mentioned in the conceptual framework of this thesis, the basis of human behavior are strongly influenced by the physical-social environment which effects health and well-being (Glanz et al., 2008). Moreover, “every aspect of human existence occurs in one environment or another, and the transactions with and within them have important consequences both for people and their natural and built worlds” (Gifford, 2014, p. 541). This concept suggests that also clinical issues, especially those occurring during children’s development, need to be reframed by integrating aspects deriving from the physical environments in which people daily interact since they hide a potential to improve or worsen the state of their health. Therefore, the environment-based behavioural treatment implemented in this thesis (Study 1 and Study 2) addresses the need to consider the potential of the physical outdoor environment, in particular the natural one. Finally, the type of treatment implemented consists of a simple twenty minute – individually guided – walk.

In summary, the key feature of ADHD linked to ART is related to the inhibition system, which results impaired in ADHD, yet it has a potential to be restorable by Nature contact. Nature contact

exposure aims to restore attentional capacity and requires low physical exertion as well as engagement and connection with the surroundings. For this purpose, a restorative activity would enhance the number of benefits Nature offers. A reference from literature gives the following definition of what is considered restorative: “activities that are thought to be especially helpful in resting and restoring the ability to concentrate. They involve experiencing nature in some way, for example, sitting or walking in the natural environment (backyard, garden, park), observing a natural view (trees, clouds, a sunset)... sitting by water... observing wildlife, birds, and animals...” (Cimprich, 1993, p. 87). Therefore, sitting or walking while engaging with the natural environment are considered restorative activities (please see Collado et al., 2017).

Another important concept for this study regards the restorative potential of Nature. While most of the existing literature examined the effect of Nature exposure on cognitive functioning among typical children (Dadvand et al., 2015; Martensson et al., 2009), only a few authors involved children affected by ADHD. In spite of the fact that there is little research about the restorative potential of Nature for ADHD children, there are a few studies that are worth mentioning. For instance, a study conducted in New Zealand among 49,923 children born in 1998 showed that rurality and increased minimum greenness are related to a lower risk of ADHD (Donovan et al., 2019). Similarly, Faber Taylor et al. (2002) demonstrated that green views from apartment windows reduced both symptoms of Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). Subsequently, the same authors tried to differentiate environments between ADD and ADHD groups. It resulted that hyperactive children improved only after playing on open grass whereas children diagnosed with attention deficits disorder improved after playing both in grassy areas with big trees and grass open lawns (Faber Taylor et al., 2001, 2002; Faber Taylor and Kuo, 2011; Kuo & Faber Taylor, 2004). In concordance with these results, Markevych et al. (2014) showed that as the distance from home to green areas decreased, so did the probabilities to present symptoms of inattention and hyperactivity in a sample of children living in Germany. Similar results were obtained in a study

conducted in the United States by Wells (2000) on an Attention Deficit Disorder (without hyperactivity) children sample. Outcomes revealed that symptoms reduced after moving to a greener area, measured in terms of grass yards and green views, no matter of what income the family had. With regards to this, a study conducted in Spain (Amoly et al., 2014) showed that, following parents and teachers' assessment of children's ADHD symptoms, greenness around residential areas was related to less inattention and hyperactivity and this result was not dependent on family income.

Regarding experimental studies in the Environmental psychology framework including ADHD children, to our knowledge, there are only two examples: one conducted in the USA by Faber Taylor and Kuo (2008); and a second one conducted by Van den Berg and Van den Berg (2010) in The Netherlands.

The first study (Faber Taylor & Kuo, 2008) examined the impact of three different environments – a park, an urban residential area and a downtown area - on attention and impulse control among ADHD children. The sample consisted of seventeen children aged seven to twelve, usually medicated yet not on the testing days. Ten of the children were hyperactive and six were not. Experimenters took the children out for an individually guided slow paced walk of twenty minutes and afterwards attention was measured by using four objective tests. Outcomes showed that children concentrated better after walking in the park than in the two other conditions and authors suggest that improvement was comparable to methylphenidate peak effect of extended release. These findings show that Nature “might serve as a safe, inexpensive, widely accessible new tool in the tool kit for managing ADHD symptoms” (Faber Taylor & Kuo, 2008, p. 402).

The second study (Van den Berg & Van den Berg, 2010) compared the behaviour and the emotional and cognitive functioning of twelve medicated children aged nine to seventeen affected by ADHD in a natural setting and in a built setting – a wooded area and a small town. Results showed that children had less difficulties to concentrate in the woods than in the town, and that woods were perceived as more restorative than the town. Their behaviour was less impulsive and inattentive in

the woods and children reported somewhat more positive feelings in the woods than in the town. In general, the authors demonstrated that children with ADHD functioned at a constant high level in the natural area, whereas their behaviour was more variable and cognitive functioning was generally poor in the built condition.

Both studies, Faber Taylor and Kuo (2008) and Van den Berg and Van den Berg (2010), compared a natural setting to a general urban setting, similarly to research literature on typical children. Although literature shows that urban environments offer some degree of restorative properties, the need to differentiate urban environments by considering the architectural style and historical period emerged. Literature on attractive urban places such as historical sites on typical adults is still very scarce. In spite of the relatively little research about the restorative potential of historical sites, there are a few studies that are worth mentioning. For instance, the study conducted by Fornara (2011) revealed that, overall, places with panoramic and historical features were perceived as restorative as an urban park. In addition, Fornara (2011) argues that the study conducted by Bornioli, Parkhurst and Morgan, (2018a) revealed that sites characterised by different architectural styles from different historic periods, or the also defined high quality urban design sites, were perceived as restorative as large green spaces. Conversely, Van den Berg, Joye, and Koole, (2016) showed that natural environments were perceived as more restorative and fascinating than urban environments due to visual complexity and fractal geometry of greenness (please see Berto, 2019).

Similarly, Xu, Zhao and Ye, (2018) compared the restorative potential of natural landscapes and cultural landscapes (the latter displaying culturally relevant elements such as The Great Wall etc.) and results revealed no differences in terms of restoration between the two conditions. In addition, San Juan, Subiza-Pérez and Vozmediano, (2017) showed that public urban squares lead to an increase of cognitive performance, a decrease in negative affect after walking for thirty minutes showing overall that urban sites have restoration potential. Similarly, Bornioli, Parkhurst and Morgan, (2018b) investigated how walking in urban environments support psychological wellbeing. Their study

revealed that personal connections, the identity of place and sense of community resulted beneficial for psychological wellbeing, showing that non-natural elements can promote cognitive appraisals and positive affect amongst adults. Similar results were found by Collado and Manrique (2019). Finally, Scopelliti, Carrus and Bonaiuto, (2019) recently demonstrated how, in adult subjects, restorative effects can happen both thanks to natural and historical urban settings, though they are stronger in the first rather than in the second case.

Considering the above-mentioned studies conducted among typical adults on restoration in built (historical) environments and already existing studies on ADHD and Nature contact, the present study addresses the need to extend previous research on children affected by ADHD, by evaluating how settings with different physical characteristics influence their perceived restorativeness and their symptoms.

The present study

Children diagnosed with ADHD are at high risk of remarkable consequences since they become more vulnerable to experience frustration, emotional problems and impaired cognitive functioning, with implications in self-esteem and socialization (Foley-Nicpon, Rickels, Assouline, & Richards, 2012; Lee, Falk, & Aguirre, 2012). In some cases, these children need pharmacological aid but even though there could be an improvement of symptomatology, they must deal with side effects of medication.

Hence, by applying ART to ADHD, the present research aims to find and promote a link between environmental psychology and clinical psychology. The objective of this study is to gain more insight into the emotions, attention, impulsivity and perceived restorativeness of children and adolescents affected by ADHD when exposed to natural as opposed to built environments.

To achieve this, a twenty minute slow paced individually guided walk was performed in three different settings located in the north east part of Rome (Italy): two urban walks (standard vs.

historical) and a walk in Nature (a high prospect large open green field). The duration of the walk was predetermined to twenty minutes due to the effectiveness revealed by Faber Taylor and Kuo, (2008). Considering previous research with ADHD in the environmental psychology framework (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010), this study design includes several innovative points, as detailed below:

- a. Attention is measured at baseline (T0) and after mental fatigue provoking task (T1) since ART (Kaplan, 1995) states that restoration is possible after being mentally fatigued (as well as at post-test or T2);
- b. Two group ages affected by ADHD were compared – children vs. adolescents – with the purpose of evaluating possible differences on the effect of a recovery experience as, Marzocchi et al., (2010) show that attention and impulsivity performance change depending on age group;
- c. Focus on the Here and Now outcome or the also defined concept of mental presence (Kabat-Zinn, 2006);
- d. Natural condition is characterised by a green field with high prospect rather than an urban park or a wood as in previous studies (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010);
- e. One of the settings in which treatment takes place consists in an urban-historical environment;

The general aim is to show that participants would respond more positively in the natural condition than the standard urban condition, yet in the historical condition the performance would be better than the standard-urban condition. In summary, in the natural environment participants would

display the best performance (and highest perceived restorativeness) whereas in the historical urban condition they would display average performance and average restorativeness; last, in the standard urban condition performance and restorativeness would be the worse.

Hypotheses

This experimental study tests the following main hypotheses, grouped according to the same conceptual hypothesis:

Hypothesis no. 1: Children and adolescents' positive-negative emotions score decreases more after a natural setting recovery experience than after an urban one (either historical or standard); moreover, the same level decreases after the same experience in historical vs. standard urban setting.

Hypothesis no. 2a: Children and adolescents' attention performance level in terms of accuracy improves more after a natural setting recovery experience than after an urban one (either historical or standard). Moreover, the same performance improves more after the same experience in historical vs. standard urban setting. Since the accuracy is measured in terms of the number of omissions (omissions score), the attention performance level is higher with lower scores.

Hypothesis no. 2b: Children and adolescents' attention performance level in terms of latency (response time latency) improves more after a natural setting recovery experience than after an urban one (either historical or standard). Moreover, attention performance level improves more after the same experience in historical vs. standard urban setting. Since the latency is measured in terms of response time latency (latency score), the attention performance level is higher with higher scores.

Hypothesis no. 3a: Children and adolescents' impulsivity level in terms of accuracy (errors score) decreases more after a natural setting recovery experience than after an urban one (either historical or standard). Moreover, the same level decreases more after the same experience in historical vs. standard urban setting. Since the accuracy is measured in terms of the number of errors score (errors score score), the impulsivity level decreases with lower scores.

Hypothesis no. 3b: Children and adolescents' impulsivity level in terms of latency (response time latency) increases more after a natural setting recovery experience than after an urban one (either historical or standard). Moreover, the same level increases more after the same experience in historical vs. standard urban setting. Since the latency is measured in terms of response time latency (latency score), the impulsivity performance level is lower with higher scores (more latency);

Hypothesis no. 4: Children and adolescents' environmental perception (perceived restorativeness) increases more after a natural setting recovery experience than after an urban one (either historical or standard). Moreover, the same level improves after the same experience in a historical setting as opposed to a standard urban setting;

Hypothesis no. 5: Children and adolescents' thoughts experienced during treatment are grounded in the Here and Now more in the natural setting than after an urban setting (either historical or standard) .Moreover, thoughts are grounded in the Here and Now are more after the same experience in historical vs. standard urban setting.

2.2 Method

Participants

Twenty-one drug-naïve children and adolescents with attention deficit hyperactivity disorder (ADHD) aged 8 to 14 ($M = 11.87$, $SD = 1.76$), participated in the study (16 males, 5 females). Children were twelve aged 8 to 10 ($M = 10.57$, $SD = 1.11$), eight males and four females whereas adolescents were nine, aged 13 to 14 ($M = 13.61$, $SD = 4.42$), eight males and one female,

ADHD children were consecutive referrals at the TSMREE/Mental health safeguard and rehabilitation service for developing age of Mentana, a small town near Rome (Italy), part of the local NHS named ASL Roma G/5. The ADHD diagnosis respected the DSM-IV-TR criteria (APA, 2000). Inclusion criteria were diagnosis of ADHD combined-type or non-combined as well, and the most common comorbidities of ADHD (Please see Batteria Italiana per l'ADHD authored by Marzocchi

et al., 2010), such as learning disabilities, speech disease and opposition-defiant disorder. Exclusion criteria were mental retardation, brain trauma, physical impairment and neurological diseases. Participants lived in the North-East quadrant of Rome, in a range of about 84 square kilometres. They attended public schools within the area.

Procedure

The study procedure was approved by the Ethical Committee within the Department of Psychology of Developmental and Socialization Processes at Sapienza University of Rome (submitted on the 26th of April and approved on the 11th of May 2017). In April 2017, parents were contacted by phone and invited for a meeting aimed to explain the purpose of the study. Both parents of each participant signed a written informed consent form that also included a specific section for sensitive data treatment. Data were collected in springtime during May and beginning of June 2017.

The study had a mixed-factorial design. Average execution time for the whole procedure in each setting was about 75 to 90 minutes. Each testing day took into consideration only one setting and included 6 to 9 children. Each child was tested three times at a time distance of 2 to 4 days, one for each environmental setting. Data collection took place from 3 to 8 pm and each child was tested in the same time range (for instance 3 to 4.30 pm or 4.30 to 6 pm, or 6.30 to 8 pm) in order to make sure the child always had a more comparable tiredness level. Several experimenters, experienced with ADHD, trained on the procedure and blind to the hypothesis of the research, were involved in the data collection, each one working with one participant per time and, administering to the assigned participant, one per time, all measures of the entire trial. Data collection took place during the school year therefore participants went to school in the mornings and cooperated with the data collection in the afternoons.

Study site

Regarding the spatial organisation of the testing, each of the environmental condition in which the walk was carried out included an indoor testing room, located into the selected site so that participants did not have to move from one place to another. For instance, in the natural environment, testing room was located inside a family farm (Azienda Agricola Sciarratta Ornella), whereas in the historical urban condition testing room was in the Mentana public library, located in Palazzo Crescenzio, a building that dates back to the 9th century. In the case of the standard urban condition, testing room was in the local health unit office for mental health in developing age, located in Mentana. All the three institutions gave their approval for using the testing room with the purpose of supporting non-profit research. Please see Figure 1 to view the three locations on google maps. The natural environment selected for data collection was the Marcigliana natural reserve, which is located at the northeast part of Rome province (Figure 2).

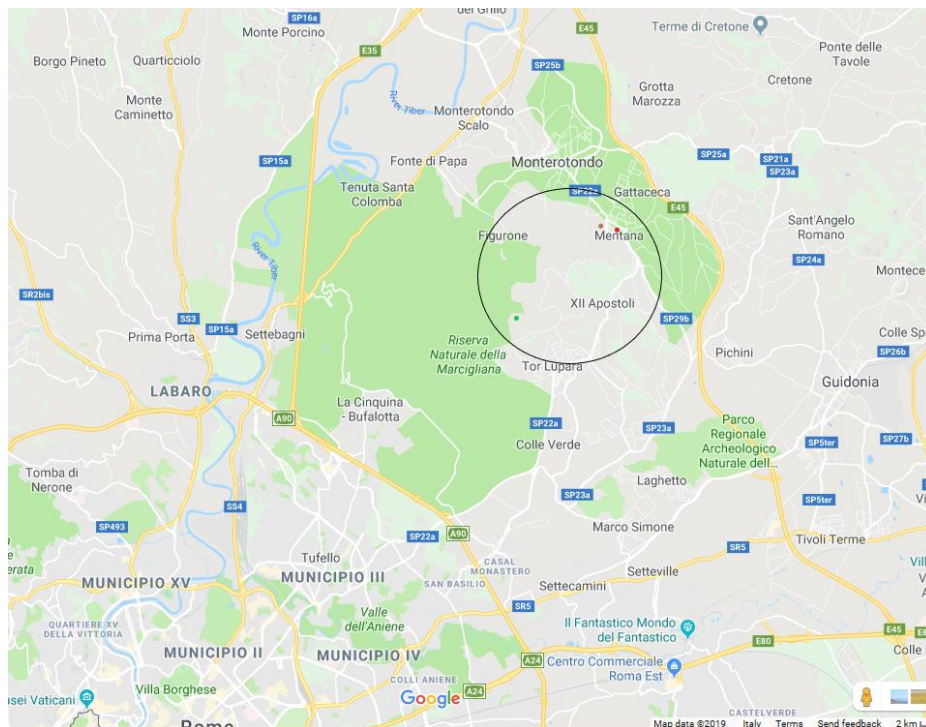


Figure 1: A map of the three settings.

Note: Inside the circle, the green point represents the natural environment, the brown point represents the historical-urban and the red point represents the standard-urban environment.



Figure 2. The natural environment (Marcigliana Natural Reserve).

At the time of data collection (May and June 2017), the natural environment consisted of a green field, cultivated with wheat at its beginning stage, therefore it was still green. The area of the natural reserve selected for data collection is characterised by high prospect, in which the field of vision could be widely extended up to a few tens of hectares. The historical-urban environment was a medieval village, named Mentana (Figure 3). It is located in the northeast part of Rome province, at a few kilometres distance from the natural site. Mentana's historical area is a small pedestrian, well-kept and quite village, representing a typical Italian medieval site. It still preserves its historical area surrounded by original walls. The standard urban setting was the modern part of Mentana, a town inhabited by around twenty thousand people (Figure 4).



Figure 3. The historical-urban environment.

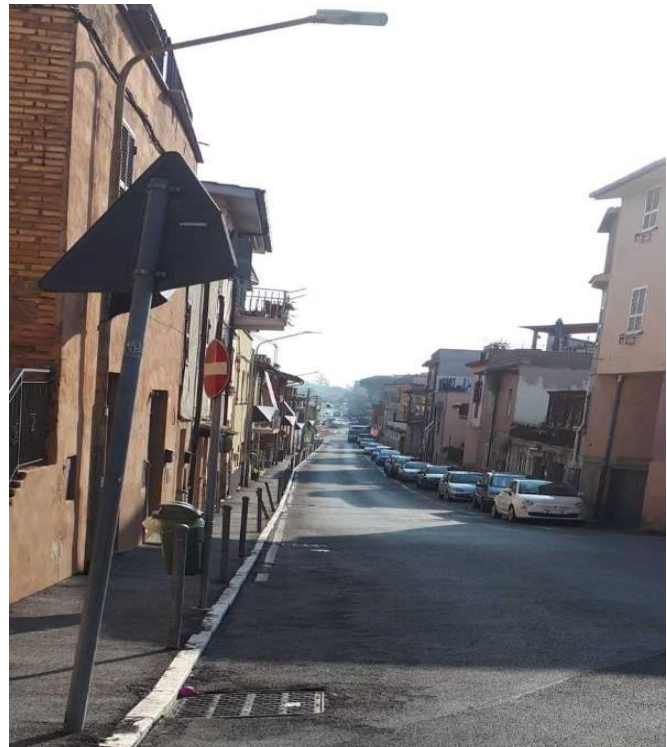


Figure 4. The standard-urban environment

Participants were driven to the selected setting for the day by their parents and once they arrived, they were asked for their oral consent (even though both parents had already signed the informed consent form). Right after, testing started by conducting a first mood, attention and impulsivity measurement in order to have a baseline or Time 0 (T0; please see Figure 5). Thereafter, a fifteen-minute task was administered which purpose was to provoke mental fatigue (Please see Faber Taylor & Kuo, 2008; Kaplan, 1995). The task consisted in assembling a puzzle for 10 minutes and solving a maths problem for additional 5 minutes. The maths problem (which numerical data were changed for each setting) was extracted from INVALSI, a written test battery aimed to assess learning levels among students and to form general data on the efficiency of the Italian training system (for those having dyscalculia, a different 5' task was suggested. It consisted in finding words that start with a given letter. Please see paragraph 2.3.5). Right after, that is at Time 1 (T1), attention was re-measured. Finally, from the testing area, an experimenter joined one participant per time in a 20 minutes slow-paced walk, that is a restorative walk in the environmental setting selected for the day.

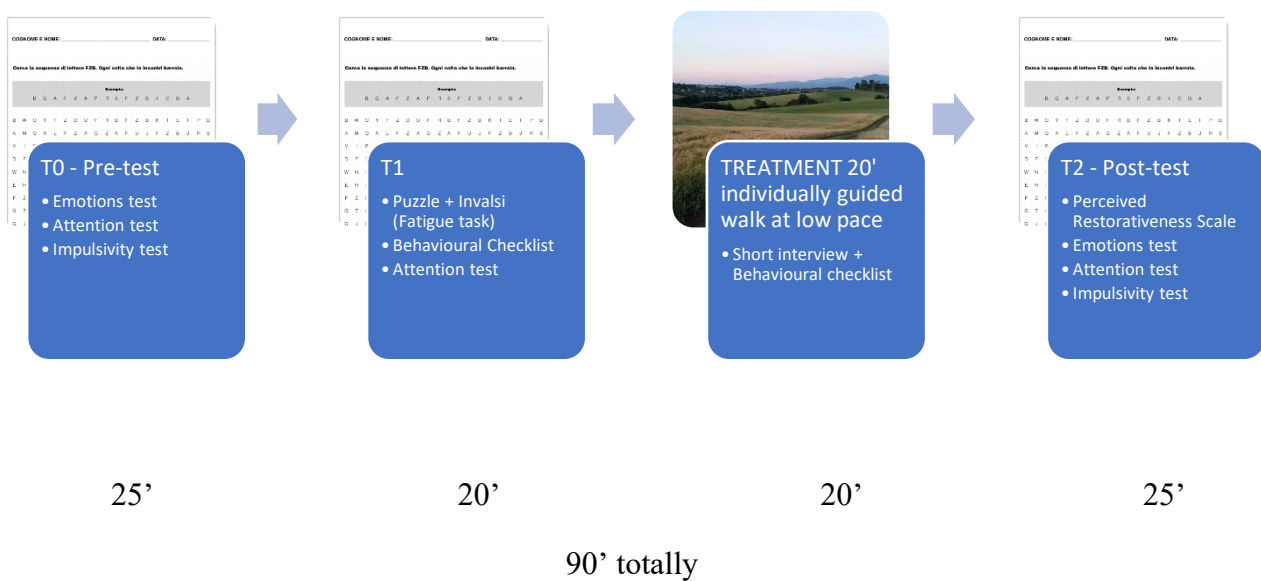


Figure 5. Experimental procedure

In literature, restorative activity is defined as “activities that are thought to be especially helpful in resting and restoring the ability to concentrate; involves experiencing nature in some way, for example, sitting or walking in the natural environment (backyard, garden, park), observing a natural view (trees, clouds, a sunset)... sitting by water... observing wildlife, birds, and animals...” (Cimprich, 1993, p. 87). By aiming to conduct a restorative activity as defined above, physical exertion was kept to a minimum level amongst the three conditions. In addition, because the walk was aimed to connect to the surroundings, conversation was also kept at minimum level. Just after returning from the walk, perceived restorativeness was measured and the three variables were re-measured (mood, attention, impulsivity) (T2). Moreover, on the way back from the walk, experimenters filled a behavioural checklist aimed to assess the behaviour of the participants during the treatment. In this way we obtained a manipulation check of the treatment, in case the latter was not effective. Specifically, the treatment was subjected to a control of its effectiveness by implementing a scale, an adapted version of the SDAI (Marzocchi et al., 2010) aimed to rate

behaviours of inattentiveness and hyperactivity during the treatment at a level that could interfere with the effectiveness of the treatment (as above mentioned, treatment was a twenty minute walk at a slow pace with the purpose of getting engaged with the surroundings during which conversation was kept at minimum). In other words, its function was to assess the conduct of the participants during the treatment and in case of problematic behaviour – over the threshold established by the test - the assumption is that the treatment could not be effective. For more details please see paragraph 2.3.5.

Participants were divided in three groups in order to randomize treatment order and avoid learning effects. Each group was balanced in terms of co-morbidities, gender, ages (both younger and older ones) and number of participants. Therefore, the first group (A) visited the environments in the following order: natural setting (N), historical setting (H), standard-urban (S) setting. The second group (B) visited the environments in the following order: H, S, N. The third group (C) visited the environments in the following order: S, N, H.

At the end of data collection, each of the participants received a gift that consisted of a tomato plant with an enclosed seed of the same plant and a letter aimed to promote the child's care for the plant and to encourage Nature connectedness and, hopefully, manage attention deficits through Nature contact. In addition, parents received a practical ADHD guide that included a section concerning Environmental Psychology and a brief review of the main theories and empirical studies on attention restoration and restorativeness (Barbiero & Berto, 2016; Chawla, 2015; Kaplan, 1995; La Prova, 2011), possibly relevant for the considered condition.

Measures

Emotions measurement

In order to measure the current mood of participants, a graphic smiley-test, which was originally developed and used among healthy children (Van den Berg, Koenis, & Van Den, 2007b)

and afterwards applied to children affected by ADHD (Van den Berg & Van den Berg, 2010; see Appendix A), was implemented.

Six pairs of feelings were illustrated by two smiley faces, one for the positive and one for the negative side. For instance, emotions were listed in the following presentation order and respectively from left to right: happy vs. sad, not worried vs. worried, energetic vs. tired, not angry vs. angry, certain vs. uncertain, not scared vs. scared. Each of the two smiley faces were presented in the left and right side of the paper (negative side on left whereas positive side on right) and in the middle, seven circles indicating the intensity of the emotions that the child was currently experiencing were presented. Therefore, children were asked to describe the intensity of each pair of emotions via a seven steps bi-polar response scale having the positive and negative emotions as extremes (positive emotion on the left, negative emotion on the right for each bipolar item).

Participants had to colour the circle that could better represent their state. The instructions specified that the circles next to the smiley faces, the extreme ones, represent the highest intensity of the emotion whereas the circle in the middle is neutral, indicating that the child was not feeling either in one way or the other. Please see Figure 1 for a section of a picture of the test. In the present study, Cronbach's alpha of the Smiley test was calculated for pre-test or T1 (among environments, that is three measurements totally) and for post-test or T2 (among environment, that is three measurements totally). It resulted respectively .78 and .87.

Nome e Cognome:

Data:

Luogo:

Come mi sento adesso?

Qui di seguito trovi sei sensazioni diverse. Colora il cerchio ad ogni sentimento che meglio si adatta come ti senti ora. Ad esempio, se ti senti felice colora un cerchio vicino alla faccina felice, quanto più vicino è il cerchio, tanto più felice ti senti ora. Se ti senti triste, colora il cerchio vicino al viso triste. Se ti senti né tanto felice né tanto triste, colora il cerchio in mezzo.

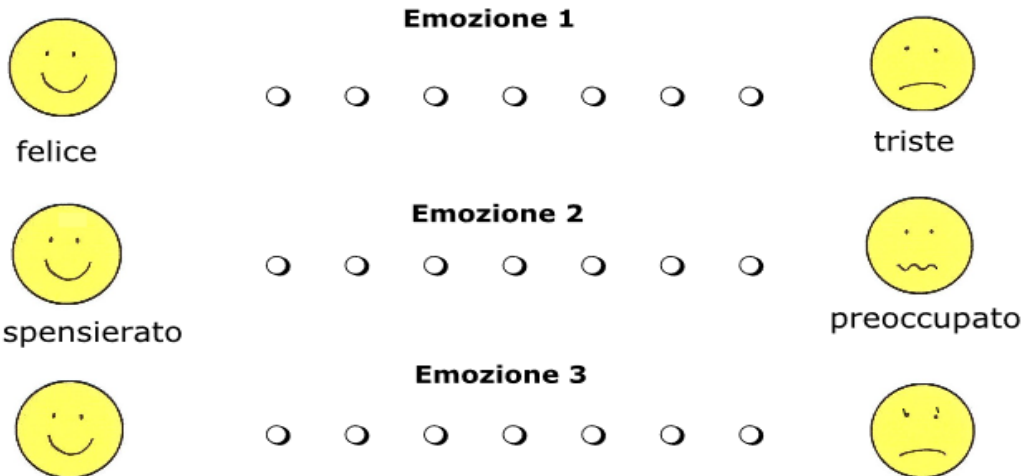


Figure 6. A section of the Smiley test in the Italian version.

Attention measurement

The continuous performance test or CP test (Mackworth & Taylor, 1963) measures processes related to response inhibition, visual sustained attention, vigilance and other aspects of cognitive functioning and attention. It has been used in a wide-ranging variety of clinical contexts, such as dementia, depression and finally ADHD (Barkley, 1997, 1998; Corkhum & Siegel, 1993; Grunebaum, Weiss, Gallant, & Cohler, 1974; Nichols & Waschbusch, 2004). Marzocchi et al. (2010) validated the Italian version of the CP test and included it into the Italian Battery for ADHD (Batteria Italiana per l'ADHD; BIA).

The Continuous Performance Test (Italian version validated by Cornoldi, Gardinale, Masi & Pettenò, 1996; Figure 7), also named CP Test is a pencil and paper test aimed to evaluate visual sustained attention and inhibition amongst children (please see Appendix B). It is part of the Italian battery for ADHD (Marzocchi et al., 2010). It compromises three different subtests organized in a

sequential order of difficulty (less to more). From subtest 1 (CP1) to subtest 2 and 3 (CP2 and CP3), letters are smaller, nearer to each other and the order to the letters in the string varies, therefore none of the subtests is identical to the others. Each one of the three subtest presents long strings of letters where the child needs to find three chosen contiguous letters (e.g., FZB) in a collection of sparse letters. Such test requires the child to identify the chosen target (letters FZB) in an alphabet soup.

<p>Sub-test 1</p> <p>B W O Y F Z O U F R B F Z B K T E I P D</p> <p>A M Q X L F Z A Q Z A F U J F Z B J R S</p> <p>V I P N T G F Z B W C H N R K F Z Q F R</p> <p>Sub-test 2</p> <p>A Q X F Z B I S D F Z F O T W L Q V F Z M B L V P I F Z B H</p> <p>D O G K W R E F Z B N H S O J T X A F Y Q U F Z B N W F Z</p> <p>L R F Z P I F Z B T J X D F O M K S F Z V X D Z P G O Q W G</p> <p>Sub-test 3</p> <p>V F Z O H N I K L F Z D S F E J S F Z B G A Y Q C B F W Q R F Z B T E J Z S P X D Z T A F Z B E W U D G L F Z B F P F Z</p> <p>F Z B K G L R F Z K M B X I O W F Z B H Y J F Z B P C Y F A T S A F Z W V I F E H O X Q D F Z G L S C A G N H N G S O</p> <p>F Z Y L F J D F Z B Z H B V F Z W F E I J S W E Q U F Z B X U F W R D V L F Z B R P B T R V A F Z M K T Y F Z B Q G M</p>
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Figure 7: Example of the three sub-tests making up the Continuous Performance Test (CP test). FZB is the sequence to be marked here.

Before administering the test, each subtest has an example that the child is invited to consider. After that, the experimenter administers the three subtests and records the time the child takes to execute the task (latency), for each subtest. The scoring reveals the number of targets found by the child, the false positives, the omissions and the latency expressed in seconds.

Based on the Italian validated version of the test, normative data is available only on omissions and latency, therefore these are the data taken into account in the present study. The CP test is not sensitive to learning effects.

Impulsivity measurement

The Matching Familiar Figure Test (MFFT; Kagan, 1966), Italian version validated by Cornoldi et al., (1996) aims to detect the degree of impulsivity of the child and is one of the most discriminatory tests for ADHD and impulsivity in general (Cairns & Cammock, 1978; Douglas & Peters, 1979; Milich & Kramer, 1984).

It requires a strategy of visual analysis since each item consists of two pages, where on the first page a target figure is represented, whilst on the other one 6 figures similar to the target are represented and only one of them is identical to the target. The task consists into choosing the figure that is identical to the target model. The model and the 6 alternatives are presented to the child at the same time (please see example in Figure 1 and Appendix C).

The variables taken into consideration are the following ones: response time latency for the first response (whether it was correct or not) entered as latency score and the number of errors score the child makes. The tendency of the impulsive child is to respond precipitously. In particular, impulsivity makes children being both fast and incorrect, whereas typical children take more time to analyse the images, thus they provide more correct answers (Mulder et al., 2010; Vallesi et al., 2013). Another parameter to be taken into consideration refers to the performance over time: the more the child goes on, the more difficult the items are, so, theoretically, more time should be required. In such a case, ADHD children fail since they do not increase the time of analyses of the image, yet they continue to provide impulsive responses whereas typical children take more time to analyse the details with the increasing difficulty of the task items. The test is supposed to be easier in the first part, and harder in the second one, hence ADHD children usually perform better in the first items of the test

than in the last ones. Normative data on ADHD children refer to the outcomes of errors score and latency and this data was taken into account in this study.

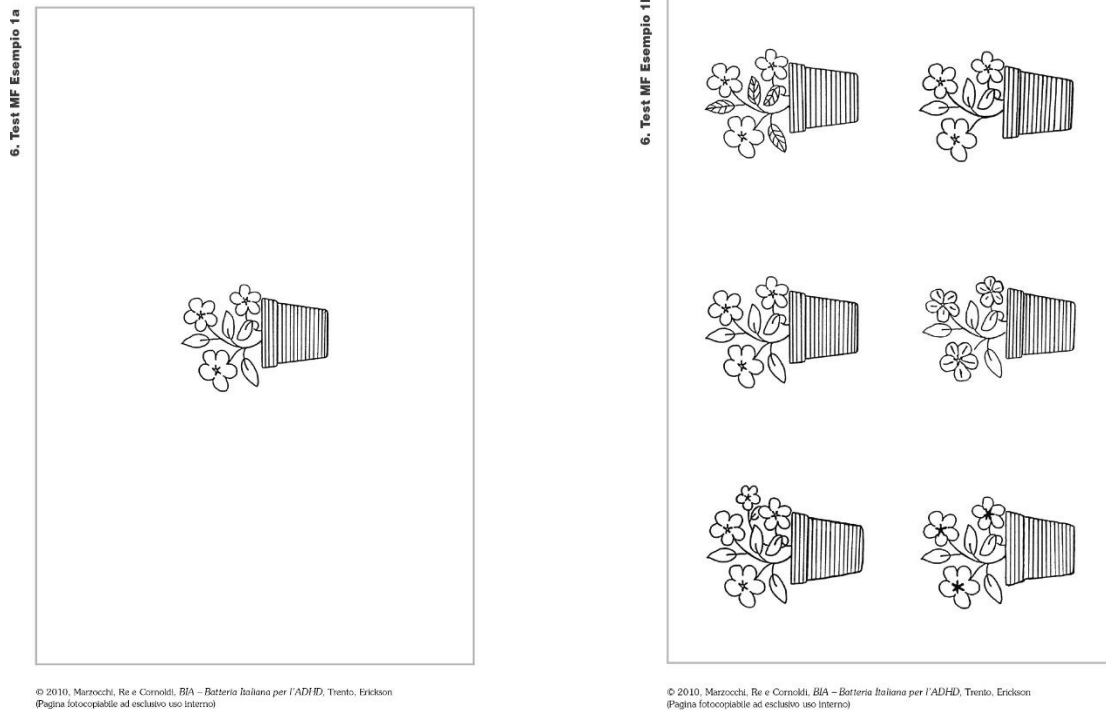


Figure 8: Items no. 1a and 1b (examples) of the MF test.

Perceived Restorativeness measurement

The Perceived Restorativeness Scale for children (PRS-ch), based on the ART (Kaplan, 1995), is a self-report scale aimed to measure the perceived restorative value of a place. The PRS-ch was developed by Hartig, Korpela, Evans, & Gärling, (1997) and then adapted to children by Bagot (2004) and Bagot, Kuo, & Allen (2007).

In the present study, the Italian version of the PRS-ch was used (Berto et al., 2012; Pasini, Berto, Scopelliti, & Carrus, 2009; Appendix G). It consists of 17 items organized in four restorative factors (being away, scope, coherence, fascination) and a single item measuring environmental

preference. Judgements are made on a scale of 0 to 10, where 0 = “not at all” and 10 = “very much”. For instance, item no. 1 reads: “In this place I don’t think at my worries”. ($\alpha = .87$, measured by including the three measurements amongst environments).

Behavioural checklists: fatigue task and treatment

In order to check the effectiveness of fatigue task (T2) and treatment, we used behavioural checklists filled in by the experimenters, with the purpose to assess the fatigue task (Please see Appendix D) and the quality of the walk (treatment; Please see Appendix E).

Referring to the mental fatigue provoking task, participants had given a task for 15 minutes. This task included 10’ for puzzle assembling in which the participants chose among a variety of puzzles according to his/her age and 5’, on choice of the participant, for a game named both “boy girl animal” and ”scategories” (given a letter chosen casually, the task of the participant consisted in finding words that start with the chosen letter. Such words were grouped in categories such as names, things, animals, cities...) or a maths test for those having dyslexia and not being able to do the previous ones. The maths test was extracted from the INVALSI, a written test battery aimed to assess learning levels among students and to form general data on the efficiency of the Italian training system. Before the fatigue provoking task, we asked the children to give an oral answer to the three following open-ended questions: “How experienced are you in doing puzzles?”, “How often do you do a puzzle?”, “How many pieces do they have?”.

In addition, experimenters filled a behavioural checklist in order to assess the child’s conduct during the mental fatigue task. Such scale consisted of 9 adjectives, listed specifically for this study, that had to be rated on a scale from 0 (very low) to 5 (very much). Adjectives were the following: absorbed, frustrated, oppositional, inattentive, restless, concentrated, interested, inadequate, angry.

Referring to the treatment, experimenters filled the behavioural checklist on the way back to the testing room. For this purpose, a scale was adapted from the SDAI (Scale per l’individuazione di

comportamenti di Disattenzione e Iperattività in età scolare per Insegnanti-Genitori-Bambini), a rating scale part of the Italian Battery to assess ADHD (Marzocchi et al., 2010), which usually aims to assess the impulsive behaviour and inattentiveness. It is usually used by teachers within school contexts. The adapted version consisted of 10 items which judgements were made on a scale of 1 to 5, where 1 means very low and 5 means very much. In addition to the adapted version of the SDAI, two open-ended questions were posed to the children: “Was the walk pleasant or boring? Please explain” and “What did you mostly think of during the walk? Please explain”. Such questions, specifically designed for this study, aimed to explore whether pleasantness of the walk and thoughts oriented to the Here and Now could address in favour of the two first levels of recovery due to the restorative properties of the environment (Kaplan & Kaplan, 2011. Please see Introduction). Behavioural checklist during treatment amongst the three environmental conditions: $\alpha = .87$.

2.3 Statistical Analyses

As indicated above, the study design is mixed factorial. Independent variables or factors for testing hypothesis 1 to 4 are the following ones:

1. Environment: three levels (natural, historical urban, standard urban); within subjects.
2. Time: depending on the dependent variable, such factor has different levels (emotions include two levels, that is pre-test/T0 and post-test/T2), attention include three levels (T0, T1, T2 that is respectively pre-test, fatigue task and post-test), impulsivity include two levels (T0 and T2 that is pre-test and post-test), perceived restorativeness only has one level (post-test/T2); within-subjects.
3. Age: children (aged 8-11) vs. adolescents (aged 13-14); between-subject.

The software used to analyse data were SPSS and STATISTICA.

Statistical analyses on children and adolescents' emotions – Hypothesis 1

A repeated measures ANOVA with three factors - time (T0, T2 that is respectively pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - is conducted on positive-negative emotions score in order to test Hypothesis 1.

Statistical analyses on children and adolescents' attention - Hypothesis 2 (a, b)

Hypothesis 2a

A MANOVA with three factors - time (T0, T2 that is pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - is conducted on accuracy and latency of attention in order to test Hypothesis 2a. Then, a repeated measures ANOVA with three factors - time (T0, T1, T2), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - is used to test accuracy.

Analyses are conducted by dividing the subjects into two age groups (children vs. teenagers) and by using the normative data (Marzocchi et al., 2010). Therefore, scores are transformed into z points. Additional data regarding false positive and number of correct answers are not considered since no normative data are provided by the MF test authors (Marzocchi et al., 2010).

Hypothesis 2b

A MANOVA with three factors - time (T0, T2 that is pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - is conducted in order to test whether the type of environment (more particularly the treatment among environments) affects latency of attention and whether any differences between ages exist. Then, repeated measures ANOVA with three factors - time (T0, T1, T2), type of environment

(natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - was conducted to test latency, followed by LSD *Post-hoc* comparisons.

Analyses is conducted by dividing the subjects into two age groups (children vs. teenagers) and by using the normative data (Marzocchi et al., 2010). Therefore, scores are transformed into z points. Additional data regarding false positive and number of correct answers are not considered since no normative data are provided by the MF test authors.

Statistical analyses on children and adolescents' impulsivity – Hypothesis 3 (a, b)

Hypothesis 3a

A MANOVA with three factors - time (T0, T2 that is pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14)- is conducted in order to test whether the type of environment (more particularly the treatment among environments) affects accuracy of impulsivity (errors score), as well as response time latency (latency score) for the type of analyses, and whether any differences between ages exist. Then, repeated measures ANOVA with three factors - time (T0, T1, T2), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) – is used to test accuracy.

Analyses was conducted by dividing the subjects into two age groups (children vs. teenagers) and by using the normative data (Marzocchi et al., 2010). Therefore, scores are transformed into z points. Additional data regarding the number of correct answers (as on the notation sheet) are not considered since no normative data are provided by the MF test authors. Analyses are conducted both on response time latency and errors score (which scores were first standardized based on normative data). Data related to correct answers are not considered in the analyses because no normative data are available for the MF test authors (Marzocchi et al., 2010).

Hypothesis 3b

A MANOVA with three factors - time (T0, T2 that is pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14)- was conducted in order to test hypothesis 3 (a, b). Then, a repeated measures ANOVA with three factors - type of environment (natural, historical-urban, standard-urban), time (T0, T1, T2) and age (children aged 8-11 vs. teenagers aged 13-14) – was used to test time response latency. Analyses was conducted by using normative data (Marzocchi et al., 2010), therefore scores were transformed into z points.

Statistical analyses on children and adolescents' perceived restorativeness - Hypothesis

4

A repeated measures ANOVA with three factors - time (T0, T2 that is respectively pre-test and post-test), type of environment (natural, historical-urban, standard-urban) and age (children aged 8-11 vs. teenagers aged 13-14) - was conducted on perceived restorativeness score in order to test Hypothesis 4.

Statistical analyses on children and adolescents' thoughts during treatment – Hypothesis

5

Qualitative lexicographic analyses of valence was conducted on the first multiple choice question (“Was the walk pleasant or boring? Please explain”). Valence was assessed by being positive or negative. Afterwards, qualitative lexicographic analyses with categorical amplitude attribution was conducted on the second open-ended question (“What did you mostly think of during the walk? Please explain”) by considering whether the words reported by the participants were related to the Here and Now of the selected setting. Both analyses were conducted by a blinded judge.

2.4 Results

Effects of the treatment on children and adolescents' emotions – Hypothesis 1

Findings revealed no significant differences between time, conditions (natural, historical-urban and standard-urban environments) and ages (children vs. teenagers) on emotions. An additional outcome resulted from correlations will be cited in the discussions section. Therefore, we cannot confirm hypothesis no. 1.

Effects of the treatment on children and adolescents' attention – Hypothesis 2 (a, b)

Hypothesis 2a

After conducting a MANOVA (please see Table 1) on accuracy, as well as on latency for the type of analyses, findings revealed a significant main effect for Time (T0, T1 and T2) $F(4, 16) = 4.15$, $p < .05$, partial eta-squared = 0.51 and a significant interaction effect for Environment*Time $F(8, 12) = 5.95$, $p < .001$, partial eta-squared = 0.80. The values of partial eta-squared revealed that the effect of treatment is large (both for main and interaction effect but more particularly for the latter). The repeated measures ANOVA conducted afterwards on accuracy did not reveal any significant results. As consequence, hypothesis 2a cannot be confirmed.

Table 1. MANOVA Attention

	Test	Value	<i>F</i>	Effect df	Error df	<i>p</i>	partial eta-squared
Intercept	Wilks	0.42	12.53	2.00	18.00	0.00	0.58
Age	Wilks	0.93	0.65	2.00	18.00	0.53	0.07
Environment	Wilks	0.89	0.50	4.00	16.00	0.74	0.11
Env*Age	Wilks	0.86	0.67	4.00	16.00	0.62	0.14
Time	Wilks	0.49	4.15	4.00	16.00	0.02	0.51
Time*Age	Wilks	0.71	1.67	4.00	16.00	0.21	0.29
Env*Time	Wilks	0.20	5.95	8.00	12.00	0.00	0.80
Env*Time*Age	Wilks	0.43	2.00	8.00	12.00	0.14	0.57

Note: Age = children vs. adolescents; Environment =nature vs historical-urban vs. standard-urban; Time =T0, T1, T2.

Hypothesis 2b

After conducting a MANOVA (please see Table 1) on latency, as well as on accuracy for the type of analyses as mentioned above, findings revealed a significant main effect for Time (T0, T1 and T2) $F(4, 16) = 4.15, p < .05$, partial eta-squared = 0.51 and a significant interaction effect for Environment*Time $F(8, 12) = 5.95, p < .001$, partial eta-squared = 0.80. The values of partial eta-squared revealed that the effect of treatment is large (both for main and interaction effect but more particularly for the latter). Means and Standard Deviations of the three conditions, times and age are reported in Table 1, 2 and 3. Afterwards, repeated measures of ANOVA (Table 2) were conducted on response time latency.

Table 2. Repeated measures of ANOVA for Attention - LATENCY

Effect	SS	DF	MS	F	<i>p</i>	Partial eta-squared
Intercept	124.52	1.00	124.52	20.65	0.00	0.52
Age	4.66	1.00	4.66	0.77	0.39	0.04
Error	114.57	19.00	6.03			
Env	1.29	2.00	0.65	0.22	0.80	0.01
Env*Age	1.78	2.00	0.89	0.30	0.74	0.02
Error	112.06	38.00	2.95			
Time	7.37	2.00	3.69	10.78	0.00	0.36
Time*Age	2.08	2.00	1.04	3.04	0.06	0.14
Error	12.99	38.00	0.34			
Env*Time	3.92	4.00	0.98	5.39	0.00	0.22
Env*Time*Age	2.53	4.00	0.63	3.48	0.01	0.15
Error	13.83	76.00	0.18			

Note: Age is for children vs. adolescents, Env is for the three environmental conditions, Time is for three times (T0, T1, T2).

Outcomes showed a significant main effect for Time (T0, T1, T2) $F = 10.78, p < .001$, an interaction effect for Environment*Time $F = 5.39, p < .001$ and an additional interaction effect for Environment*Time*Age $F = 3.48, p < .05$, (Figure 9). The 3-way interaction outcomes indicate that there is a significant difference between the response time latency of the three times, environments and age groups. *Post-hoc* comparisons of latency scores in the natural environment

indicated statistically significant differences from T1 to T2 for both age groups, showing mental fatigue (less latency score) and statistically significant differences from T2 to T3, showing restoration (more latency score).

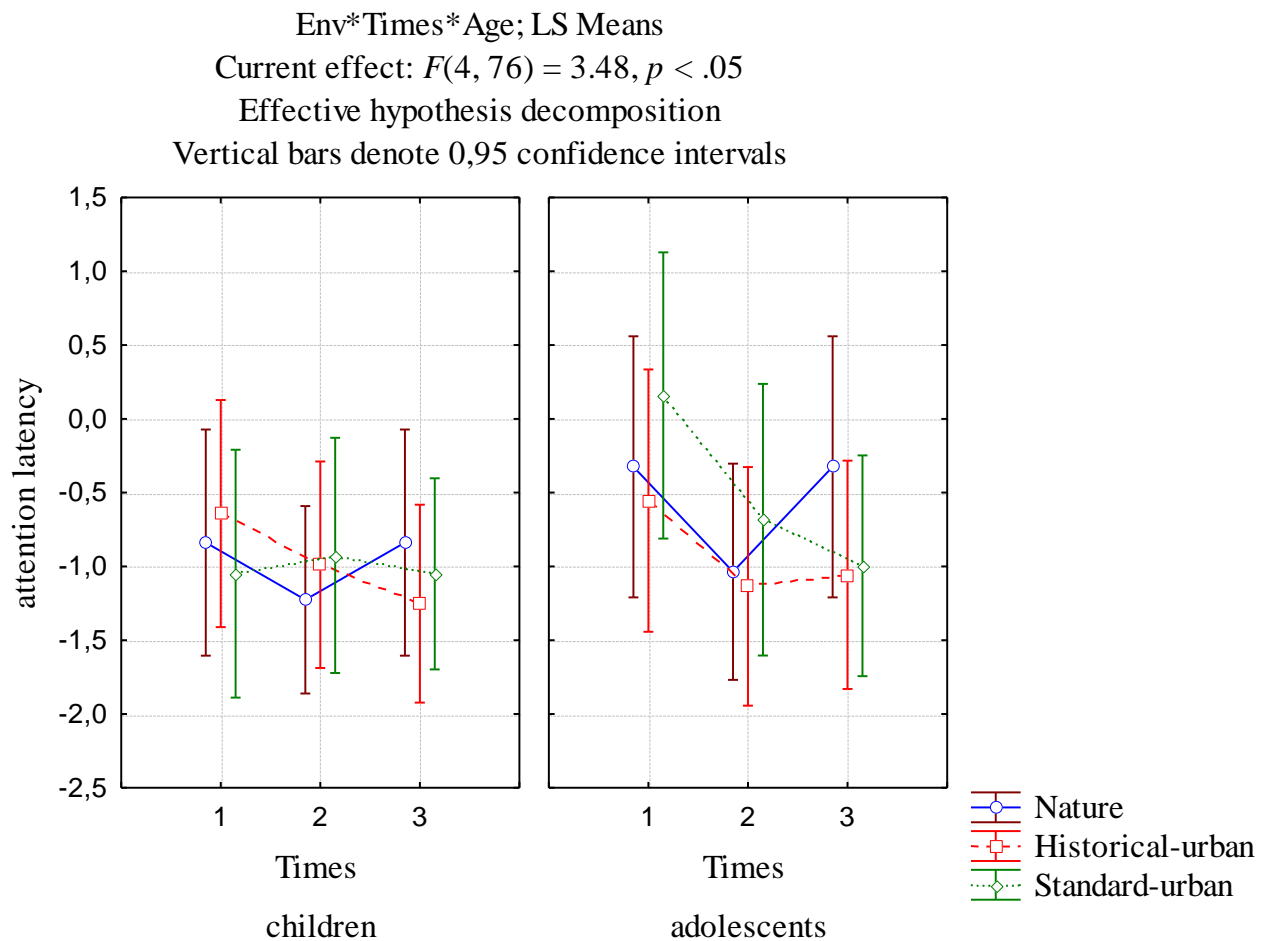


Figure 9. Environment*Time*Age interaction effect for attention – latency.

Next, *post-hoc* comparisons of latency score in the historical-urban environment of children indicated a statistically significant difference from T1 to T2, showing mental fatigue and a statistically significant difference from T2 to T3 yet showing more mental fatigue than T2, therefore treatment did not help in this case. Regarding adolescents in the historical-urban environment, *post-hoc* comparison revealed statistically significant difference from T1 to T2 showing mental fatigue but from T2 to T3 the statistically significant difference slightly shows more mental fatigue than T2,

therefore, again, treatment did not help. Regarding the standard-urban environment, *post-hoc* comparisons on children's scores did not reveal any statistically significant differences in any of the times therefore there was no mental fatigue and no restoration either, but for adolescents, *post-hoc* comparisons revealed a statistically significant difference from T1 to T2, showing mental fatigue whereas from T2 to T3 no statistically significant differences occurred. Descriptive statistics grouped for Nature, Historical-urban and Standard-urban condition are reported respectively in Table 3, 4 and 5.

Table 3. Descriptive Statistics (attention, latency) in the NATURE condition.

Effect	Level of (Factor)	N	T0	T0	T1	T1	T2	T2
			Latency	Latency	Latency	Latency	Latency	Latency
			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total		21	-0.61	1.26	-1.14	1.03	-0.61	1.26
Children	1	12	-0.83	0.85	-1.22	0.92	-0.83	0.85
Adolescents	2	9	-0.32	1.68	-1.03	1.21	-0.32	1.68

Table 4. Descriptive Statistics (attention, latency) in the HISTORICAL-URBAN condition.

Effect	Level of (Factor)	N	T0	T0	T1	T1	T2	T2
			Latency	Latency	Latency	Latency	Latency	Latency
			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total		21	-0.60	1.24	-1.05	1.13	-1.17	1.09
Children	1	12	-0.64	1.58	-0.99	1.38	-1.25	1.17
Adolescents	2	9	-0.55	0.65	-1.14	0.74	-1.06	1.02

Table 5. Descriptive Statistics (attention, latency) in the STANDARD-URBAN condition.

Effect	Level of (Factor)	N	T0	T0	T1	T1	T2	T3
			Latency	Latency	Latency	Latency	Latency	Latency
			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Total		21	-0.53	1.49	-0.82	1.29	-1.03	1.05
Children	1	12	-1.04	1.09	-0.92	1.64	-1.05	1.34
Adolescents	2	9	0.15	1.72	-0.68	0.65	-1.00	0.50

These results partially support hypothesis no. 2b because the natural environment helped cognitive restoration whereas in the two urban environments participants got equally mentally fatigued without experiencing restoration after treatment. As a consequence, both urban environments

exert the same psychological effect in terms of lack of attention restoration, an aspect in contrast with our hypothesis.

Effects of the treatment on children and adolescents' impulsivity – Hypothesis 3 (a, b)

Hypothesis 3a

A MANOVA (Table 6) was used to examine the influence of the treatment implemented among the three environmental conditions on the impulsivity of the participants. Times of impulsivity measurement (T0 and T2, that is pre-test and post-test) and environmental conditions (natural, historical-urban, standard-urban) were entered as the within-subjects variable whereas age (children vs. adolescents) as the between-subjects variables. Means and standard deviations of the errors score (accuracy) and latency scores are presented in Table 7. The MANOVA revealed a significant main effect for Age, $F(2, 18) = 7.52, p = < .001$ and a significant main effect for Time, $F(2, 18) = 54.21, p = < .001$ showing that an overall difference of performance from T0 to T2 occurred as well as a significant difference between children and adolescents performance.

Table 6. MANOVA Impulsivity.

Effect	Value	<i>F</i>	Effect (df)	Error (df)	<i>p</i>
Intercept	0.00	1977.89	2	18	0.00
Age	0.54	7.52	2	18	0.00
Environment	0.94	0.24	4	16	0.91
Environment*Age	0.94	0.24	4	16	0.91
Time	0.14	54.21	2	18	0.00
Time*Age	0.87	1.30	2	18	0.30
Environment*Time	0.91	0.39	4	16	0.81
Environment*Time*Age	0.96	0.16	4	16	0.95

Note: Age = Older vs. younger children; Environment = natural vs. historical urban vs. standard-urban; Time = T1 vs. T2 vs. T3.

Table 7. Descriptive statistics for Impulsivity errors in the three environmental conditions.

	N	Nature T0 Errors M	Nature T0 Errors SD	Nature T2 Errors M	Nature T2 Errors SD	Historical- u. T0 Errors M	Historical- u. T0 Errors SD	Historical- u. T2 Errors M	Historical- u. T2 Errors SD	Standard- u. T0 Errors M	Standard- u. T0 Errors SD	Standard- u. T2 Errors M	Standard- u. T2 Errors SD
Total	21	-1.36	0.14	-1.39	0.14	-1.37	0.15	-1.41	0.14	-1.37	0.14	-1.41	0.15
Children	12	-1.42	0.15	-1.46	0.14	-1.44	0.17	-1.49	0.14	-1.45	0.13	-1.49	0.15
Adolescents	9	-1.27	0.05	-1.29	0.03	-1.28	0.03	-1.30	0.03	-1.27	0.09	-1.30	0.03

Note: T0 is for pre-test and T2 is for post-test.

In addition, the ANOVA conducted on errors score (Table 8), a parameter for accuracy, confirmed the results obtained through the above mentioned MANOVA and revealed a significant main effect of Age $F = 13.65, p = < .001$ and a significant main effect of Time, that is from T0 to T2, $F = 21.02, p = < .001$. This indicates that there is a significant difference between the errors score of T0 (pre-test) and T2 (post-test) and that children and adolescents differed significantly in their performance. By observing the means (Table 7) it is evident that, overall, participants committed less errors score from T0 to T2 through environmental conditions (in the Nature condition T0 $M -1.36, SD 0.14$; T2 $M -1.39, SD 0.14$; in the Historical-urban condition T0 $M -1.37, SD 0.15$; T2 $M -1.41, SD 0.14$; Standard-urban condition T0 $M -1.37, SD 0.14$; T2 $M -1.41, SD 0.15$).

Table 8. ANOVA Impulsivity - errors

Effect	SS	DF	MS	F	p
Intercept	232.72	1	232.72	3487.66	0.00
Age	0.91	1	0.91	13.65	0.00
Error	1.27	19	0.07		
Environment	0.01	2	0.00	0.59	0.56
Environment*Age	0.00	2	0.00	0.34	0.72
Error	0.21	38	0.01		
Time	0.03	1	0.03	21.02	0.00
Time*Age	0.00	1	0.00	2.75	0.11
Error	0.02	19	0.00		
Environment*Time	0.00	2	0.00	0.52	0.60
Environment*Time*Age	0.00	2	0.00	0.31	0.74
Error	0.04	38	0.00		

Note: Age = Older vs. younger children; Environment = natural vs. historical urban vs. standard urban; Time = T0 vs. T2.

In addition, a comparison of children and adolescents' performance based on the means reported on Table 7, shows that children committed less errors (errors score is lower; in the Nature condition T0 $M -1.43, SD 0.15$; T2 $M -1.46, SD 0.14$; in the Historical-urban condition T0 $M -1.44, SD 0.17$; T2 $M -1.49, SD 0.14$; Standard-urban condition T0 $M -1.45, SD 0.13$; T2 $M -1.49, SD 0.15$) than adolescents (in the Nature condition T0 $M -1.28, SD 0.05$; T2 $M -1.29, SD 0.03$; in the Historical-urban condition T0 $M -1.28, SD 0.03$; T2 $M -1.30, SD 0.03$; Standard-urban condition T0 $M -1.27,$

SD 0.09; T2 *M* -1.30, *SD* 0.03), corroborating the above mentioned analyses. These results show an improvement of impulsivity (accuracy) after treatment but without environmental effect, therefore hypothesis 3a is not confirmed.

Hypothesis 3b

The MANOVA (Table 9) conducted on latency of impulsivity, which is the same analyses also performed on accuracy (as mentioned above), revealed a significant main effect for Age, $F(2, 18) = 7.52, p < .001$ and a significant main effect for Time, $F(2, 18) = 54.21, p < .001$. Then, the ANOVA analyses conducted on latency as dependent variable revealed (Table 9) that a significant difference from T0 to T2 exists (that is from pre-test to post-test), $F = 76.65, p < .001$, but without interaction effects of the environment nor of age. Means and standard deviations are presented in table 10 and clearly reveal that latency score was lower from T0 to T2.

Table 9. ANOVA for Impulsivity latency

Effect	SS	DF	MS	F	p
Intercept	218.68	1.00	218.68	469.11	0.00
Age	0.68	1.00	0.68	1.46	0.24
Error	8.86	19.00	0.47		
Environment	0.19	2.00	0.10	0.09	0.91
Env*Age	0.39	2.00	0.19	0.19	0.83
Error	39.11	38.00	1.03		
Time	19.22	1.00	19.22	75.65	0.00
Time*Age	0.02	1.00	0.02	0.10	0.76
Error	4.83	19.00	0.25		
Env*Time	0.26	2.00	0.13	0.27	0.76
Env*Time*Age	0.15	2.00	0.07	0.15	0.86
Error	18.25	38.00	0.48		

Note: Age = Older vs. younger children; Environment = natural vs. historical urban vs. standard urban; Time = T1 vs. T2 vs. T3.

Table 10. Descriptive statistics Impulsivity latency.

	N	N T0 M	N T0 SD	N T2 M	N T2 SD	H T0 M	H T0 SD	H T2 M	H T2 SD	S T0 M	S T0 SD	S T2 M	S T2 SD
Total	21	-0.84	0.98	-1.73	0.43	-1.04	0.93	-1.71	0.33	-0.98	1.16	-1.76	0.38
Children	12	-0.87	0.84	-1.76	0.38	-1.05	0.95	-1.76	0.33	-1.16	0.94	-1.84	0.31
Adolescents	9	-0.79	1.20	-1.69	0.51	-1.02	0.96	-1.65	0.34	-0.73	1.43	-1.66	0.45

Note: means and standard deviations for impulsivity LATENCY among environmental conditions (N = Nature, H = historical-urban, S = Standard-urban), times (T1, T2) and ages.

In other words, ADHD children and adolescents took less time to execute the test at T2 (Nature condition $M -1.73$, $SD 0.43$; Historical-urban condition $M -1.71$, $SD 0.33$; Standard-urban condition $M -1.76$, $SD 0.38$) than T0 (Nature condition $M -0.84$, $SD 0.98$; Historical-urban condition $M -1.04$, $SD 0.93$; Standard-urban condition $M -0.98$, $SD 1.16$). This outcome, considered on its own, would probably indicate that participants' impulsivity level did not allow them to carefully analyse the visual stimuli. Yet, taken together with accuracy outcomes (mentioned at paragraph 4.3.1), lower response time latency as resulted with the above-mentioned ANOVA suggests an improvement of perceptual analyses skills, as observed by the Italian version of the MF test authors (Marzocchi et al., 2010). As a consequence, these results show an improvement of impulsivity symptoms but without an environmental effect therefore hypothesis 3b is not confirmed.

Effects of the treatment on children and adolescents' perceived restorativeness Hypothesis 4

A Repeated measures ANOVA on perceived restorativeness (Table 11) revealed a main effect of the environment $F(2) = 20,35$, $p < .001$, partial eta-squared = 0.51. Next, *post-hoc* comparisons (Table 12) indicate that participants perceived the three environmental conditions in three statistically different ways (please see Figure 10). Indeed, natural condition ($M 6.72$) differed significantly from the historical condition ($M 5.60$), the latter displaying a lower level of perceived restorativeness. Then, standard urban condition ($M 3.89$) differed significantly both from natural and historical – urban condition displaying the lowest level of perceived restorativeness among the three environments.

Table 11. Repeated Measures of ANOVAs for PERCEIVED RESTORATIVENESS

Effect	SS	df	MS	F	p	partial eta-squared
Intercept	1796.81	1.00	1796.81	425.50	0.00	0.97
Age	0.32	1.00	0.32	0.08	0.78	0.00
Error	80.23	19.00	4.22			
Environment	83.48	2.00	41.74	20.35	0.00	0.51
Env*Age	0.07	2.00	0.03	0.02	0.98	0.00
Error	77.94	38.00	2.05			

Note: Age = Adolescents vs. children; Environment = natural vs. historical-urban vs. standard-urban;

Table 12. Post Hoc LSD test for Perceived Restorativeness

Cell. No.	Environment	{1}	{2}	{3}
1	Natural		0.02	0.00
2	Historical-urban	0.02		0.00
3	Standard-urban	0.00	0.00	

These outcomes are completely in accordance to hypothesis no. 4 and, because ANOVA analyses did not reveal any age effects ($p = .78$), both children and adolescents perceived the three environments' differences in the same way.

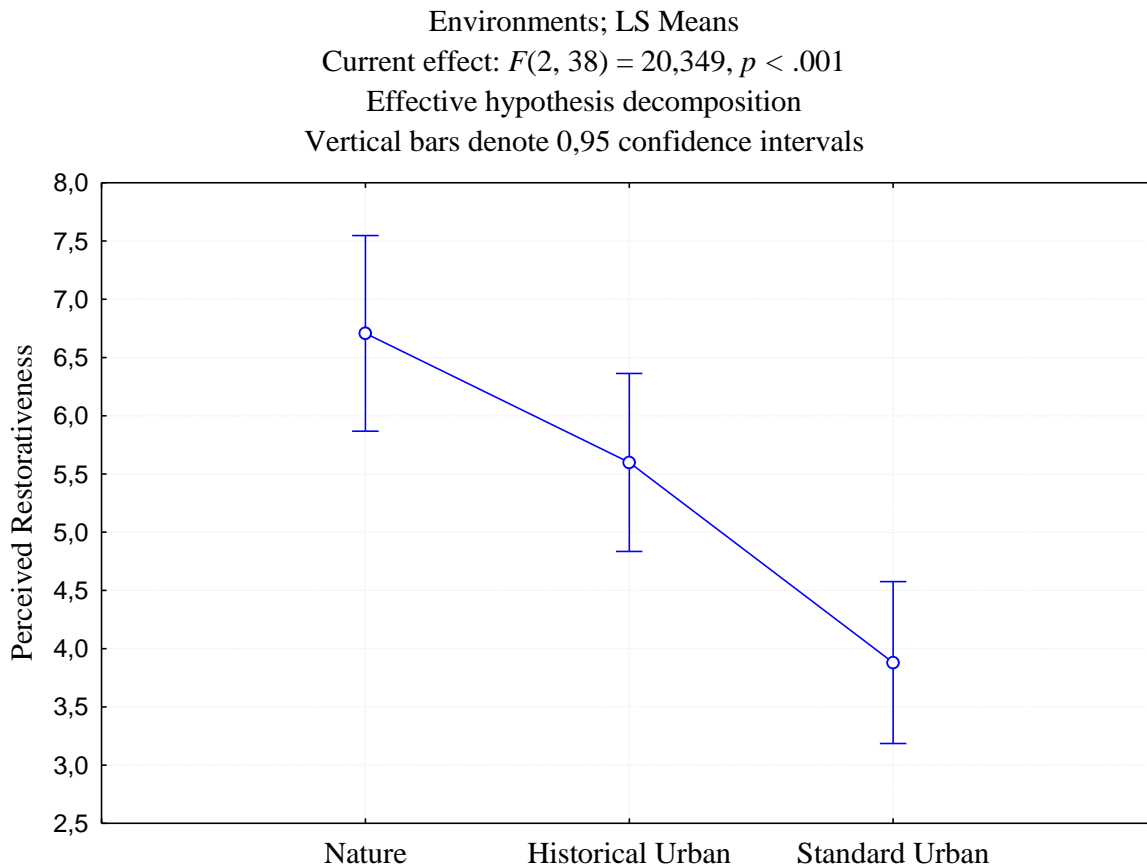


Figure 10. Main effect of the environment on perceived restorativeness

Effects of the environment on children and adolescents' thoughts during treatment –

Hypothesis 5

Regarding the natural environment, qualitative analyses on valence revealed that 19 participants found the treatment pleasant whereas 2 participants found it unpleasant. Qualitative lexicographic analyses with categorical amplitude attribution revealed that 11 participants could focus their thoughts on the Here and Now, 6 reported ambiguous thoughts and 4 reported unrelated thoughts to the Here and Now.

Next, regarding the historical-urban environment, qualitative analyses on valence revealed that 17 participants found the treatment pleasant whereas 2 participants found it unpleasant and 2 participants were neutral. Qualitative lexicographic analyses with categorical amplitude attribution

revealed that 8 participants could focus their thoughts on the Here and Now, 4 reported ambiguous thoughts and 9 reported unrelated thoughts to the Here and Now.

Finally, regarding the standard-urban environment, qualitative analyses on valence revealed that 12 participants found the treatment pleasant whereas 5 participants found it unpleasant and 4 participants were neutral. Qualitative lexicographic analyses with categorical amplitude attribution revealed that 6 participants could focus their thoughts on the Here and Now, 6 reported ambiguous thoughts and 9 reported unrelated thoughts to the Here and Now.

Listed below are some of the phrases used by participants as examples of their reported thoughts attributed to the Here and Now category and that relate to ART factors: “*Mother Nature*” (being away factor), “*I was willing to observe the natural elements from nearer*” (extent factor), “*picking up a flower*”, “*laying down on the grass*”, “*playing on the grass*”, “*creating a whistle with a plant*”, “*looking for boars*”, “*moving freely*” (compatibility factor), “*Nature, green, Sun, they all relax me*” (soft fascination). These findings are in accordance with Hypothesis no. 5.

2.5 Discussion

The present study aims at evaluating the possible restorative effect of a twenty minutes individually guided walk at slow pace in three different outdoor environments (natural, historical-urban and standard-urban) on ADHD children symptomatology.

Therefore, we began by assessing positive-negative emotions of children and adolescents who took part in the study, both at pre-test and post-test. Based on the underlying hypothesis, children and adolescents’ positive-negative emotions score would decrease more after a natural setting recovery experience than after an urban one (either historical or standard); moreover, the same level would decrease after the same experience in historical vs. standard urban setting. In other words, hypotheses on emotions refers to a positive effect of the natural environment primarily, in which participants would experience more (positive) emotions than the urban environments (yet in the historical

environment emotions would be more positive than in the standard one). Findings did not reveal any significant data therefore hypothesis no. 1 cannot be confirmed.

However, it is interesting to note what additional analyses revealed. For instance, a correlation between perceived restorativeness of the natural environment, and positive-negative emotions score at post-test in the natural environment, showed a negative correlation $r = - 0.47$. This means that as emotions increase (based on the Smiley test used in the present study, as the negative emotions increase), perceived restorativeness decreases. This negative correlation appeared only in the natural environment and it is the condition in which the level of perceived restorativeness is the highest compared to the two other settings (perceived restorativeness will be mentioned further on in this section).

Consequently, this marginal finding suggests that the contrary could be true as well. In other words, the more restorative the (natural) environment is perceived, the less negative emotions will turn to. This finding is in consonance with Van den Berg and Van den Berg (2010) which revealed that, overall, children affected by ADHD perceived the natural environment (the woods) more restorative than the urban one and, regarding emotions, participants reported more positive feelings in the natural environment than in the urban one.

Similarly, the study conducted by Maas et al., (2009) revealed that greenness around homes was associated with lower rates of depression among typical children under twelve and Wells and Evans (2003) showed that greenness in and around children's homes was related to less psychological distress and a greater sense of self-worth. In addition, Korpela's review (2002) reveals that children in general associate natural favourite places to feelings of relaxation, calm and comfort. Overall, such examples in literature suggest that (positive) emotions and contact with Nature among children are related.

Regarding attention, it was first hypothesized that participants would improve their performance level mostly after the Nature condition than the two other conditions (historical-urban and standard-urban). General findings revealed significant differences from T1 to T2 and among environmental conditions, an important interaction effect of Environment*Time which partial eta-squared is equal to 0.80 (please see Table 1). Afterwards, the interaction Environment*Time*Age (and related *post-hoc* comparisons) show that both children and adolescents experienced, in the natural environment, an effective mental fatigue from T1 to T2 and a restoration of cognitive functioning at T3; whereas in the two other conditions there was an effective mental fatigue at T2 but no restoration at T3 neither for children nor for adolescents (with the only exception for children in the standard-urban environment that, based on measurements results, do not report effective mental fatigue nor restoration).

These outcomes demonstrate that only in the natural condition participants, both children and adolescents, could slow down and take longer time to observe the visual stimuli and execute the test unlike from the other two conditions (historical-urban and standard-urban). Because only response time latency is improved by the treatment in the natural environment, yet it is not the case of accuracy and attention construct considers a combination of both factors, the present results suggest that natural environment can partially help ADHD children and adolescents into renewing attention. This is an surprising point since being hasty is associated with ADHD and conversely, controls spend more time analysing the visual stimuli therefore their response time latency is major (Vallesi et al., 2013). The combination of both factors into defining the attention construct could be an additional interpretation of the interaction effect of Environment*Time which partial eta-squared is equal to 0.80, as above mentioned. Actually, the MANOVA considered both dependent variables, accuracy and speediness (response time latency) showing and confirming that both variables have to be considered together theoretically and statistically. As a consequence, on the MANOVA, accuracy and

speediness taken together meant attention recovery after being in contact with Nature (Environment*Time interaction $p = < .001$).

Such result on attention suggests that not only the treatment itself - a restorative walk - helps into reducing inattentiveness but also the type of environment in which it takes place. According to ART (Kaplan & Kaplan, 1989) and recent literature on infancy and adolescence (Barbiero & Berto, 2016; Chawla, 2015), Nature helps into renewing one's cognitive functioning but a few recent studies (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010) and the present study are suggesting that these benefits could be extended also to children and adolescents affected by ADHD. Therefore, their symptoms could be alleviated, substantially at zero costs (Faber Taylor & Kuo, 2008).

Next, regarding impulsivity, it was first hypothesized that participants would improve their impulsive behaviour mostly after treatment in the Nature condition than in the two other conditions (historical-urban and standard-urban). Outcomes revealed an improvement after treatment in terms of accuracy (yet without environmental effect) since both children and adolescents committed less errors. In addition, the two age groups' errors score statistically differed. However, when comparing the two age groups' means, it is evident that children committed less errors compared to adolescents. However, as shown in the graph no. 1, the same trend from pre-test to post-test was observed between both age groups in terms of errors. In other words, they maintained the same errors means differences throughout the two times and three conditions hence children resulted more accurate than their older mates.

Normative data of the MF test, the one used to measure impulsivity, shows an opposite trend compared to the present study, in which children aged 8-11 committed more errors than to adolescents aged 13-year olds (Marzocchi et al., 2010). A possible interpretation of this unexpected outcome relates to the complexity of ADHD symptoms assessment. Because ADHD children can display a controlled behaviour in an atypical setting like the one of the assessment, it could be that during some

time of the collecting data. the automatic behaviours that usually occur in the daily life, were not displayed. In fact, ADHD is also defined as attention inconsistency and/or short-term fluctuations of performance rather than only attention disease. Indeed, five to six-year-old ADHD children and children at risk of ADHD early show great fluctuations in speed information processing, showing difficulty in maintaining a stable level of performance (Kalff et al., 2005). Extreme variability in response time was also found by Paule et al. (2000) among children affected by Attention deficit/hyperactivity disorder (Campbell & Hewing, 1990; DuPaul & Barkley, 1992; Faber Taylor & Kuo, 2008; Hallowell & Ratey, 1994).

As confirmed by Sergeant et al., (1999), performance obtained in the attention test could depend on the context the task is administered, (minimal) environmental variations, the presence of the experimenter, the pleasantness of the material, the way the stimuli are presented and, eventually, the presence of reinforcers during the test administration. One of these factors could have influenced the adolescents' performance. Moreover, impulsivity can be particularly evident when ADHD occurs in combination with specific learning difficulties or with oppositional or provocative behaviors. In fact, some adolescents had previously been diagnosed with oppositional-defiant disorder. Based on DuPaul, Guevremont and Barkley (1991), children with ADHD tend to be more contentious, dominant, aggressive and unstable, which can lead to rejection and social isolation. Their impulsiveness can affect their ability to process socially relevant clues, it can also affect their ability to accurately process information and can emphasize the tendency to see ambiguous or neutral social interactions in a negative or hostile way (Chiarenza et al., 2004). Consequently, it is arguable that their performance during the test can result in a worsening.

Regarding speediness (impulsivity), a statistical difference between pre-test and post-test occurred but, by observing the means, it is evident that the direction of such difference goes into a lowering of response time latency, in other words both age groups took less time to execute the task. For ADHD, this result shows a worsening of attention (for latency). The interpretation of the data

could suggest that participants could not elaborate the visual stimuli and hastily passed from one stimulus to another, but because their accuracy improved, an additional and more adequate interpretation would be that participants needed less time to accurately perform the task. As test authors mention (Marzocchi et al., 2010), a low latency does not indicate a problem if it is not accompanied by a corresponding high number of errors. It would be paradoxical to penalize a child for the fact that he is quick and efficient at the same time in performing a task. Therefore, hypotheses 3 (a and b taken together), cannot be confirmed regarding the environment: impulsivity symptoms in fact improved after any kind of treatment, i.e., without being affected by the specific environmental conditions (particularly by Nature vs. the urban environments).

Overall, impulsivity was partially improved (by only considering accuracy) after treatment among the three environmental conditions but without any environment-based effects. Again, hypothesis 3 (a, b) are not confirmed for the same reason above. The interpretation of this outcome could address whether the treatment itself is effective for impulsivity. In other words, walking at least 20 minutes at a slow pace, with another person but by keeping the conversation level at minimum and focusing on the surroundings, could help into alleviating impulsive symptoms, being even more effective on children than on adolescents although effective on adolescents as well (because in general children were less impulsive than adolescents). Overall, considering that ADHD symptoms involve an inability to increase accuracy and decrease speediness, in the present study ADHD participants could have a general improvement of their symptomatology, that for attention was in terms of lower speediness and for impulsivity was in terms of greater accuracy.

Another important finding in this study refers to the perceived restorativeness. Outcomes show a main effect of the environment in which the natural environment is perceived as the most restorative, followed by the historical one and then by the standard-urban. The present study revealed that both children and adolescents followed the same trend in the perceived restorativeness process and that, in accordance with hypothesis no. 4, both ADHD children and adolescents perceived the

natural environment as the most restorative, the standard urban as the less restorative and the historical urban in the middle of the other two settings. As above mentioned, the more restorative the (natural) environment is perceived, the less negative emotions will turn to, showing a link between emotions and restorative potential of the natural environment selected for the study, that is a large open field.

Moreover, because ART states that being exposed to highly restorative environments (such as the natural ones) reduces cognitive noise or mental fatigue and promotes full recovery (Herzog et al., 1997), we hypothesised (hypothesis no. 5) that walking in the natural environment would help participants to focus on the Here and Now, more than walking in the historical setting and in the standard urban setting (the last one having the lowest influence).

For instance, by considering each of the four restorative factors of ART (Kaplan, 1995; Kaplan & Kaplan, 1989), findings show that children and adolescents tended to engage with the Here and Now, or were mentally present. In particular, thanks to *soft fascination*, the natural stimuli spontaneously captured their attention with no effort, eliminating useless thoughts that crowded their mind (first level of restoration), the cognitive noise or the *mental fatigue* (Herzog et al., 1997; Kaplan, 2001). As consequence, orienting their (reported) thoughts to the Here and Now was possible. Participants experienced certain amount of restoration, both first and second levels of restoration (elimination of cognitive noise followed by directed attention recovery through the soft fascination; Barbiero & Berto, 2016; Kaplan & Kaplan, 2001). These outcomes indirectly relate to the concept of mindfulness, which is the capacity of being present to oneself, in the Here and Now (Kabat-Zinn, 2006). It works on the same neural correlates related to attention (Lazar, 2005). People vary in terms of mindful personality traits but to enhance the benefits of being mindful, mindfulness can be learned and requires practice. Previous research among healthy children showed how effective it is (Berto et al., 2015), also amongst ADHD adolescents (Zylowska et al., 2007).

Mindfulness requires an active process that also leads to restoration. Indeed, restorative environments and mindfulness both aim to break automatic thoughts (or the cognitive noise unrelated to the Here and Now that generate mental fatigue and prevent restoration), respectively in a passive and in an active process (Barbiero & Berto, 2016). In summary, the present study suggests that the natural environment promotes recovery also amongst children and adolescents affected by ADHD and leads to a fuller experience of the Here and Now, or a mindful experience that characterises a more positive and aware mind, that is a healthier brain (Siegel, 2009).

Nevertheless, there are some limitations that should be considered when interpreting the results. First, the number of participants is small. This is due to the fact that recruiting ADHD participants was challenging. For instance, their schedule is full since they have many commitments with therapy and. recruitimh them in diagnostic centres invoves obtaining their consent as well) and, additionally, collecting data presents challenges due to the clinical aspects of the disease and its comorbidities. Also, the historical urban environment represents an Italian middle age site therefore this outcome is not applicable to other historical contexts.

A second limitation is that the procedure adopted was quite long and tiring for participants that clinically tend to get tired faster than healthy children. Thus, further investigation should take into consideration a more practical procedure to collect data. For instance, researchers could consider the possibility to avoid a fatigue provoking task in the schedule of the procedure since the sustained attention tests as well as the impulsivity tests require a prolonged use of attention indeed mental fatigue (Kaplan, 1995) has already occurred as a direct consequence. We hope that future research might count on bigger samples, a shorter procedure to collect data on ADHD and that more relative historical environment could be taken into consideration in order to evaluate the impact of different architectural styles.

Despite these limitations, the results exposed may be considered innovative, for several main reasons. First, the setting order was randomised. Second, attention measurement was taken also at

baseline rather than only at post-test (as in most previous studies, such as, Faber Taylor & Kuo, 2008). Third, a comparison of children and adolescents affected by ADHD gives more insight on how treatment and environments affect symptomatology, how to plan specific interventions and the need to consider age range. Fourth, the tests for measuring attention and impulsivity were specifically adjusted to ADHD by previous authors and were used internationally (Marzocchi et al., 2010), and fifth, each child was tested individually from the beginning to the end of the trial.

Regarding future research, the present study suggests the need to be replicated in form of a longitudinal study in order to investigate how a regular contact with Nature improves ADHD symptoms and the quality of life of children and adolescents who struggle for attention. Another interesting aspect that could be addressed is how learning and socialization can be influenced, which are key features of ADHD daily demands.

To sum up, findings of the present study demonstrate that children and adolescents with ADHD can benefit from Nature contact, even with a minimum exposure of twenty minutes. Considering the busy life that nowadays families experience on daily basis in western countries and, at the same time knowing that only twenty minutes are potentially effective for recovery, offers a great opportunity for parents and teachers to help their children improve their quality of life, with minimum effort. Therefore, parents and teachers are encouraged to create opportunities for Nature contact on a regular basis.

STUDY 2

PROSPECT AND REFUGE OF TWO DIFFERENT NATURAL AREAS OF THE BOTANICAL
GARDEN ON ADHD SYMPTOMS, PERCEIVED RESTORATIVENESS, REPORTED
RESTORATION AND “HERE AND NOW” REPORTED THOUGHTS

3.1 Introduction

It is well-known that being exposed to natural environments leads to several mental and physical health benefits, both amongst children and adults (Berto, 2014; Chawla, 2015). For instance, literature shows improvements in cognitive functioning (Berto et al., 2015) and pro-environmental behaviour (Collado et al., 2015), among other benefits. Non-threatening natural environments have commonly been compared to (stressful) built environments (Hartig, Evans, Jamner, Davis, & Gärling, 2003), showing that benefits are greater for the former than for the latter. However, literature aimed to investigate the possible positive effects of different natural environments on psychological resources is still scarce. The aim of the present study is to compare the possible positive effects that being exposed to two different natural environments might have.

Despite the limited studies conducted on the effects that exposure to environments with different characteristics have on people, we do concur with some studies indicating that exposure to natural environments with different physical characteristics has different effects on people. For instance, Berto and Barbiero (2017) created the Biophilic Quality Index, a tool based on humans' evolutionary adaption rules aimed to objectively rate to what extent an environment is biophilic. The biophilic quality of an environment "can be roughly summarized in the environment's naturalness, functional, and aesthetic value" (Berto et al., 2018, p. 1). Similarly, another tool used to differentiate natural environments is the Recreational Opportunity Spectrum (ROS; Clark & Stankey, 1979), which is aimed to differentiate natural environments on the variety arrange of recreational opportunities they offer (Maes et al., 2012; Paracchini et al., 2014). Considering a well-known theoretical point of view, Attention Restoration Theory (Kaplan & Kaplan, 1989) claims that natural environments offer different degrees of restoration due to the fact that each restorative factor is present in different quantities. For instance, regarding the restorative factor named compatibility, not all natural environments are compatible to the visitors needs in the same way since people needs

change with age, personal characteristics etc., therefore it is arguable that they do not all restore in the same way.

The prospect-refuge theory (Appleton, 1975) is another framework used to evaluate the level of safety that different natural environments offer and investigates how rural and natural landscapes are places for comfort and security. Based on this theory, the perception of safety is necessary for feelings of enjoyment and comfort while being in a physical place. The concept of prospect refers to a clear field of vision in which individuals can see what is around them, without being seen, and therefore being able to identify potential dangers. Conversely, the concept of refuge refers to the number of (potential) hiding places (Gatersleben & Andrews, 2013) that certain types of vegetation configuration might offer. It is found that these two characteristics of the physical environment might influence people's perceived security (Luymes & Tamminga, 1995).

Accessibility to the environment is also a concept addressed by literature. Staats, Gatersleben, and Hartig, (1997) showed that lowest reported levels of pleasure are related to low levels of accessibility, defined as the ease with which it is possible to move through the place.

To the best of our knowledge, there is only one study examining if different physical characteristics among natural environments influence people's psychological restoration. By considering the prospect-refuge theory (Appleton, 1975), Gatersleben and Andrews (2013) conducted two studies in England with the purpose to ascertain whether two types of natural environments – one characterised by high prospect and low refuge, and another one characterised by low prospect and high refuge – influence the levels of reported and actual restoration. Findings showed that natural places offering a clear vision and few hiding places are restorative yet, conversely, places characterised by low prospect and high refuge might be stressful and attention depleting.

All the above-mentioned studies were conducted on adults. At present, similar studies do not seem to exist in order to assess the spatial attributes of green outdoor places leading to restoration

among children. To fill this gap in the literature, this study is aimed to compare the psychological and behavioural effects that two different natural environments might produce on ADHD children, though addressing an innovative point in the Environmental Psychology literature.

The present study

By following the same procedure of Study 1 within the present research programme, the present study is aimed to investigate whether spending time in natural environments characterised by different levels of prospect and refuge (Appleton, 1975) have a different effect on ADHD children's restoration. For details on ADHD clinical aspects and links with ART, please see the Introduction of Study 1.

The present experimental study is aimed to compare the (restorative) effect of two natural environments located in the Botanical garden of Rome (Italy), part of the Sapienza University of Rome, representative, in a first case, of low prospect and high refuge and, in a second case, of high prospect and low refuge.

Based on Stress Recovery Theory (Ulrich, 1983), the natural environment is a source of relieve that allows stress and negative emotions reduction, leading to restoration. In addition, ART (Kaplan & Kaplan, 1989) argues that Nature contact leads to improved cognitive functioning. Moreover, Botanical gardens are examples of urban Nature that may lead to restoration (Carrus et al., 2017) and pleasant moods (Nisbet & Zelenski, 2011). Hence, the present study evaluates influences of Nature contact (in two different settings differentiated in terms of prospect and refuge) on emotions and cognition. In addition, the objective of this study is to gain more insight into the perceived restorativeness, reported restoration and Here and Now (reference) reported thoughts of children and adolescents effected by ADHD. As in Study 1, the treatment consists in a twenty minutes individually guided walk, in which an experimenter worked with one participant per time.

Considering previous research in the Environmental Psychology framework conducted with ADHD children and with healthy children and adults (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010), the present study design includes several innovative points (in addition to those listed in Study 1, such as one child tested per time by one experimenter etc.), as detailed below:

1. A comparison of the restorative effect of two natural areas differentiated in terms of prospect and refuge (high prospect and low refuge vs. low prospect and high refuge);
2. Focus on the Here and Now outcome or the also defined concept of mental presence (Kabat-Zinn, 2006) in two natural areas;
3. Natural conditions are located in a Botanical garden rather than a common public green area like an urban park or a wood as in previous studies (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010);
4. Reported restoration outcome, a measure aimed to evaluate how a person reports to effectively feel restored, as a possible direct consequence of having perceived an environment as restorative that, to the best of our knowledge, has not as yet been used amongst ADHD children;

Hypotheses

The conceptual framework is based on prospect-refuge theory (Appleton, 1975) and the assumption that feeling secure and safe is related to restoration derived from restorative environments (Gatersleben & Andrews, 2013). However, contact with Nature could not always be restorative due, for instance, to characteristics of the vegetation that permit, or not, a clear field of vision. The physical characteristics would have a positive or negative impact on feelings of safety (Gatersleben & Andrews, 2013).

The general hypothesis of this study is to verify whether participants would respond more positively in the high prospect vs. low refuge condition than in the low prospect vs. high refuge

condition. It is based on Gatersleben and Andrews (2013) study and on prospect-refuge theory (Appleton, 1975).

In summary, in the high prospect vs. low refuge condition, participants would display a high level of performance (and high perceived restorativeness and reported restoration) whereas in the low prospect vs. high refuge condition they would display a low level of performance (and low perceived restorativeness and reported restoration). Below are reported six hypotheses that this experimental study aims to test. Each main conceptual hypothesis is numbered (1 to 6) and in some cases specific hypotheses belonging to the same conceptual hypothesis has been detailed (i.e., for both hypothesis 2 and hypothesis 3).

Hypothesis no. 1: Children's positive-negative emotions score decreases more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge;

Hypothesis no. 2a: Children's attention performance level in terms of accuracy improves more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge. Since the accuracy is measured in terms of the number of omissions (omissions score), the attention performance level is higher with lower scores.

Hypothesis no. 2b: Children's attention performance level in terms of latency (response time latency) improves more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge. Since the latency is measured in terms of response time latency (latency score), the attention performance level is higher with higher scores.

Hypothesis no. 3a: Children's impulsivity level in terms of accuracy (errors score) decreases more after a recovery experience in a natural setting with high levels of prospect and low levels of

refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge. Since the accuracy is measured in terms of the number of errors score (errors score score), the impulsivity level decreases with lower scores.

Hypothesis no. 3b: Children's impulsivity level in terms of latency (response time latency) increases more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge. Since the latency is measured in terms of response time latency (latency score), the impulsivity performance level is lower with higher scores (more latency);

Hypothesis no. 4: Children's environmental perception (perceived restorativeness) increases more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than in a natural environment with low levels of prospect and high levels of refuge;

Hypothesis no. 5: Children's reported restoration increases more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge;

Hypothesis no. 6: Children's thoughts experienced during treatment are oriented to the Here and Now more after a recovery experience in a natural setting with high levels of prospect and low levels of refuge than after a recovery experience in a natural environment with low levels of prospect and high levels of refuge;

3.2 Method

Participants

Thirteen drug-naïve children and adolescents with attention deficit hyperactivity disorder (ADHD), aged 8 to 14 ($M = 11.46$, $SD = 1.94$) participated in this study (12 males; 1 female). Five of the thirteen participants were recruited from the previous group of subjects that participated in

Study 1. Three participants (one of them is included in the five participants mentioned above) could not attend the 2nd meeting for data collection (in the Mediterranean condition 11 children participated whereas in the Palms condition 12 Children participated. For details about the procedure and the number of meetings organized to collect data please see the paragraph on the procedure).

ADHD children were consecutive referrals at the TSMREE/Mental health safeguard and rehabilitation service for developing age of Mentana, a small town near Rome (Italy), part of the local health unit named ASL Roma G/5. The ADHD diagnosis respected the DSM-IV-TR criteria (APA, 2000). Inclusion criteria were diagnosis of ADHD combined-type or non-combined as well, and the most common comorbidities of ADHD (Please see Batteria Italiana per l'ADHD authored by Marzocchi et al., 2010), such as learning disabilities, speech disease and opposition-defiant disorder. Exclusion criteria were mental retardation, brain trauma, physical impairment and neurological diseases. Participants lived in the North-East quadrant of Rome province, in a range of about 84 square kilometres. All participants attended public schools within the area.

Study sites

Regarding the spatial organisation of the testing, the two environmental areas (Mediterranean area vs. Palms area) selected for the walk were at two minutes walking distance from each other. In the middle of the two areas, a testing room was located, made available by the Botanical garden director. In addition, the testing room was located right at the entrance of the Botanical garden therefore participants were not immersed in the greenness before the treatment. The Botanical garden director gave written consent for conducting the data collection. Additionally, during testing, parents were given the opportunity to visit the entire Botanical garden at a reduced fee. Please see Figure 11 to view the two locations on the Botanical garden map.

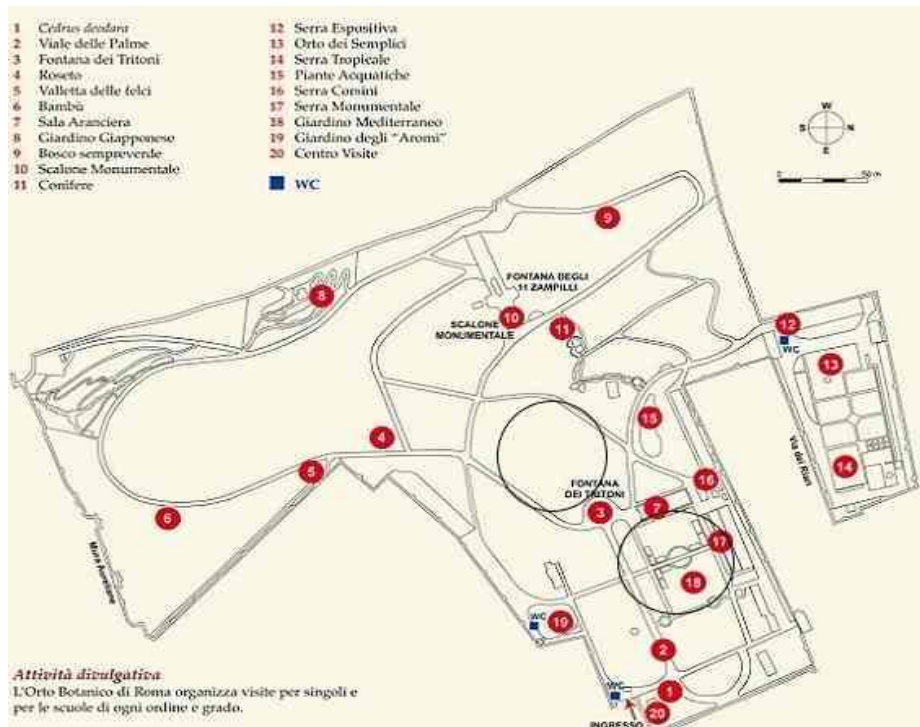


Figure 11. Botanical garden map. The upper circle represents the Palms area whereas the lower circle represents the Mediterranean area. Ingresso = Entrance/testing room.

The Mediterranean area (identified in the Botanical garden as Mediterranean garden; Figure 12) is equipped by flower beds, where it is possible to observe typical species of the Mediterranean maquis (*Quercus ilex* L., *Arbutus unedo* L., *Phillyrea latifolia* L., *Pistacia lentiscus* L., *Myrtus communis* L.), Australian species (*Hakea laurina* R.Br and *Callistemon citrinus* (Curtis) Skeels) and species native of South Africa (*Polygala myrtifolia* L.). Among the endemic species there are *Antirrhinum tortuosum* Bosc, *Euphorbia myrsinites* L., *Matthiola sinuata* (L.) R.Br., *Erodium corsicum* Liman, *Helichrysum litoreum* Guss., *Centaurea cineraria* L. var. *circa* Sommier and *Limonium* about Pign. In addition, species of the genera *Cistus*, *Salvia*, *Teucrium* and *Lavandula* are represented. Overall, the conformity of vegetation, in other words the presence of shrubberies, reduces the visibility of the area and the field of vision cannot extend deep into the scene, by offering quite a few number of potential hiding places and opportunities to hide. Therefore, the Mediterranean area was selected for representing a low prospect and high refuge setting.

The Palms area (identified in the Botanical garden as Palms; Figure 13), is one of the most important collections due to the large number of entities that are grown outdoors. Among the most representative genres: Phoenix, Trachycarpus and Sabal. Among the rare species: Trachycarpus takil Becc., Brahea edulis H.Wendl. ex S. Wats., Nannorrhops ritchieana (Griff.) Aitch. Species of Chamaerops humilis L., Washingtonia robusta H. Wendl., Phoenix canariensis Hort. ex Chabaud, Phoenix dactylifera L are also found. Among the species at risk included in the red lists of the International Union for Conservation of Nature (IUCN) are: Jubaea chilensis Baill (VU, vulnerable), Phoenix theophrasti Greuter (NT, almost at risk), Washingtonia filifera (Linden ex Andr), H. Wendl. (NT, almost at risk). In its front area the palms area hosts a historical fountain. Overall, the conformity of the plants, defined as jamb palms due to the straight and cylindrical stem, makes the view clear enough, the field of vision can widely extend into the scene (up to some tens of meters) indeed it is unlikely to find potential hiding places and opportunities to hide. Consequently, the Palms area was selected to represent a high prospect and low refuge setting. Both areas are flat land therefore the same physical effort is required. Moreover, they seem to have the same level of visible sky fraction (Martensson et al., 2009).



Figure 12. Mediterranean area.

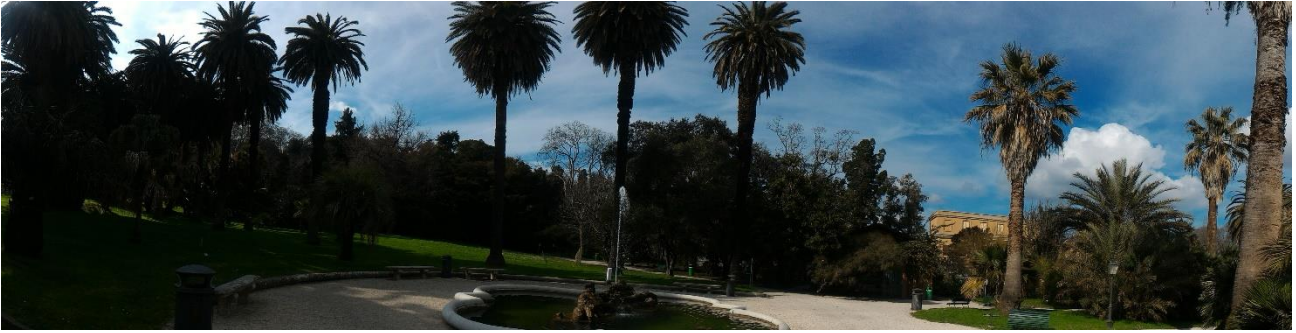


Figure 13. Palms area.

In order to assess whether two natural environments might be classified as high prospect and low refuge, a manipulation check was conducted in two areas of the Rome Botanical Garden: the Mediterranean area and the Palms area. Eleven typical children aged twelve (5 males, 6 females) rated ten sites for each environmental condition. They were asked to express their agreement (low, medium, high) in response to three independent questions measuring prospect (“The extent to which your view is clear and unobstructed to allow your field of vision to extend deep into the scene”), accessibility (“The ease in which you can move through the site”) and the number of hiding places (“The number of potential hiding places and opportunity for concealment”). Mean ratings of prospect, accessibility and number of hiding places are reported in Table 13.

Afterwards, a Wilcoxon matched-pairs test (Table 14) did not reveal a statistically significant difference neither between ratings of Palms condition prospect and ratings of Mediterranean condition prospect ($p = 0.23$), nor between ratings of Palms condition refuge and ratings of Mediterranean condition refuge ($p = 0.31$). The same occurred for accessibility, no statistically significant difference was revealed by the Wilcoxon matched-pairs test between ratings of Palms condition and ratings of Mediterranean condition ($p = 0.28$).

Finally, the manipulation check of prospect-refuge was not successful and did not confirm hypothesis that Palms area would be considered with highest scores of prospect and accessibility and lowest scores of refuge and the hypothesis that Mediterranean area would be considered with lowest

scores of prospect and accessibility and highest scores of refuge. Even if the outcomes of the manipulation check executed with healthy children was not in accordance to the hypotheses, the present study constitutes an attempt to verify whether the two selected natural environments could instead be differentiated by unhealthy (ADHD) children on the same variables (prospect, refuge, accessibility). In addition, the manipulation check sample presents limitations regarding the males vs. females ratio, which is respectively five vs. six.

Table 13. Descriptive Statistics of Manipulation check

	Mediterranean		Palms	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Visibility	18.91	8.61	19.91	2.51
Accessibility	18.82	5.59	20.55	3.01
Refuge	22.73	5.00	21.64	4.02

Table 14. Wilcoxon Matched Pairs Test - pre-test

	Valid	T	Z	<i>p</i> - level
palms prospect & palms refuge	11	6.00	1.95	0.05
palms prospect & mediterranean refuge	11	8.00	2.22	0.03
mediterranean prospect & palms refuge	11	8.50	1.66	0.10
mediterranean prospect & mediterranean refuge	11	10.00	1.78	0.07
palms accessibility & mediterranean accessib	11	17.00	1.07	0.28
palms accessibility & palms refuge	11	13.00	1.13	0.26
palms accessibility & mediterranean refuge	11	8.00	1.72	0.09
mediterranean accessib & palms refuge	11	13.00	1.78	0.08
mediterranean accessib & mediterranean refuge	11	8.00	1.99	0.05

Note: accessib=accessibility

In addition to the manipulation check, the treatment was subjected to a control of its effectiveness by implementing a scale, an adapted version of the SDAI (Marzocchi et al., 2010) aimed to rate behaviours of inattentiveness and hyperactivity during the treatment at a level that could interfere with the effectiveness of the treatment (which was supposed to be a slow paced walk with the purpose of getting engaged with the surroundings). In other words, its function was assessing the conduct of the participants during the treatment and in case of a problematic behaviour – over the

threshold established by the test - the assumption is that the treatment could not be effective. For more details please see paragraph 2.3.6.

Procedure

The study procedure respects the ethical norms of the Ethical Committee within the Department of Psychology of Developmental and Socialization Processes at Sapienza University of Rome which gave specific approval. In April 2018, parents were contacted by phone and invited to let their children participate in the study. Both parents of each participant signed a written informed consent form that also included a specific section for sensitive data treatment. Data was collected between May and October 2018.

The study had a within-subject design. Average execution time for the whole procedure in each setting was about 75 to 90 minutes. Each testing day took into consideration only one setting and included 2 to 3 children. Each child was tested twice at a minimum time distance of one week. Data collection took place on Saturdays in order to ascertain that the children had a comparable tiredness level due to school break. In addition, considering that the testing site (the Botanical garden, part of Sapienza University of Rome) was located at about 1 hour drive by car, 45 kms, from their residential area, during the weekends parents were more available and reaching the city was easier because of better road traffic conditions. Two experimenters, trained on the procedure and blind to the hypothesis of the research, were involved in the data collection and, because the procedure was completely individual, they worked with one participant per time during the whole ninety minutes procedure, administering all the measures of the entire trial.

Participants were driven to the selected setting for the day by their parents and once they arrived, they were asked for their oral consent. Both parents signed their informed consent form. Right after, testing started by conducting a first mood, attention and impulsivity measurement in order to have a baseline or Time 0 (T0; please see Figure 14). Thereafter, a fifteen minutes task was

administered. The purpose of this task was to provoke mental fatigue (Please see Faber Taylor & Kuo, 2008; Kaplan, 1995). The task consisted in assembling a puzzle for 10 minutes and solving a mathematical problem for an additional 5 minutes. The mathematical problem (which numerical data was changed for each setting) was extracted from INVALSI, a written test battery aimed to assess learning levels amongst students and to form general data on the efficiency of the Italian training system (for those having dyscalculia, a different 5' task was suggested. It consisted in finding words that start with a given letter. Please see paragraph 2.3.5). Right after, that is at Time 1 (T1), attention was re-measured. Finally, right from the testing area, an experimenter joined one participant per time in a 20 minutes slow-paced walk, that is a restorative walk in the environmental setting selected for the day. The duration of the walk was established to twenty minutes due to the effectiveness of the same treatment duration revealed by Faber Taylor and Kuo, (2008).

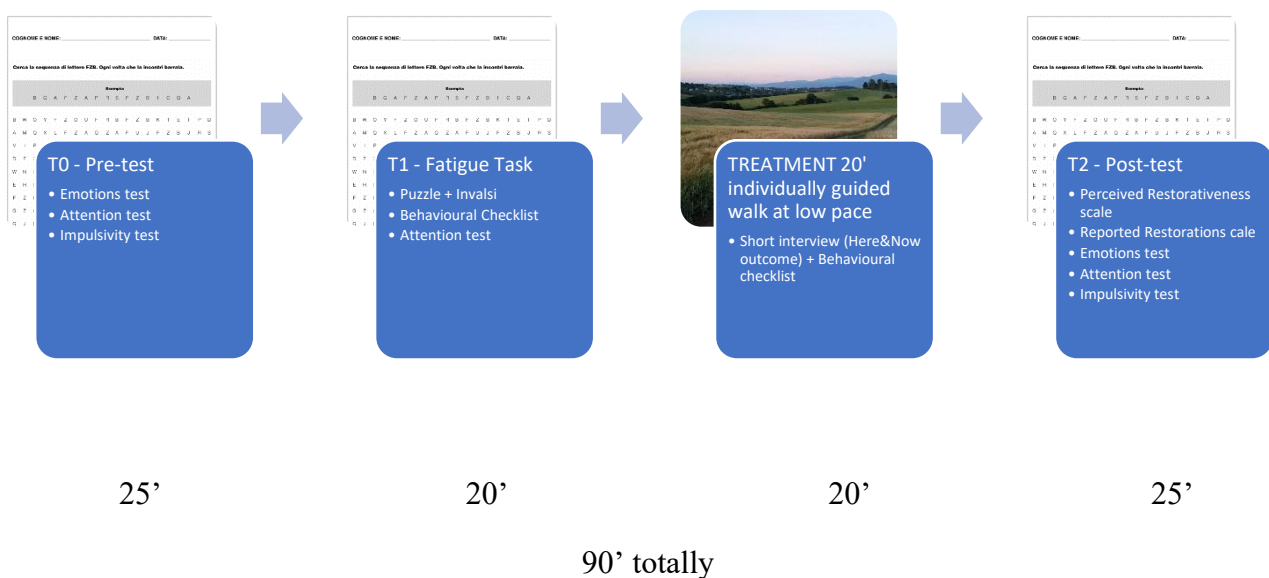


Figure 14: Procedure.

A reference from literature defines a restorative activity such as “activities that are thought to be especially helpful in resting and restoring the ability to concentrate involves experiencing nature in some way, for example, sitting or walking in the natural environment (backyard, garden, park),

observing a natural view (trees, clouds, a sunset)... sitting by water... observing wildlife, birds, and animals..." (Cimprich, 1993, p. 87). By aiming to conduct a restorative activity as defined above, physical exertion and conversation were kept at minimum level among the two conditions with the purpose to let participants softly connect to the surroundings. After returning from the walk, the perceived restorativeness and the reported restoration was measured and the three variables of pre-test were remeasured (mood, attention, impulsivity) at post-test (T2). Moreover, during the return walk, experimenters filled a behavioural checklist aimed to assess the behaviour of the participants during treatment. In this way a manipulation check of the treatment was obtained, in case the latter was not effective. Participants were randomly assigned to the environmental condition in order to avoid learning effects.

There will be an information meeting in the future in order to describe the main results to parents and children who participated into the study. A practical ADHD guide that includes a section concerning Environmental Psychology and a brief review of the main theories and empirical studies on attention restoration and restorativeness (Barbiero & Berto, 2016; Chawla, 2015; Kaplan, 1995; La Prova, 2011), possibly relevant for the considered disease, will be gifted to each family as a token of appreciation for participating.

Measures

Emotions measurement

In order to measure the current mood of participants, as in Study 1 within the present research programme, a graphic smiley-test, which was originally developed and used among healthy children (Van den Berg et al., 2007b) and afterwards applied to children affected by ADHD (Van den Berg & Van den Berg, 2010; see Appendix A) was implemented.

Six pairs of feelings were illustrated by two smiley faces, one for the positive and one for the negative. For instance, emotions were listed in the following presentation order and respectively from

left to right: happy vs. sad, not worried vs. worried, energetic vs. tired, not angry vs. angry, certain vs. uncertain, not scared vs. scared. Each of the two smiley faces were presented in the left and right side of the paper (negative side on left whereas positive side on right) and in the middle, seven circles indicating the intensity of the emotions that the participants were currently experiencing were presented. Therefore, children were asked to describe the intensity of each pair of emotions via a seven steps bi-polar response scale having the positive and negative emotions as extremes (positive emotion on the left, negative emotion on the right for each bipolar item).

Participants had to colour the circle that, could better represent their state. The instructions specify that the circles next to the smiley faces, the extreme ones, represent the highest intensity of the emotion whereas the circle in the middle is neutral, indicating that the child was not feeling either in one way or the other). Please see Figure 15 for a section of a picture of the test. (T1 $\alpha = .73$; T2 $\alpha = .76$).

Nome e Cognome: Data:

Luogo:

Come mi sento adesso?
 Qui di seguito trovi sei sensazioni diverse. Colora il cerchio ad ogni sentimento che meglio si adatta come ti senti ora. Ad esempio, se ti senti felice colora un cerchio vicino alla faccina felice, quanto più vicino è il cerchio, tanto più felice ti senti ora. Se ti senti triste, colora il cerchio vicino al viso triste. Se ti senti né tanto felice né tanto triste, colora il cerchio in mezzo.






	Emozione 1	
felice	○ ○ ○ ○ ○ ○ ○ ○	triste
	Emozione 2	
spensierato	○ ○ ○ ○ ○ ○ ○ ○	preoccupato
	Emozione 3	

Figure 15. A picture of a section of the Smiley test in the Italian version.

Attention measurement

As in Study 1 within the present research programme, The Continuous Performance Test or CP test (Mackworth & Taylor, 1963) was implemented (Figure 16). It measures processes related to response inhibition, visual sustained attention, vigilance and other aspects of cognitive functioning and attention. This test has been used in a wide-ranging variety of clinical contexts, such as dementia, depression and finally ADHD (Barkley, 1991, 1998; Corkhum & Siegel, 1993; Grunebaum et al., 1974; Nichols & Waschbusch, 2004). Marzocchi et al. (2010) validated the Italian version of the CP test and included it into the Italian Battery for ADHD (Batteria Italiana per l'ADHD; BIA). The test is not sensitive to learning effects.

Sub-test 1

B W O Y F Z O U F R B F Z B K T E I P D

A M Q X L F Z A Q Z A F U J F Z B J R S

V I P N T G F Z B W C H N R K F Z Q F R

Sub-test 2

A Q X F Z B I S D F Z F O T W L Q V F Z M B L V P I F Z B H

D O G K W R E F Z B N H S O J T X A F Y Q U F Z B N W F Z

L R F Z P I F Z B T J X D F O M K S F Z V X D Z P G O Q W G

Sub-test 3

V F Z O H N I K L F Z D S F E J S F Z B G A Y Q C B F W Q R F Z B T E J Z S P X D Z T A F Z B E W U D G L F Z B F P F Z

F Z B K G L R F Z K M B X I O W F Z B H Y J F Z B P C Y F A T S A F Z W V I F E H O X Q D F Z G L S C A G N H N G S O

F Z Y L F J D F Z B Z H B V F Z W F E I J S W E Q U F Z B X U F W R D V L F Z B R P B T R V A F Z M K T Y F Z B Q G M

Figure 16: Example of the three sub-tests making up the Continuous Performance Test (CP test). FZB is the sequence to be marked here.

The Continuous Performance Test (Italian version validated by Cornoldi et al., 1996), also named CP Test is a pencil and paper test aimed to evaluate visual sustained attention and inhibition among children (please see Appendix B). It is part of the Italian battery for ADHD (Marzocchi et al., 2010). It comprises three different subtests organized in a sequential order of difficulty (less to more). From subtest 1 (CP1) to subtest 2 and 3 (CP2 and CP3), letters are smaller, nearer to each other and the order to the letters in the string varies, therefore none of the subtests is identical to the others. Each one of the three subtest presents long strings of letters where the participants need to find three chosen contiguous letters (e.g., FZB) in a collection of sparse letters. Such test requires the child to identify the chosen target (letters FZB) in an alphabet soup.

Before administering the test, each subtest has an example that the participants were invited to consider. After that, the experimenter administered the three subtests and records the time the participants took to execute the task (latency), for each subtest. The scoring reveals the number of targets found by the child, the false positives, the omissions and the latency expressed in seconds. Based on the Italian validated version of the test, normative data are available only on omissions and latency, therefore these are the data considered in the present study. The CP test is not sensitive to learning effects.

Impulsivity measurement

As in Study 1 within the present research programme, The Matching Familiar Figure Test (MFFT; Kagan, 1966), Italian version validated by Cornoldi et al., (1996), was implemented. It aims to detect the degree of impulsivity of children and is one of the most discriminatory tests for ADHD and impulsivity in general (Cairns & Cammock, 1978; Douglas & Peters, 1979; Milich & Kramer, 1984). It requires a strategy of visual analysis since each item consists of two pages, where on the first page a target figure is represented, while on the other one 6 figures similar to the target are represented and only one of them is identical to the target. The task consists of choosing the figure

that is identical to the target model. The model and the 6 alternatives are presented to the participants at the same time (please see Figure 17 and Appendix C).

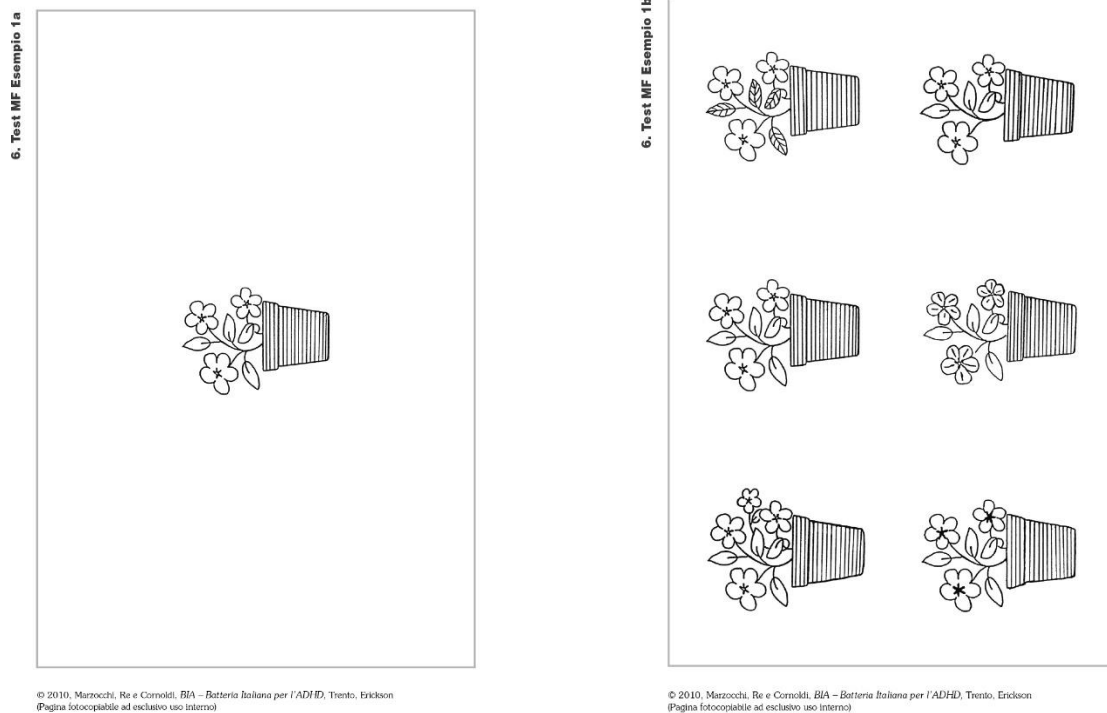


Figure 17: Items no. 1a and 1b (examples) of the MF test.

The variables taken into consideration are the following ones: response time latency for the first response (whether it was correct or not) entered as latency score and the number of errors score the child makes. The tendency of impulsive children is to respond precipitously. In particular, impulsivity makes children being both fast and incorrect, whereas typical children take more time to analyse the images, thus they provide more correct answers (Mulder et al., 2010; Vallesi et al., 2013). Another parameter to be taken into consideration refers to the performance over time: the more children go on, the more difficult the items are, so, theoretically, more time should be required. In such a case, ADHD children fail since they do not increase the time of analyses of the image, yet they

continue to provide impulsive responses whereas typical children take more time to analyse the details with the increasing difficulty of the task items. The first part of the test is supposed to be easier, and harder in the second part, hence ADHD children usually perform better in the first items of the test than in the last ones. Normative data on ADHD children refer to the outcomes of errors score and latency. This is the data taken into account in the present study as well.

Perceived Restorativeness measurement

As in Study 1 within the present research project, the Perceived Restorativeness Scale for children (PRS-ch) was implemented (Appendix G). It is a self-report scale based on the ART (Kaplan, 1995) aimed to measure the perceived restorative value of a place. The PRS-ch was developed by Hartig et al. (1997) and then adapted to children by Bagot (2004) and Bagot et al., (2007).

The Italian version for children, the one used in the present study, was validated by Berto et al. (2012). It consists of 17 items organized in four restorative factors (being away, scope, coherence, fascination) and a single item measuring environmental preference. Judgements are made on a scale of 0 to 10, where 0 = “not at all” and 10 = “very much” (Pasini et al., 2009). For instance, item no. 1 reads: “In this place I don’t think at my worries”. ($\alpha = .87$, for two measurements or 36 items totally).

Reported restoration measurement

The Reported Restoration Scale for children (Appendix H) is a self-report scale aimed to measure the restoration reported by participants, that is how they effectively report to feel after being in contact with a restorative environment. The reported restoration scale was originally developed by Staats, Kieviet & Hartig, (2003) for adults and then adapted to children by Collado et al., (2016). The version used in this study comprises thirteen items. Judgements are made on a seven likert scale, where 1 is for “totally in disagreement” and 7 is for “totally in agreement”. For instance, item no. 1 reads “I feel free and relaxed”. $\alpha = .90$ (26 items, among two environmental conditions).

Behavioural checklists of fatigue task and treatment

As in Study 1, within the present research project, in order to check the effectiveness of fatigue task (T2) and treatment, we used behavioural checklists filled in by the experimenters, with the purpose to assess respectively the fatigue task (Please see Appendix D) and the quality of the walk (treatment; Please see Appendix I).

Referring to the mental fatigue provoking task, participants were given a task for 15 minutes. This task included 10' for puzzle assembling during which the participants chose among a variety of puzzles according to their age and 5', on choice of the participants, for a game named both "boy girl animal" and "scategories" (given a letter chosen casually, the task of the participants consisted in finding words that start with the chosen letter. These words were grouped in categories such as names, things, animals, cities...) or a mathematical test for those having dyslexia and not being able to do the previous tests. The mathematical test was extracted from the INVALSI, a written test battery aimed to assess learning levels among students and to form general data on the efficiency of the Italian training system. Before the fatigue provoking task, we asked the children to give an oral answer to the three following open-ended questions: "How experienced are you in doing puzzles?", "How often do you do a puzzle?", "How many pieces do they have?".

In addition, experimenters filled a behavioural checklist in order to assess the children's conduct during the mental fatigue task. This scale consisted of 9 adjectives, listed specifically for this study, that had to be rated on a scale from 0 (very low) to 5 (very much). Adjectives were the following: absorbed, frustrated, oppositional, inattentive, restless, concentrated, interested, inadequate, angry.

Referring to the treatment, experimenters filled the behavioural checklist on the way back to the testing room. For this purpose, a scale was adapted from the SDAI (Scale per l'individuazione di comportamenti di Disattenzione e Iperattività in età scolare per Insegnanti-Genitori-Bambini), a

rating scale part of the Italian Battery to assess ADHD (Marzocchi et al., 2010), which usually aims to assess the impulsive behaviour and inattentiveness. A score greater than 14 shows a challenging behaviour, therefore in that case the treatment implemented in the present study could not be effective. It is usually used by teachers within school contexts. The adapted version consisted of 18 items (in accordance with the full original scale) which judgements were made on a scale of 0 to 3, where 0 means never and 3 very often. In addition to the adapted version of the SDAI, two open-ended questions were posed to the children: “Was the walk pleasant or boring? Please explain” and “What did you mostly think of during the walk? Please explain”. These questions, specifically designed for this study, aimed to explore whether pleasantness of the walk and thoughts oriented to the Here and Now could address in favour of the two first levels of recovery due to the restorative properties of the environment (Kaplan & Kaplan, 2011). $\alpha = .97$ (36 items total, measured among two environmental conditions).

3.3 Statistical analyses

As indicated above, the study design is within-subject. Independent variables or factors for testing hypothesis 1 to 5 are the following ones:

- 1 Environment: two levels (low prospect and high refuge vs. high prospect and low refuge, that is Mediterranean vs. Palms area); within subjects.
- 2 Time: depending on the dependent variable, such factor has different levels and/or sub-variables.

Dependent variables are the following ones:

1. Emotions (measured at T0 and T2, that is pre-test and post-test);
2. Attention (measured at T0, T1, T2, that is pre-test, after fatigue task and post-test; sub-variables are omissions and latency);

3. Impulsivity (measured at T0, T2; sub-variables are errors and latency);
4. Perceived Restorativeness (one measurement per condition, at post-test/T2);
5. Reported Restoration (one measurement per condition, at post-test/T2);
6. Here&Now (one measurement per condition, at post-test/T2. Only for this variable, analyses were conducted with qualitative methods. For details please see below);

The software used to analyse data was STATISTICA. The Wilcoxon matched pairs test is a nonparametric alternative to the paired t-test for dependent samples. The Wilcoxon signed ranked tests does not require the assumption that the population is normally distributed which is the case of the present study. It tests the hypothesis that the scores for two variables, or matched pairs, were drawn from the same distribution. Indeed, in this study, Wilcoxon test was run by selecting two values of the same variable that is the pre-test and post-test or the same variable taken in two (environmental) conditions. To see any differences among environmental conditions, the effect size was calculated “by dividing the Z value by the square root on N. In this situation, however, N = the number of observations over the two time points, not the number of cases” (Pallant, 2007, p. 225).

Wilcoxon analyses are run in the following way: two variables or matched pairs such as pre-test and post-test in each environment or the same variable between environments are compared. Times between conditions are compared for each dependent variable and for variables measured only at post-test (perceived restorativeness, reported restoration and additionally) they are compared both between environments and among them in each setting.

For testing hypothesis 6, a qualitative method was implemented. In particular, textual analyses with categorical amplitude was conducted. Words referred by the participants were grouped into two categories: Here and Now vs. Non-Here and Now (one measurement per condition, at post-test/T2) by two independent judges.

Statistical analyses on children's emotions – Hypothesis 1

A Wilcoxon matched-pairs test was run by inserting positive-negative emotions score at T0 and positive-negative emotions score at T2 of the Mediterranean condition. Afterwards, the same analyses were run considering the scores of the Palms condition. Next, effect size is calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two);

Statistical analyses on children's attention – Hypothesis 2 (a, b)

Hypothesis no. 2a: Raw scores are transformed into standardised points of the same age, by using the normative data provided by the CP test authors. Obtained the z points, a Wilcoxon matched-pairs test was conducted on omissions score of attention in the Mediterranean condition, comparing T0 to T1. Then, the same analyses was conducted by comparing T1 to T2 in the same condition. Afterwards, the same analyses, in the same order, were conducted for the Palms condition. Finally, the effect size of each analyses was calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two). Effect size is evaluated by using Cohen's criteria (1988) of .1 = small effect, .3 = medium effect, .5 = large effect;

Hypothesis 2b: Raw scores are transformed into standardised points of the same age, by using the normative data provided by the CP test authors. Obtained the z points, a Wilcoxon matched-pairs test was conducted on latency score of attention, comparing T0 to T1. Then, the same analyses was conducted by comparing T1 to T2 in the same condition. Afterwards, the same analyses, in the same order, were conducted for the Palms condition. Finally, the effect size of each analyses is calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two). Effect size is evaluated by using Cohen's criteria (1988) of .1 = small effect, .3=medium effect, .5=large effect;

Statistical analyses on children's impulsivity – Hypothesis 3 (a, b)

Hypothesis no. 3a: Raw scores are transformed into standardised points of the same age, by using the normative data provided by the CP test authors. Obtained the z points, a Wilcoxon matched-pairs test was conducted on errors score of impulsivity, considering pre-test and post-test scores of the Mediterranean condition (that T0 and T2). Afterwards, the same analyses, was conducted for the Palms condition. Next, effect size of each analyses is calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two). Effect size is evaluated by using Cohen's criteria (1988) of .1 = small effect, .3 = medium effect, .5 = large effect;

Hypothesis 3b: Raw scores are transformed into standardised points of the same age, by using the normative data provided by the CP test authors. Obtained the z points, a Wilcoxon matched-pairs test was conducted on latency score of impulsivity, considering pre-test and post-test scores of the Mediterranean condition (that T0 and T2). Afterwards, the same analyses were conducted for the Palms condition. Next, effect size of each analyses was calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two). Effect size was evaluated by using Cohen's criteria (1988) of .1 = small effect, .3 = medium effect, .5 = large effect;

Statistical analyses on children's perceived restorativeness – Hypothesis 4

Hypothesis no. 4: A Wilcoxon matched-pairs test was run by inserting the perceived restorativeness scores obtained both in the Mediterranean and Palms condition. Next, effect size was calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two); Effect size is evaluated by using Cohen's criteria (1988) of .1 = small effect, .3 = medium effect, .5 = large effect;

Statistical analyses on children's reported restoration – Hypothesis 5

Hypothesis no. 5: A Wilcoxon matched-pairs test was run by inserting the reported restoration scores obtained both in the Mediterranean and Palms condition. Next, effect size is calculated by dividing the Z value by the square root on N, where N consists into the number of observations (that is two); Effect size is evaluated by using Cohen's criteria (1988) of .1 = small effect, .3=medium effect, .5=large effect;

Statistical analyses on children's thoughts during treatment – Hypothesis 6

Hypothesis no. 6: Qualitative methods were used. After creating two categories (Here&Now vs. NonHere&Now), two judges implemented the lexicographic analyses with amplitude categorical attribution. The interpretative criteria used was based on the content: if participants' thoughts included elements or processes of the environment they were exposed to, then the attribution was to the Here&Now category. Conversely, if participants' thoughts did not include element or processes of the environment they were exposed to, then the attribution was to the Non-Here&Now category. The criteria on the present tense was not used because most of participants tended give direct oral answers without using enough verbs to describe their thoughts.

Statistical analyses on children' behavioural checklist during treatment

Two scores were calculated, one for items referring to inattentiveness (9 items) and another one for items referring to hyperactivity (9 items). Each subscale cut-off score is 14. A score greater than 14 represented a problematic behaviour that might interfere with the efficacy of the treatment.

3.4 Results

Effect of the environment on children's emotions – Hypothesis 1

A Wilcoxon matched-pairs test indicated that post-test ranks (T2) on positive-negative emotions scores was not statistically different than pre-test ranks (T0) for each environment. Therefore, hypothesis 1 is not supported.

Effect of the Environment on children's attention – Hypothesis 2 (a, b)

Accuracy (Omissions) – Hypothesis 2a

A Wilcoxon matched-pairs test indicated that omissions scores at T1 were statistically different than T0 in the Mediterranean condition, $Z = 2.66, p = < .001$ (Table 2) with a large effect size ($r = 0.56$). Then, a Wilcoxon matched-pairs test indicated that omissions scores at T2 were statistically different than T1 in the Mediterranean condition, $Z = 2.36, p = < .05$, (Table 2) with a large effect size ($r = .55$). By considering the medians (Table 3) at T0, T1 and T2, respectively 0.66, -0.25, 0.56, the trend reveals a recovery (from T0 to T1) followed by a depletion (T1 to T2).

A Wilcoxon matched-pairs test indicated that omissions score at T1 were statistically different than T0, $Z = 2.24, p = < .05$, (Table 15) in the Palms condition with a medium effect size ($r = .43$). A Wilcoxon matched-pairs test indicated that omissions score at T2 were statistically different than T1, $Z = 2.59, p = < .001$ (Table 2) in the Palms condition with a large effect size ($r = .50$). By considering the medians (Table 3) at T0, T1 and T2, respectively -0.11, -0.70, -0.47, the trend reveals a recovery (from T0 to T1) followed by a depletion (T1 to T2). Descriptive statistics regarding T0, T1 and T2 for both environmental conditions are reported in Table 16. Hypothesis 2a is not supported.

Table 15. Wilcoxon Matched Pairs Test Attention Omissions

	Valid	T	Z	p-level
medit_om_T0 & medit_om_T1	11	0.00	2.67	0.01
medit_om_T1 & medit_om_T2	9	0.00	2.37	0.02
palms_om_T0 & palms_om_T1	13	2.00	2.24	0.03
palms_om_T1 & palms_om_T2	13	2.00	2.60	0.01

Note: om = omissions; medit = mediterranean condition; palms = palms condition.

Table 16. Descriptive statistics of attention - omissions

	Mean	Valid N	Median	25,000th Percentile	75,000th Percentile	Std.Dev.
medit_om T0	9.07	12	0.66	0.08	1.76	28.97
medit_om T1	8.88	11	-0.25	-0.29	-0.12	30.55
medit_om T2	10.52	10	0.57	-0.12	1.49	31.80
palms_om T0	7.48	13	-0.12	-0.83	0.23	28.11
palms_om T1	7.12	13	-0.71	-0.90	-0.41	28.21
palms_om T2	7.33	13	-0.47	-0.74	-0.09	28.15

Note: om = omissions; medit = mediterranean condition; palms = palms condition.

Speediness (Latency) – Hypothesis 2b

A Wilcoxon matched-pairs test indicated that a significant difference of latency score exists from T0 to T1, $Z = 2.80$, $p < .05$, (Table 4), in the Mediterranean condition with a large effect size ($r = .59$). Then, a Wilcoxon matched-pairs test indicated that a significant difference of latency score exists from T1 to T2, $Z = 2.66$, $p < .001$ (Table 4) in the Mediterranean condition with a large effect size ($r = .59$). By considering the medians (Table 5) at T0, T1 and T2, respectively -0.03, -0.70, -1.52, the trends reveal a depletion (from T0 to T1), followed by a depletion (T1 to T2).

A Wilcoxon matched-pairs test indicated that a significant difference between T0 and T1 in the Palms condition does not exist (Table 17). Then, a Wilcoxon matched-pairs test indicated that a significant difference between T1 and T2 in the Palms condition does not exist (Table 4). However, analyses revealed a marginal result: a Wilcoxon matched-pairs test indicated that a significant difference between T0 and T2 in the Palms condition exists, $Z = 2.03$, $p < .05$, with a medium size

effect ($r = .39$). Descriptive statistics regarding T0, T1 and T2 for both environmental conditions are reported in Table 18. Therefore, hypothesis 2b is not supported.

Table 17. Wilcoxon Matched Pairs Test - attention latency

	Valid	T	Z	<i>p</i> -level
medit_latency_T0 & medit_latency_T1	11	0.00	2.80	0.01
medit_latency_T1 & medit_latency_T2	10	0.00	2.67	0.01
palms_latency_T0 & palms_latency_T1	13	16.00	1.80	0.07
palms_latency_T1 & palms_latency_T2	13	16.00	1.80	0.07

Note: medit = mediterranean condition; palms = palms condition.

Table 18. Descriptive statistics of attention - latency

	Mean	valid N	Median	25,000th Percentile	75,000th Percentile	Std.Dev.
medit_latency_t0	8.47	12	-0.03	-0.68	1.48	29.16
medit_latency_t1	8.48	11	-0.70	-1.42	0.12	30.70
medit_latency_t2	7.82	11	-1.52	-2.01	-0.72	30.91
palms_latency_t0	7.61	13	-0.40	-0.87	0.45	28.09
palms_latency_t1	7.29	13	-0.79	-1.10	0.11	28.18
palms_latency_t2	7.02	13	-0.76	-1.13	-0.42	28.25

Note: om = omissions; medit = mediterranean condition; palms = palms condition.

Effect of the environment on children’s impulsivity – Hypothesis 3 (a, b)

Accuracy (errors) – Hypothesis 3a

A Wilcoxon matched-pairs test revealed no significant differences from T0 to T2 neither in the Mediterranean condition nor in the Palms condition therefore hypothesis 3a is not supported.

Speediness (latency) – Hypothesis 3b

A Wilcoxon matched-pairs test indicated that a significant difference on latency exists between T0 and T2, $Z = 2.76$, $p = < .001$, in the Mediterranean condition (Table 6) with a large effect size ($r = .56$). Medians at T0 and T2 are the following ones: -0.76 and -1.48 (Table 20). The trend shows a depletion.

A Wilcoxon matched-pairs test indicated that a significant difference exists on latency between T0 and T2 $Z = 2.82, p = < .001$ (Table 19) in the Palms condition with a large effect size ($r = .53$). Medians at T0 and T2 are the following ones: -0.86 and -1.63 (Table 19). The trend shows a depletion, therefore hypothesis 3b is not supported. Descriptive statistics are reported in Table 20.

Table 19. Wilcoxon Matched Pairs Test - Impulsivity latency

	Valid	T	Z	p-level
medit_latency_T0 & medit_latency_T2	12	2.00	2.76	0.01
palms_latency_T0 & palms_latency_T2	14	3.00	2.82	0.00

Note: medit = mediterranean condition; palms = palms condition

Table 20. Descriptive statistics - Impulsivity latency

	Mean	Valid N	Median	25,000th Percentile	75,000th Percentile	Std.Dev.
medit_latency_T0	7.79	14	-0.76	-1.73	-0.76	43.94
medit_latency_T2	20.60	14	-1.48	-2.05	-0.85	37.44
palms_latency_T0	13.88	14	-0.86	-1.37	0.67	37.14
palms_latency_T2	13.13	14	-1.63	-2.05	-0.85	37.44

Results on Perceived Restorativeness – Hypothesis 4

Wilcoxon matched-pairs test revealed no significant differences between perceived restorativeness among conditions. Median of perceived restorativeness in the Mediterranean condition was 6.89 whereas in the Palms condition was 7.51. Hypothesis 4 is not supported.

Results on Reported Restoration – Hypothesis 5

Wilcoxon matched-pairs test revealed no significant differences between perceived restorativeness among conditions. Medians are the following ones: Mediterranean condition 3.84, Palms condition 4.96. A correlation between the two measures taken into both conditions exists $r = .65$. However, hypothesis 5 is not supported.

Results on the children's reported thoughts during treatment – Hypothesis 6

Children's reported thoughts during treatment data are analysed by implementing qualitative methods. In particular, lexicographic analyses with textual amplitude are used. Total number of subjects reporting thoughts attributed to the category Here&Now and Non-Here&Now are indicated as marginal outcome, yet it does not constitute a cut-off level as not previously hypothesized. Results revealed that 8 subjects reported thoughts during treatment in the Mediterranean condition refer to the Here&Now (and 3 refer to Non-Here&Now) whereas 12 subjects reported thoughts during treatment in the Palms condition refer to the Here&Now.

Below the full versions of the phrases used by the participants are cited, aiming to report their thoughts during the treatment. Next to each subject's answer is reported the coding attributed (yes for Here&Now and no for Non-Here&Now).

1) Mediterranean condition (11 participants):

1 "nothing in particular, perhaps to trees and pigeons" - YES

2 "looking at tree names on tags" - YES

3 "to look around (natural things)" - YES

4 "I thought about plants, about the pleasure of being together" - YES

5 "to the most beautiful things" - NO

6 "anything" - NO

7 "I was thinking about the boy who didn't hurt himself and the plants. Insects and birds. History of the the place" - YES

8 "to poisoned things and to ducks" - YES

9 "to the plants" - YES

10 "to poisonous and more exotic plants. At the palms, I like palm trees. To the statues" - YES

11 "to kill Marco because he bothered him" - NO

2) Palms condition (12 participants):

“the thing I thought of most was the water. I loved the fountain - YES

“I thought of trying to discover the names of the big trees and to understand where certain odors came from” - YES

“nothing special. I liked the staircase” - YES

“on palms and bird sounds” - YES

“at the fountain of 376 years! To the child from the other time who said bad words” - YES

“to the fact that I am hot, very hot” - YES

“to plants, photographic effects, palm trees and the smell of dew” - YES

“funny because I pushed a duck, I saw the fish, not poisonous plants” - YES

“fountain, and nothing more”. – YES

“to the palms, to the effect of the plants on the rain” – YES

“to the parrots” - YES

“looking for animals, I really like fish. But, apart from a small pond, I didn't find many. But the walk was pleasant. For me all the trees are a bit similar, not like the botanical garden of Ischia, where I saw a tree that impressed me. his trunk was full of thorns so big they pierced a hand” - YES

As hypothesized, in the Mediterranean condition less subjects were attributed to the Here&Now category than in the Palms condition (respectively 8 subjects vs. 12 subjects), supporting hypothesis 6.

Results on the Behavioural Checklist during treatment

Findings show that 3 participants in each environmental condition have crossed the threshold of 14, displaying problematic behaviours during the treatment. A fourth participant in each environmental condition obtained a score near to the threshold. Overall, 4 participants were

considered to have a problematic behaviour during the walk, which corresponds to nearly 30% of the sample.

3.5 Discussion

The present study aimed to assess whether two types of natural environments with dissimilar physical characteristics differently effect ADHD symptomatology as well as perceived restorativeness, reported restoration and reported thoughts on Here and Now. The conceptual hypothesis is that a high prospect and low refuge environment, represented by the palms area, would lead to greater restoration than a low prospect and high refuge environment. This is due to the fact that it allows clear field of vision therefore the participants would feel safe and secure (Gatersleben & Andrews, 2013). Conversely, according to the same authors, a low prospect and high refuge environment, represented by the Mediterranean area, would lead to a lower level of restoration due to the fact that it presents places to hide therefore the participants would feel unsafe and insecure for unexpected situations.

The conceptual framework is based on prospect-refuge theory (Appleton, 1975) and the assumption that feeling secure and safe is related to restoration derived from restorative environments (Gatersleben & Andrews, 2013). The hypotheses underlying this study makes reference to more positive emotions, greater attention, lower impulsive symptoms, higher perceived restorativeness and reported restoration as well as more focus on the Here and Now in the palms condition. All the contrary would occur in the Mediterranean condition. The palms setting is constituted by very high palms characterised by straight and cylindrical stems which make the view clear, the field of vision widely extended into the scene indeed it is unlikely to present potential hiding places, that is threatening events. Indeed, a sense of security would be implicitly felt by participants while walking into the palms area. Conversely, in the Mediterranean condition, the presence of shrubberies make the view unclear and presents opportunities to hide, therefore, walking in this area would probably make the participants feel more insecure.

Before collecting data, a manipulation check aimed to evaluate whether the two natural environments might be classified as high prospect and low refuge was conducted among eleven healthy children (5 males, 6 females). They were asked to rate ten sites for each environmental condition and then they were asked to express their agreement (low, medium, high) in response to three independent questions measuring prospect, accessibility and refuge. Outcomes revealed no statistically significant differences between conditions. Indeed, it is possible to assume that the (healthy) children did not consider the two conditions as different, at least in terms of the dimension considered by the manipulation. However, it is still arguable that unhealthy children could distinguish the two environments, therefore the present study was conducted. Moreover, the sample of the manipulation check presents another difference compared to the ADHD sample: the males vs. females ratio is, in the first case 5:6 whereas in the second case is 12:1. This is another limitation of the manipulation check. Coherently to the manipulation check results, the general findings of the present study are not in accordance to the hypotheses mentioned. For instance, regarding emotions (hypothesis 1), findings did not reveal any significant difference from pre-test to post-test, neither a difference of positive-negative emotions score between the two environments.

Regarding accuracy of attention, both environments revealed significant differences from T0 to T1 and from T1 to T2. Unfortunately, the medians show an opposite trend compared to the hypothesis 2a: first (after fatigue task) there is a recovery, instead of a depletion, and afterwards (after treatment) there is a depletion instead of a recovery. This could be due to several reasons, that are mentioned further on in the present discussion.

Almost the same occurs for latency of attention (hypothesis 2b). Only in the Mediterranean condition findings reveal significant differences from T0 to T1 and from T1 to T2 but the medians show first a depletion (which is coherent with hypothesis), followed by a depletion after treatment (uncoherent with hypothesis no. 2b). Yet, a marginal outcome for latency in the palms condition was revealed by the analyses: a Wilcoxon matched-pairs test indicated that a significant difference

between T0 and T2 exists, $Z = 2.03$, $p = < .05$, with a medium size effect ($r = .39$) - that is from pre-test to post-test without considering the T1 - but it is still uncoherent with hypothesis 2b since a depletion occurs after treatment.

Regarding accuracy of impulsivity (hypothesis 3a), findings did not reveal any significant differences from T0 to T2 neither in the Mediterranean condition nor in the Palms condition. Hypothesis 3a is not supported. Conversely, regarding latency of impulsivity (hypothesis 3b), statistically significant differences from T0 to T2 exist but, again, the trend of the medians show that participants took less time to execute the task therefore their impulsive symptoms were not alleviated by the treatment, and paradoxically, they were worsened.

Considering the perceived restorativeness (hypothesis 4), outcomes did not reveal any statistically significant differences between perceived restorativeness of the two areas. This means that in statistical terms, both environments are perceived in the same way. However, medians show that the Mediterranean condition was perceived as less restorative than the Palms condition (respectively mdn 6.89 vs 7.51). Although this data is not significant, we might speculate that this trend goes in favour to hypothesis 4, which posits that the low prospect and high refuge condition (the Mediterranean area) would be perceived as less restorative than the high prospect and low refuge condition (the Palms condition). However, this point should be better verified with a bigger sample of ADHD children.

Next, the reported restoration between the two environments did not show any significant difference. Yet, the Mediterranean condition median was equal to 3.84 whereas in the Palms condition it was equal to 4.96. This finding would go in favour of hypothesis 5. Even though it is not a significant difference, participants reported feeling more restored after Palms condition than the Mediterranean condition. In addition, a correlation between the two measures taken into each condition exists. For instance, in the Mediterranean condition Perceived Restorativeness is correlated with Reported Restoration $r = .69$ (spearman rank non-parametric). The same occurs in the Palms

condition: Perceived Restorativeness is correlated with Reported Restoration $r = .57$ (spearman rank non parametric; in the palms condition an additional marginal result shows that a significant difference exists between perceived restorativeness and reported restoration in the palms condition $Z = 3.05$, $p = < .001$, with a large effect size $r = .57$).

These correlations suggest that, coherently with the theoretical framework, perceived restorativeness and reported restoration belong to the same construct: restorativeness, from the perception of the restorative qualities of a place to reporting feelings of restoration of the same place. Accordingly, medians of both measures suggest that the two conditions were assessed in different ways, even though not enough to be considered a statistical difference.

Similarly, in each of the two environments, correlations among each of the three measurements of omissions for attention and latency for attention exist. The same occurred for the impulsivity test. These marginal findings might suggest that the tests used are robust and confirm that they both measure variables of the same construct.

Also, the effect sizes for attention (omissions and latency) are generally higher in the Mediterranean condition than in the Palms condition, probably showing that the depletion related to the former is greater than the latter. This interpretation would support hypotheses 2 (a, b). For instance, an additional marginal result of attention latency in the palms condition shows that a significant difference between T0 and T2 (from pre-test to post-test excluding fatigue task time or T1) in the Palms condition exists, $Z = 2.03$, $p = < .05$, with a medium size effect ($r = .39$), whereas other effect sizes are large.

Lastly, analyses on the behavioural checklist during the treatment showed that almost four participants (which constitute almost the 33% of the sample) were consistently hyperactive and inattentive, obtaining the score for problematic behaviours. This data suggests that treatment was not effective for them. This might also be an additional explanation to the fact that there were no

improvements in emotions, attention, impulsivity at post-test. The fact that they could not engage with Nature also reveals that they could not probably perceive the restorative properties it encompasses, hence feel restored. “Directed attention can be recovered when a person can engage in activities that draw primarily on involuntary attention” (Collado et al., 2016, p. 130), the also defined fascination by Kaplan and Kaplan (1989). Therefore, engaging with Nature is a basic requirement for experiencing restoration. Soft fascination allows the person to softly engage with the surroundings by being still able to reflect, as third level of restoration (Herzog et al., 1997). Interestingly, participants’ reported thoughts oriented to the Here&Now were greater in the Mediterranean condition than in the Palms condition, supporting hypothesis 6. Being in the Here and Now suggests that participants could at least experience the first level of restoration, which requires the elimination of cognitive noise (thoughts unrelated to the Here and Now). However, they could not experience the second level of restoration which consists in the temporary inactivity of directed attention, as shown in the attention tests. This was probably caused to the fact that engaging with Nature did not fully happen almost for 33% of the sample, as shown by the fact that participants’ behaviour tended to be inattentive and hyperactive during treatment.

Finally, the findings show that both environmental conditions were perceived similarly in terms of their restorative potential, and that walking in the Botanical garden in general, did not lead to restoration instead to a depletion of their resources.

Another interpretation of this outcome needs to take into account the distance from residential area of the participants and the Botanical garden in which the data collection took place. Previous research investigated the relation between child’s residence and the nearest urban green space (Markevich et al., 2014). Outcomes revealed that such relation was positively associated with the odds of hyperactivity/inattention, especially amongst children with abnormal values (and mostly among males). Overall, the study showed that children living further than 500 m away from urban green spaces had more overall behavioural problems than those living within 500 m of urban green

spaces. Even though authors investigated the distance between the children's residence and the nearest greenness areas and not the effect of driving to a green area which was located far away, we might speculate that the distance travelled by the families in the present study might have effected the cognitive resources of the children, already fatigued by the ADHD. Indeed, they took at least one hour to get into the testing site and another hour to return home and most of the driving was through urban crowded areas that might fatigue ADHD children (Faber Taylor & Kuo, 2008; Van den Berg & Van den Berg, 2010). Parsons (1991) states that because urban environments are not habitable in evolutionary terms, they are stressful.

It is plausible that participating in the data collection was too tiring for the participants therefore only twenty minutes treatment (Faber Taylor & Kuo, 2008) could not be enough to face such tiredness level. In fact, Hartig et al., (1997) found that different restorative outcomes take place at a different pace, and attentional recoveries usually need longer periods of exposure to nature than other restorative benefits. Future studies with longer expositions to nature in the botanical garden will help us understand whether participants did indeed need longer time of exposure to nature to recover their attentional capacity.

Furthermore, children could not perform an active travel behaviour such as cycling or walking which would have given some benefits (Kemperman & Timmermans, 2014). Much of the existing literature on the benefits deriving from Nature contact relate to nearby Nature or residential greenness, suggesting that the accessibility metrics (Ekkel & de Vries, 2017) and, indirectly, the distance in general, might play an important role (Cox et al., 2017; Degenhardt & Buchecker, 2012; de Vries et al., 2010; Richardson, Hallam, & Lumber, 2015; Wells & Evans, 2003). Another alternative interpretation could involve the motivation. Perhaps, participants' motivation to participate in the data collection was not enough in general and not enough in order to cope with the challenge that reaching the testing site involved (Brose et al., 2012). Indeed, future research on ADHD comparing the effects

of two natural environments that differ in terms of physical characteristics have on psychological variables, should take into account the proximity of settings for testing.

Finally, the present study shows that ADHD children do not benefit from walking in the Botanical garden, an example of urban Nature, and that natural areas distinguished in terms of prospect and refuge do not make the difference on their perceived restorativeness and ADHD symptomatology. Another explanation could rely on the type of Nature participants were exposed to (Hartig et al., 2014): a Botanical garden presents quite different scenarios compared to wild or more pristine Nature. Infact, a Botanical garden is the result of human touch, a place where collections of plants and trees are grown for scientific study and exhibition, a well-tended area. However, in terms of connectedness with Nature, people tend to feel connected with pristine Nature, example of a preserved land, “that is uninhabited and unaltered by human beings” (Vining et al., 2008, p. 8). The interpretation of the present findings could consider this aspect yet future investigation should address whether ADHD children and adolescents recover more in pristine natural environment rather than in urban natural environments.

Study 2 encompasses several limitations. In addition to those listed in Study 1 (for instance the length of the procedure), an important difficulty in conducting the present study was enrolling participants. The reason for this was that many parents could not plan an entire afternoon for data collection at a remote site and some of them could not even drive so far away. Consequentially the second limitation is that the number of participants was very low, which might have effected our results. A third limitation might be the size of the areas selected for testing, maybe too small for a twenty-minute walk. A fourth limitation relates to the relation between the treatment and ART factors (Kaplan, 1995; Kaplan & Kaplan, 1989). For instance, the walking was not very compatible (factor compatibility) with children’s aspirations in that moment: running and moving freely. Due to their hyperactivity, part of the core symptoms of ADHD, it was quite hard to walk slowly and maintain conversation level at a minimum.

Further investigation is needed to better explore the minimum size needed for a twenty-minute walk, whether visiting parts of the same area for several times during the treatment increases or decreases restoration. Moreover, considering the need of ADHD children (especially those diagnosed with hyperactivity prevalence) to be in constant physical movement, and the importance of the ART compatibility factor (Kaplan, 1995) which states that the environment should be compatible to one's needs in order to be restorative, researchers should investigate a treatment that allows ADHD children to freely move into the space, for instance through free play in Nature (conversely to a slow paced walk as in Study 1 and Study 2). Furthermore, future research should compare characteristics of different natural environments, though differentiate natural environments and evaluate the recovery effects on ADHD children in order to understand which natural areas are more compatible to their needs (Faber Taylor et al., 2001; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004).

Study 3

EFFECTS OF FREQUENCY OF CONTACT AND CONNECTION TO NATURE ON ADHD
SYMPTOMS SEVERITY

4.1 Introduction

Attention deficit hyperactivity disorder (ADHD) is characterised by attention inconsistency (Faber Taylor & Kuo, 2008) which is constituted by difficulty in maintaining a stable level of performance (Kalff et al., 2005). This inconsistency of attention is manifested mostly in the school and home environments. Indeed, based on the diagnostic criterion established by the DSM (Apa, 2013), it is important to involve parents and teachers in the diagnostic process of ADHD and this aspect suggests the importance to investigate Nature contact on a relational basis.

Indeed, although the general aim of the present research programme is to consider whether and how Nature contact might be of help among ADHD children (Collado & Staats, 2016), the present study explores ADHD symptoms related to frequency of contact and connection to Nature on a contextual and relational or familial level. Most of the studies on human-Nature transactions explore the benefits on individuals whereas the relational area has been neglected and very few studies have addressed this topic (see Carrus et al., 2017). Consequently, this angle of perspective is quite under-researched in the environmental psychology framework. In addition, it seems an important point to be addressed among ADHD framework since joint attention – the one related to the social cognition or the social aspects of information processing – seems to be impaired (Marotta et al., 2013) as well as other impaired types of attention (e.g., sustained attention).

Among the few studies that concern this topic (yet involving typical children and adults), of interest to ADHD children and related families, it is worthy to cite Cameron-Faulkner, Melville and Gattis, (2018) who conducted a study in England which showed that parent-child communication is influenced by natural environments. Indeed, authors compared parent-child communication in a natural and indoor setting and findings revealed that in the natural environment communication was more responsive and connected, suggesting that natural environments could be considered as optimal places not only for development in general but also for communication among family members, at least in present time Western post-industrial societies. Similarly, a qualitative study conducted by

Burke (2016) showed that being exposed to a natural environment heightened feelings of familial connection and closeness, enhanced the communication as well as the desire to share aspects of Nature with others and it created vivid memories of nature experiences among family components. Similar findings were obtained by Ashbullby, Pahl, Webley and White (2013) who demonstrated that families were mostly benefited psychologically rather than only physically (e.g., due to increased exercise) from spending time on beach environments in England. In particular, familial interactions were improved. Accordingly, Izenstark and Ebata (2019) showed that participation in family-based nature activities encouraged and improved mother and daughter communication and relation (Izenstark & Ebata, 2016).

Besides the above-mentioned benefits that contact with Nature offers on family relations, the school context, which is usually attention demanding, could offer opportunities for Nature contact and relief to children effected by ADHD. Despite the lack of studies on ADHD related to school contexts in the environmental psychology framework, it is worth mentioning a few studies that could be of insight among ADHD children.

For instance, Humberstone and Stan (2012), explored the experience of outdoor pedagogies aimed to promote specific engagement with Nature. Teachers' interactions with pupils provided positive learning opportunities, an outcome of interest to ADHD children who struggle for attention and whose learning might become challenging at times. For this purpose, Bagot, Allen, and Toukhsati (2015) aimed to identify what factors are associated with the perceived restorativeness of children's environments. Based on ART, they investigated how attention resources are promoted by the greenness together with other individual resources such as biological, psychological and social, "required for successful adaptation to current circumstances" (Kaplan, 1995, p. 1). The team conducted a study in Australia on 550 elementary school students aged between eight and eleven years, across a broad range of socio-economic groups, and outcomes revealed what would make a playground perceived as restorative: playground naturalness and grass covering but most of all

vegetation volume. The more vegetation volume, the higher perceived restorativeness was felt. Similar results were obtained by Martensson et al., (2009) among preschool children in Sweden. Authors hypothesized that outdoor green environments have a salutogenic potential for children who spend their recess there. They assessed the quality of the outdoor environment and fraction of visible sky from play structures used by children. Teachers observed 198 children aged 4.5 – 6.5 and rated their attention level and impulsive behavior. Findings showed that “children playing in large and integrated outdoor areas containing large areas of trees, shrubbery and a hilly terrain showed less often behaviours of inattention” (Martensson et al., 2009, p. 1149).

Accordingly, Chawla et al., (2014) showed that children from an elementary school felt relief from stress and better concentration after spending their recess playing with woods in a natural area of the school playground. This result was compared to indoors classes, and it was significant. Students spending their recess outdoors also described the experience as relaxing, calm and peaceful. More recently, Amicone et al. (2018) had similar results by testing primary school children before and after their recess time (green vs. built) and showing both working memory and selective and sustained attention recovery happens only after a green (vs. built) outdoor recess break (and perceived restoration is stronger after the green vs. built break too). A meta-analysis by Weeland et al. (2019), which included Amicone et al.’s study too, confirms the validity of such effects by means of both correlational and quasi-experimental studies.

In general, the above mentioned studies conducted among healthy children demonstrate that Nature contact might improve family relations and school experience. These findings seem to have a potential application among ADHD children.

The present study

The present study is aimed to evaluate whether Frequency of Contact with Nature (FoC) on family basis is related to Connection to Nature (CN) and whether both variables constitute a positive

influence on symptoms severity. Although literature on ADHD children in Environmental Psychology framework is scarce, two studies investigated the relation between spending time in Nature as afterschool and weekend activities, and severity of symptoms assessed by the parents (Faber Taylor et al., 2001; Kuo & Faber Taylor, 2004). The results revealed that green outdoor activities reduced symptoms significantly more than activities conducted in other settings (built indoor and outdoor), showing that green after-school activities or contact with everyday Nature and weekend activities could be implemented like a potential natural treatment for ADHD as they supported attentional functioning among ADHD children.

Considering the general literature cited above, the innovative points of the present study are the following ones:

1. The influence of family relations on Frequency of Contact with Nature and on Connection to Nature;
2. The connection to Nature as a preventive factor against ADHD symptoms severity;

In summary, the overarching aim of the present study is investigating, firstly, whether frequency of contact with Nature and connection to Nature of the child affected by ADHD are both influenced by family members' frequency of contact and connection to Nature; secondly, whether both frequency of contact and connection to Nature might act as a buffer from ADHD severity of symptoms.

Hypotheses

The present study is based on the following two hypotheses:

Hypothesis 1 Family individuals' trait levels of feeling emotionally connected to the natural world on a family level is positively related with children's regular contact with Nature.

Hypothesis 2 The greater contact and connection with Nature children, the lower their severe ADHD symptoms will be.

4.2 Method

Participants

Thirty-two children and adolescents with attention deficit hyperactivity disorder (ADHD), aged 6 to 16 ($M = 11.03$, $SD = 5.00$) participated in the study (26 males; 6 female), twenty-four of them participated in Study 1 or 2. Twenty-two of them were drug-naïve whereas ten of them did not declare whether they were medicated or not. Furthermore, parents and teachers (one teacher for each child) participated as well.

Most of participants were consecutive referrals at the TSMREE/Mental health safeguard and rehabilitation service for developing age of Mentana, a small town near Rome (Italy), part of the local health unit named ASL Roma G/5. A few of them were recruited at the Child Psychiatry Unit of “Tor Vergata” University in Rome. The ADHD diagnosis respected the DSM-IV-TR criteria (APA, 2000). Inclusion criteria were diagnosis of ADHD combined-type or non-combined as well, and the most common comorbidities of ADHD (Please see the *Batteria Italiana per l'ADHD* authored by Marzocchi et al., 2010), such as learning disabilities, speech disease and opposition-defiant disorder.

Procedure

A questionnaire in paper format was given to the families (and to the child), by including a section to be given to the teacher. Both sections of the questionnaire (for the family and for the teacher) had enclosed a consent form to be signed. Overall, it took about 20 minutes to fill the entire questionnaire. Data was collected approximately from June 2017 to June 2018. On the very first page of the questionnaire, a letter was enclosed with the purpose to describe the study and invite the families into carefully filling the questionnaire by also involving the children in first person for their assigned section. The questionnaire was then returned to the health unit by the parents. The

questionnaire includes some demographic details and the existence of a garden in the household that are not considered in the present study and thesis in general.

Measures

Frequency of Contact with Nature scales (FoC)

Frequency of Contact with Nature scale (FoC; Gotch & Hall, 2004; Larson, Green, & Castleberry, 2011), in its children and parent version, was used to assess the frequency of Nature contact of the children (rated by him/herself and the parent) during the last year (Appendix H and Appendix I).

On a scale from 1 (very little) to 5 (very much), children were asked to rate how many times they spent time in Nature in the last twelve months, both visiting awe places and nearby home sites during weekdays and weekends. For instance, item no. 1 reads “In the last 12 months, how many times have you been in natural places like countryside, beach, mountains etc.?”, item no. 2 reads “In the last 12 months, how often have you visited places like zoos and aquariums?”, item no. 3 reads “After going to school, do you go to play in natural places like the park or the garden?” and item no. 4 reads “In the weekend do you play outdoors in natural places like the park or the garden?”. In addition, an open question was added to the scale, “What do you do when you're in a natural place near your home?” (yet it is not considered in the present study). Cronbach’s alpha on the four items for the FoC child version was $\alpha = .54$.

The same scale was adapted to the parents but still aimed to investigate the frequency of contact with Nature of the children. The four items are the following ones: “In the last 12 months, how many times has your child been in natural places like countryside, beach, mountains etc.?”, “In the last 12 months, how often has your child visited places like zoos and aquariums?”, “After going to school, does your child go to play in natural places like the park or the garden?”, “In the weekend does your child play outdoors in natural places like the park or the garden?”. The open-ended question

was "What does your child do when he/she is in a natural place near home?" (yet it is not considered in the present study). Cronbach's alpha on the four items for the FoC parent version was $\alpha = .64$.

Connection to Nature scales for children and adults (CNS)

To measure the individuals' trait levels of feeling emotionally connected to the natural world or the extent to which people feel part of the natural world, the Connection to Nature scales (CNS; Mayer & Frantz, 2014) - child and adult (mother and father) versions - were used (Appendixes J, K, L). CNS is a self-report scale. The adult version was divided by parental gender because previous studies address to parents as a general category that includes both genders yet, in most cases, mothers are the ones filling the questionnaire (see Collado, Evans & Sorrel, 2017).

The Child version implemented was validated in Italian by Berto et al., 2015 which consists of seven items on a 5-point scale (0=never, 4=always). It was originally developed on the adult English version (Mayer & Frantz, 2009). An example of an item is "I feel connected to the natural world around me" (item no. 1).

The adult version implemented in the present study (Mayer & Frantz, 2014) consists of 14 items on a 5-point scale (1=strongly disagree, 5=strongly agree). An example of an item is "I often feel a sense of oneness with the natural world around me" (item no. 1). The adult version was used for mothers and fathers. Cronbach's alpha on fourteen items for the adult (father) version was $\alpha = .60$ whereas for the adult (mother) version it was $\alpha = .74$. Cronbach's alpha on seven items for the child version was $\alpha = .89$.

Inattentiveness and Hyperactivity Behaviours rating Scales for school age (SDAB, SDAG, SDAI)

In order to evaluate the behaviours related to inattentiveness and hyperactivity of the child effected by ADHD in school age, the scales SDAB, SDAG, SDAI (Marzocchi & Cornoldi, 2010), part of the Italian battery for ADHD (Marzocchi et al., 2010), were implemented (please see Appendix

M, Appendix N, and Appendix O). They measure the frequency of problematic behaviours (inattentiveness and hyperactivity) of the children in school age from the point of view of the children themselves (SDAB), of the parent (SDAG) and of the teacher (SDAI), as by the DSM IV (American Psychiatric Association, 1995).

The SDAB is constituted by 14 items which answers are given on a 4-point Likert scale, where 0 is for never and 3 is for very often. The scoring considers the sum of all the items, one final score only. SDAB is filled by the children. As example, item no. 1 reads: “At school, do they tell you that you make careless mistakes?” ($\alpha = .19$).

The SDAG and SDAI are constituted by 18 items which answers are given on a 4-points Likert scale, where 0 is for never and 3 is for very often. They are filled respectively by parents and teacher (support teacher for ADHD children in Italy). The SDAG and SDAI are divided into two subscales, one for inattentiveness constituted by nine items (odd items) and one for hyperactivity-impulsivity constituted by nine items (even items). The threshold for each subscale is 14. Above such score the behaviour is considered critical. Regarding SDAG, as example item no. 1 reads: “The child has difficulties in performing activities that require some care”. For SDAG inattentiveness $\alpha = .90$ (number of items = 9) whereas for SDAG hyperactivity $\alpha = .92$ (number of items = 9). Regarding SDAI, as example item no. 1 reads “The child has difficulty in focusing attention on details or makes mistakes of negligence”. SDAI inattentiveness $\alpha = .93$ (number of items = 9) whereas SDAI hyperactivity $\alpha = .95$ (number of items = 9).

4.3 Statistical Analyses

The study design is correlational. The software used to analyse data was STATISTICA. Analyses were conducted by first comparing variable ratings within themselves and second, by comparing the three variables (FoC, CN, Symptoms severity) between themselves in order to directly test hypotheses 1 and 2. Considering comparisons within the scales, a Pearson correlation coefficient

was computed to assess the relationship among the severity symptoms scales, SDAG and SDAI. SDAB was excluded from analyses due to the unreliable α value (.19).

Then, a Pearson correlation coefficient was computed to assess the relationship between the Frequency of Contact scale for the children and the Frequency of Contact scale for the parents. Lastly, a Pearson correlation coefficient was computed to assess the relationship among the three versions of the Connection to Nature scale, that is children, adult mothers and adult fathers.

Statistical analyses to test Hypothesis 1

Considering comparisons between the different scales, in order to test Hypothesis no. 1, a Pearson correlation coefficient was computed to assess the relationship between Connection to Nature Scale (child, adult-mother and adult-father) and FoC (child and parent). Totally, five measures were analysed.

Statistical analyses to test Hypothesis 2

In order to test Hypothesis no. 2, a Pearson correlation coefficient was computed to assess the relationship between the Frequency of Contact scales (child and parent) and the severity symptoms sub-scales – SDAG and SDAI (respectively parent and teacher versions). Totally, six measures were analysed.

4.4 Results

Results on Frequency of Contact and Connection to Nature – Hypothesis no. 1

To test hypothesis no. 1, a Pearson correlation coefficient was computed to assess the relationship between the Frequency of Contact rated by the Child and the Frequency of Contact rated by the parent. There was a positive strong correlation between the two variables, $r = .81$. Descriptive statistics and r values are reported in Table 21.

Table 21. *M, SD* and correlations of FoCB, FoCG.

	<i>M</i>	<i>SD</i>	FoCB	FoCG
FoCB	12.00	29.31	1.00	0.81*
FoCG	9.01	24.27	0.81*	1.00

Note: FoCB is filled by the child; FoCG is filled by the parent.

* $p < .05$

Then, a Pearson correlation coefficient was computed to assess the relationship between Connection with Nature of each of the three family members (mother, father, child). There was a positive strong correlation between Connection with Nature of the Mother and Connection with Nature of the father $r = .77$. Furthermore, there was a positive moderate correlation between Connection with Nature of the Mother and Connection with Nature of the Child $r = .66$. The same correlation between Father and Child is non-significant, though its magnitude is consistent ($r = .51$). For descriptive statistics and r values please see Table 22.

Table 22. *M, SD* and correlations among CNSmother, CNSfather, CNSchild

	Means	Std.Dev.	CNSmother	CNSfather	CNSchild
CNSmother	21.05	37.58	1.00	0.77*	0.66*
CNSfather	29.16	43.73	0.77*	1.00	0.51
CNSchild	10.84	28.41	0.66*	0.51	1.00

Note: CNS has three versions, each one filled by mother, father and child.

* $p < .05$

Finally, a Pearson correlation coefficient was computed to assess the relationship between Connection with Nature of each of the three family members and the Frequency of Contact with Nature rated by the children and the parents. There was a positive moderate correlation between Frequency of Contact rated by the children and Connection with Nature of the mothers $r = .68$ and a positive strong correlation between Frequency of Contact of the children and Connection with Nature of the children $r = .99$. Again, the same correlation between Fathers and Children is non-significant, though its magnitude is consistent ($r = .53$).

There was a positive moderate correlation between Frequency of Contact rated by the parents and Connection with Nature of the mothers $r = .67$ and a positive strong correlation between Frequency of Contact of the parents and Connection with Nature of the children $r = .99$. Again, the same correlation between Fathers and Children's versions is non-significant, though its magnitude is consistent ($r = .53$). For descriptive statistics and r values, please see Table 23.

Table 23. *M*, *SD* and correlations between CNS and FoC.

	CNS_mother	CNS_father	CNS_child
FoC_child	0.68*	0.53	0.99*
FoC_parent	0.67*	0.53	0.99*

Note: * $p < .05$

Results on Symptoms severity - Hypothesis no. 2

In order to test hypothesis no. 2, first, a Pearson correlation coefficient was computed to assess the relationships between SDAG and SDAI. There was a positive strong correlation between the inattentiveness and hyperactivity subscales of SDAG (rated by the parent): $r = .97$. Then, a Pearson correlation coefficient was computed to assess the relationship between SDAI (rated by the teacher) sub-scales. There was a positive strong correlation between the two variables: $r = .98$. Furthermore, there was a positive moderate correlation between hyperactivity rated by the parents (SDAG) and hyperactivity rated by the teacher (SDAI): $r = .38$. For Descriptive Statistics of SDAG, SDAI and r values, please see Table 24.

Table 24. *M*, *SD* and correlations of SDAG and SDAI.

	<i>M</i>	<i>SD</i>	SDAG_inatt_ parent	SDAG_hyper_ _parent	SDAI_inatt_ _teacher	SDAI_hyper_ _teacher
SDAG_inatt_parent	21.43	22.43	1.00	0.97*	0.34	0.33
SDAG_hyper_parent	19.06	23.55	0.97*	1.00	0.38*	0.38*
SDAI_inatt_teacher	24.90	31.40	0.34	0.38*	1.00	0.98*
SDAI_hyper_teacher	21.10	32.94	0.33	0.38*	0.98*	1.00

Note: SDAG is filled by the parent; SDAI is filled by the teacher; inatt=inattentiveness sub-scale; hyper=hyperactivity subscale.

* $p < .05$

Second, a Pearson correlation coefficient was computed to assess the relationship between the Frequency of Contact with Nature of the family members (children and parents) and the symptoms severity scales - SDAG and SDAI. There was a negative moderate correlation between Frequency of Contact of the Children and SDAG inattentiveness $r = -.39$. Please see Table 25.

Table 25. Correlations among FoC_child, FoC_parent and SDAG, SDAI.

	SDAG_inatt.	SDAG_hyper	SDAI_inatt.	SDAI_hyper.
FoC_child	-0.39*	-0.14	-0.30	-0.32
FoC_parent	-0.14	0.05	-0.04	-0.07

Note: SDAG is filled by the parent; SDAI is filled by the teacher; inatt=inattentiveness sub-scale; hyper == hyperactivity subscale. Hyper=hyperactivity subscale, inatt = inattentiveness sub-scale.

* $p < .05$

Third, a Pearson correlation coefficient was computed to assess the relationship between the Connection to Nature of mothers, fathers and children and the severity of symptoms scales rated by the parents and the teachers (SDAG and SDAI): results are reported in Table 26. There was a positive moderate correlation between SDAG inattentiveness and CNS rated by the children ($r = .67$). In addition, there was a positive moderate correlation between SDAG hyperactivity and CNS rated by the children ($r = .66$).

Table 26. Correlations between SDAG, SDAI and CNS.

	CNS_mother	CNS_father	CNS_child
SDAG_inatt_parent	0.35	0.24	0.67*
SDAG_hyper_parent	0.39	0.28	0.66*
SDAI_inatt_teacher	0.13	0.02	0.41
SDAI_hyper_teacher	0.10	0.00	0.41

Note: * $p < .05$

4.5 Discussion

The present study aims at evaluating relations between frequency of contact and connection to Nature on a family basis (Hypothesis no. 1) and possible positive effects of frequency of contact with Nature on ADHD symptoms severity (Hypothesis no. 2). A few studies addressed that contact with Nature is beneficial for the familial relations however it is unclear whether frequency of contact and connection to Nature can be increased or diminished by family components. This seems to be a fundamental aspect for ADHD children since home is one of the core places in which symptoms are manifested, hence families can play an important role into improving the daily quality of life of ADHD children by keeping contact with Nature.

The present study aimed to explore these aspects. Firstly, results showed that the Frequency of Contact reported by children is strongly correlated with the frequency of contact (of children) reported by the parents ($r = .81$). This outcome shows coherence in the data gathered. Secondly, results showed that Connection to Nature of the three family members are partly correlated. For instance, mother's and children's values are correlated ($r = .66$) and mother's and father's values are correlated as well ($r = .77$). Indeed, these outcomes suggest that being in connection with Nature is not only a matter of an individual rather it could be a matter of familial relations. Thirdly, results showed that in the family configuration, Connection to Nature and Frequency of Contact correlate (hypothesis no. 1). Specifically, children's frequency of contact is strongly correlated with children's connection to Nature ($r = .99$) suggesting that these two variables have a relation. According to literature, lifestyles oriented to green activities are part of the effective dimension of the connection to Nature (Mayer & Frantz, 2004). This outcome is in accordance with previous research. For instance, accordingly to Collado, Staats and Corraliza, (2013), "long term exposure to nature through a summer camp is an effective way of promoting children's emotional affinity to nature" (p. 43). In other words, authors suggest that frequency of contact fosters effective connection with Nature. Furthermore, in the present study, connection to Nature of the mothers resulted correlated with

children's Frequency of contact rated by parents ($r = .67$) and, by speculating on this (correlational and not experimental) outcome, it is arguable that a parent connected to Nature might offer more opportunities to their children for contact with Nature. These outcomes confirm Hypothesis no. 1.

Fourthly, the sub-scales assessing the severity of symptoms (rated by parents and teachers) were intra-correlated showing coherence among data. Indeed, inattentiveness and hyperactivity assessed by parents (SDAG) were correlated ($r = .97$). The same occurred for the scale rated by teachers (SDAI; $r = .98$) showing coherence among data gathered. Moreover, both SDAG and SDAI were correlated on the inattentiveness variable, showing that children seem to manifest the same severity of inattentiveness symptoms both at school and home.

Finally, frequency of contact resulted negatively correlated with the severity of symptoms, partly confirming Hypothesis no. 2. Specifically, children's frequency of contact (rated by children) resulted moderately and negatively correlated with the inattentiveness rated by parents ($r = -.39$), indicating that, plausibly, being in contact with Nature helps to diminish symptom severity. Although, it is important to consider that these outcomes are based on correlations and not on an experiments that offer insights on a hypothetical cause and effect relation. However, such interpretations are in accordance with previous studies such as Faber Taylor et al. (2001) and Kuo and Faber Taylor (2004) which demonstrated that green outdoor activities, conducted after school and at weekends, reduced symptoms significantly more than did activities conducted in built indoor and built outdoor settings.

Contrary to previous outcomes, analyses indicated a finding in contrast to hypothesis no. 2: a positive (instead of negative) correlation between symptoms severity of inattentiveness and hyperactivity assessed by the parents and connection with Nature of the children ($r = .67$; $r = .66$). This could be due to the small sample or the type of measures. Further investigation is needed to address the relationship between connection to Nature and symptoms severity, rather than only the relationship between frequency of contact and symptoms severity, as already assessed in literature (Faber Taylor et al., 2001). Another aspect that could be addressed by future investigation is to test a

mediation model in order to see, for instance, whether connection to Nature is a mediator factor between frequency of contact and symptom severity. Previous studies suggest that frequency of contact predicts an emotional connection to Nature (Cheng & Monroe, 2012; Collado et al., 2013) and that contact with Nature is related to a lower severity of symptoms. However, to the best of our knowledge, a study investigating the three variables in a mediation model is presently missing. Also, future investigation could focus on the relation between severity of symptoms and children's contact with Nature in order to investigate whether the former predicts the latter. This could be due to the fact that children with lower symptoms feel more like going out into Nature whereas those coping with more severe symptoms tend to have less motivation, therefore remain indoors.

Considering the limitations of the present study (small sample, low reliability of FoC scales and SDAB), overall, the study showed that contact with Nature might partly ameliorate ADHD symptoms and that frequency of contact and connection to Nature of children might be influenced by family members' levels of frequency of contact and connection to Nature.

Implications of the present study might be addressed to parents and teachers. Both are invited to consider the benefits of Nature contact for renewing children's resources, offering chances to ameliorate social relations, impaired by deficits in joint attention (Marotta et al., 2013) and improving quality of life.

STUDY 4

**ATTENTION, MINDFULNESS AND RESTORATION: AN EXPLORATIVE STUDY AT THE
BOTANICAL GARDEN AMONG HEALTHY ADOLESCENTS**

5.1 Introduction

Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) states that restoration works on a continuum level, from a superficial to a deep degree. Basic restoration allows eliminating cognitive noise that causes mental fatigue, moderate restoration allows attention to be attracted effortlessly (temporary inactivity of directed attention) and a high level of restoration which allows the person to reflect (Herzog et al., 1997; Kaplan, 2001). In order to experience restoration, firstly people need to be engaged with the environment, secondly, perceive its several characteristics. This is partially due to the soft fascination process in which attention is attracted effortlessly and people can softly engage with the surroundings by being still able to reflect (Herzog et al., 1997).

Softly engaging with the environment and being resistant to distractions at the same time, allows people to be in the Here and Now, a condition of a healthy brain (Siegel, 2007; 2009). As consequence, individuals feel restored. Based on Kaplan's meditation-fascination hypothesis (2001), such (environmental) restoration is considered to be a meditative-state or, as Cumes (1998) states, a "wilderness rapture" which includes a sense of self-awareness.

However, as mentioned in the conceptual framework of the present thesis (paragraph 1.1), attention is also related to several dynamics which are not directly linked with what individuals are doing in the present and is oriented to endogenous stimuli (unrelated to the Here and Now yet related, for instance, to past or future contents). Indeed, mind-wandering is the process by which thoughts drift away from what the person is currently doing. Some researchers agree in defining mind-wandering as task-unrelated thought (please see Christoff, 2012; McVay & Kane, 2009). Mind-wandering is also defined unguided attention, since "the focus of attention drifts unguided from one topic to the next" (Irving, 2015, p. 563). Other two processes, mostly antithetical to mind-wandering, could be rumination and absorption, in which attention remains fixed on a single topic. What differs among them is the stability versus instability of attention: in the process of mind-wandering attention is unstable, whereas in rumination and absorption it is stable and thoughts remain fixed.

Mind-wandering, absorption and rumination are forms of attention unrelated to the Here and Now and though are likely to prevent to fully experience the present moment. Hence, “this ‘lack’ of awareness may affect the perception of the restorativeness associated with exposure to Nature” (Berto et al., 2018, p. 2). Conversely, being mindful while engaging with Nature is likely to enhance the benefits that it offers, “in other words, the effects of Nature exposure may be more robust when individuals are fully immersed in these environments and more ‘fully’ present in their context compared to ... when they are distracted by thoughts and/or external stimuli unrelated to the natural environments” (Berto et al., 2018, p. 2). Mindfulness makes reference to a state of acceptance without judgement, to people’s ability to experience the present moment without evaluating it. Indeed, Mindfulness-based practices have been implemented to improve the conscious regulation of emotions, thoughts, and behaviours (Brown, Ryan, & Creswell, 2007; Chiesa, Serretti, Jakobsen, 2013; Holzel et al., 2011), dimensions impaired in the ADHD.

From literature research, only two studies seem to address these points: Lymeus et al., (2017) and Berto et al., (2015). The former, conducted among healthy adults, shows that practicing mindfulness in a natural environment reduces the attentional fatigue that beginners usually experience (the concept is that Nature helps to practice mindfulness); whereas the latter, conducted among healthy children, shows that an activity of mindful silence in a school context evoked restoration, yet also exposure to natural environment evoked restoration (the concept is that both Nature and Mindfulness evoke restoration, even though in a passive and active process).

In particular, Berto et al. (2015) contributed to understand children’s perception of restorativeness and the potential that natural environments might have in restoring their resources. They compared children’s perceived restorativeness, sense of connection with nature, and attention performance through environmental (natural and built) conditions and ongoing activities conditions. Authors used self-report instruments to assess both the perceived restorativeness and the connection to nature and measured the attention performance through the continuous performance test (CPT).

Moreover, they measured some physiological parameters in different settings and after different activities: in the classroom after the practice of Mindful silence, in the school playground after the school break, in an alpine wood after a walk. The activity of Mindful silence was taking place in the classroom. Based on Kaplan's fascination-meditation hypothesis (2001), fascination is the core aspect of restorative experiences and it can also be evoked by the practice of Mindful silence, since it is considered an activity requiring involuntary attention. The authors aimed to verify whether adults and children share the same process of psychological restoration. The most striking result makes reference to the perception of restorativeness that children experienced: the perception changed both depending on activity and place. In fact, because of the Mindful Silence condition, children felt more restored in the classroom than in the wood and this activity in turn could help in fostering the nature connectedness. Based on this study, fascination results from activities or environments that elicit fascination, which is the less effortful form of attention (involuntary) and it "is deployed when environmental stimuli are intrinsically interesting" (Berto et al., 2015, p. 7). Finally, Berto et al., (2015) show that restorativeness in children works as it does in adults, and that the choice of a restorative environment varies with the degree of naturalness and these results are consistent with Kaplan's ART and the fascination-meditation hypothesis.

In summary, the above-mentioned literature suggests that Nature helps to be mindful and both mindfulness and Nature contribute into experiencing restoration. In other words, restorative environments and mindfulness both aim to break automatic thoughts (that generate mental fatigue and prevent restoration), respectively in a passive and an active process (Barbiero & Berto, 2016).

However, what remains empirically unclear is whether a relation exists between mindfulness (trait or having mindful abilities) and restoration. In other words, between being mindful and fully perceiving the restorative qualities of a restorative environment and, finally, feeling recovered.

The present study

The aim of the present study is to empirically address whether a relation exists between being mindful (a trait rather than a state) or having mindful abilities with perceived restorativeness and reported restoration after Nature by applying the Kaplan's fascination-meditation hypothesis (2001). This aim constitutes an innovative point of the present study. Literature suggests a reciprocal relation between Nature and mindful states (Berto et al., 2015; Lymeus et al., 2017). Study 1 and 2 suggest that also for ADHD children and adolescents a reciprocal relation between Nature and mindful states exists (as resulted by reported thoughts which were mainly focused on the Here&Now). However, eliminating the cognitive noise did not necessarily mean a full recovery of directed attention (as shown by the lack of attention recovery in Study 2). Therefore, it is necessary to find a way to increase the benefits of Nature contact to experience the second and third level of restoration. This is the general purpose of the present study. The full study considers also other variables (beauty of the place or aesthetics, trait connectedness with Nature, trait dispositional affect and frequency of contact with Nature), yet they will not be taken into account in the thesis.

As mentioned further on in the Participants section, the present study is conducted on typical adolescents rather than on ADHD and the underlying reasons are worth mentioning. The first reason is that a theoretical model concerning the relation between the variables does not yet exist in literature, therefore the present study intends to explore whether it exists. The second reason is that, basically, ADHD presupposes an incapacity to be in the Here and Now and a tendency to be distracted, impulsive, and hyperactive; therefore, such a relationship is unlikely or harder to be found among ADHD samples. However, if the relation exists on typical samples, applying mindfulness to ADHD adolescents is still feasible since mindfulness abilities can be cultivated through regular practice, as successfully demonstrated by Zylowska et al., (2008). This topic will be further explored in the discussion section.

Overall, the present study is aimed to explore whether being mindful leads to fully and vividly perceive the restorative characteristics of a natural environment and hence feeling restored (reported restoration after the visit), operationalized through the two hypotheses reported below.

Hypothesis

Adolescents' mindfulness abilities would predict their reported restoration and this relation would be mediated by adolescents' perceived restorativeness.

In other words, as it can be seen in Figure 18, adolescents' mindfulness abilities are expected to predict adolescents' reported restoration, through participants' perceived restorativeness.

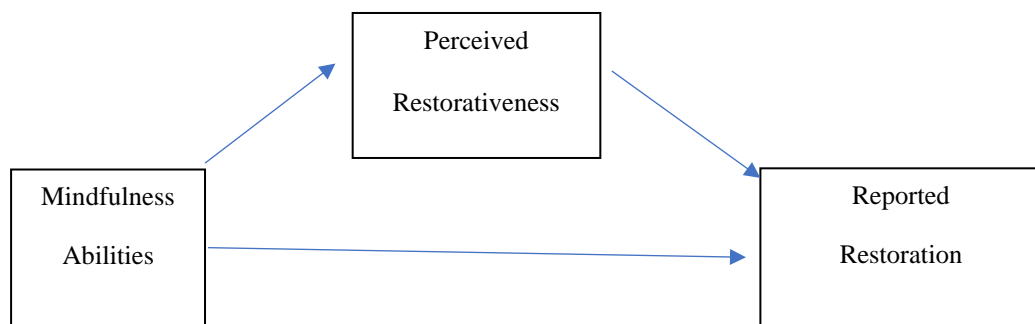


Figure 18. Illustration of the hypothesis.

5.2 Method

Participants

The sample consisted of 184 adolescents aged 14 to 18 ($M = 15.20$, $SD = 0.93$). Forty-seven percent of participants were males whereas fifty percent were females. The rest of participants did not declare the gender. All participants were students of public secondary schools.

Study site

The Rome Botanical garden was selected for data collection. Botanical gardens are examples of urban Nature that could be taken advantage of in order to experience psychological restoration from daily demands (Carrus et al., 2017). The Rome Botanical garden is part of Sapienza University of Rome, it is located in the city centre since the year 1883, and it occupies a surface of 12 hectares. It hosts a series of collections such as bambus and palms, gardens such as the Japanese and Mediterranean, as well as green houses and historical fountains. A testing room is located right at the entrance of the Botanical garden and it was made available by the director of the Botanical garden. The Botanical garden director gave written consent for conducting the data collection. Fig. 19 shows a map of the Botanical garden.

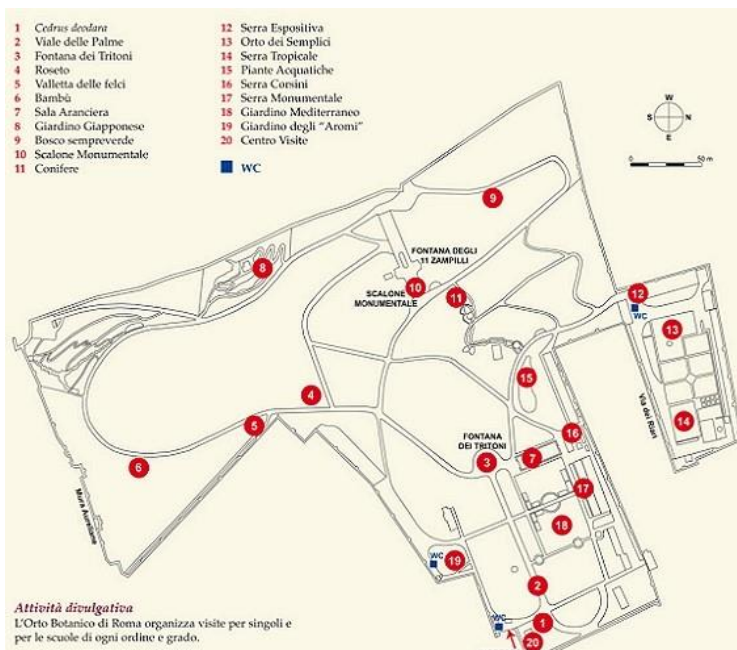


Figure 19. Map of the Rome Botanical Garden part of Sapienza University.

Procedure

The study procedure was approved on the 20th of November 2017, identification no. 1193, by the Ethical Committee within the Department of Psychology of Developmental and Socialization Processes, Sapienza University of Rome. From October 2017, after that secondary schools of Rome area and province scheduled their didactic visit at the botanical garden, they started to receive the invitation to participate into the data collection on the date of the visit. Once they expressed their agreement, a consent form to be signed by the students' parents was sent. On the testing day, consent forms were collected. Students who did not bring their signed consent form or parents did not want them to participate (or the students either did not want to be involved) were excluded from the testing procedure. Data were collected between October 2017 and May 2018. Testing was executed through a questionnaire (not all the measures implemented are considered in the present thesis), which was organized in two sections: one to be filled before the visit and another one to be filled after the visit of the Botanical Garden. Instructions were explained by the experimenter and were written on each scale. The experimenter remained available during data collection to give assistance, if needed. It took about thirty minutes to collect the full data for each subject. The didactic visit was guided by a naturalist who showed most of the botanical garden through a standard tour for all the participants. Data collection took place during weekdays.

Measures

Mindfulness measurement

The Child and Adolescent Mindfulness Measure (CAMM; Greco, Baer, & Smith, 2011) is aimed at evaluating mindfulness skills in children and adolescents. It was translated and validated into Italian by Ristallo et al. (2016). It consists of 10 items and judgements are made on a 0-to 4-point scale where 0 = never and 4 = always. Please see Appendix P. For instance, item 6 reads: "It's hard

for me to pay attention to only one thing at a time”. Alpha value of the CAMM used in the present study is equal to .75.

Perceived Restorativeness measurement

As in Study 1 and 2 within the present research programme, the Perceived Restorativeness Scale for children (PRS-ch) was implemented (Appendix G). It is a self-report scale based on the ART (Kaplan, 1995) aimed to measure the perceived restorative value of a place. The PRS-ch was developed by Hartig et al., (1997) and then adapted to children by Bagot (2004).

The Italian version for children, the one used in the present study, was validated by Berto et al. (2012). It consists of 17 items organized in four restorative factors (being away, scope, coherence, fascination) and a single item measuring environmental preference. Judgements are made on a scale of 0 to 10, where 0 = “not at all” and 10 = “very much”. For instance, item no. 1 reads: “In this place I don’t think at my worries”. Alpha value of the perceived restorativeness scale used in the present study is equal to .92.

Reported restoration measurement

As in Study 2 within the present research programme, the Reported Restoration Scale for children (Appendix H) is a self-report scale aimed to measure the restoration reported by participants, that is how they effectively report to feel after being in contact with a restorative environment. The reported restoration scale was originally developed by Staats et al. (2003) for adults and then adapted to children by Collado et al., (2016). The version used in the present study is made of thirteen items. Judgements are made on a seven-point Likert scale, where 1 is for “totally in disagreement” and 7 is for “totally in agreement”. For instance, item no. 1 reads “I feel free and relaxed”. Alpha value of the reported restoration scale used in the present study is equal to .91.

5.3 Statistical analyses

In order to test the hypothesis of the study, a Pearson correlation coefficient was computed to assess the relationship between mindfulness abilities, perceived restorativeness and reported restoration. Afterwards, a mediation analyses with mindfulness as predictor (IV), reported restoration as dependent variable and perceived restorativeness as mediator was conducted by using the Model 4 of Process SPSS (Hayes, 2013). In addition, a bootstrapping procedure (with 5000 bootstrap samples) to estimate 95% confidence intervals (95% CI) was used. A 95% CI that does not include zero suggests the existence of a significant indirect effect (Preacher & Hayes, 2008; Hayes & Scharkow, 2013).

5.4 Results

To test the hypothesis, a Pearson correlation coefficient was computed to assess the relationship between mindfulness (independent variable), reported restoration (dependent variable), perceived restorativeness (mediator). There was a positive weak correlation between mindfulness (independent variable) and perceived restorativeness (mediator), $r = .23$, $p < .001$ and a positive moderate correlation between the perceived restorativeness (mediator) and reported restoration (dependent variable), $r = .52$, $p < .001$. However, a correlation between mindfulness (independent variable) and reported restoration (dependent variable) was not revealed.

Afterwards, mediation analysis was used to investigate the hypothesis that perceived restorativeness mediates the effect of mindful personality on reported restoration. Results indicated that mindful personality was a significant predictor of perceived restorativeness, $\beta = .57$, $SE = .182$, $p < .001$, ($R^2 = .055$), and that perceived restorativeness was a significant predictor of reported restoration, $\beta = .40$, $SE = .051$, $p < .001$ ($R^2 = .275$). These results support the mediational hypothesis. However, mindful personality was not a significant predictor of reported restoration after controlling for the mediator, perceived restorativeness, $\beta = -.01$, $SE = .127$, ns. ($p = .92$). Although analyses did

not reveal a total effect between predictor and dependent variable, based on Hayes (2009) and Shrout and Bolger (2002), it is legitimate to conclude that M mediates the relationship between IV and DV even if the total effect (*c*) is not significant, therefore perceived restorativeness mediates the association between mindful personality and reported restoration. Infact, approximately 28% of the variance in reported restoration was accounted for by the predictors ($R^2 = .275$). The indirect effect was tested using a bootstrap estimation approach with 5000 samples (Hayes & Scharkow, 2013; Preacher & Hayes, 2008). These results indicated the indirect coefficient was significant, $\beta = .23$, $SE = .081$, 95% $CI = .0944, .4097$. Mindful personality was associated with approximately .33 points higher reported restoration scores as mediated by perceived restorativeness. Please see Table 1 and Figure 20. Findings support hypothesis.

Table 27. *M*, *SD* and Pearson correlations among independent variable, dependent variable and mediator (N=183)

	<i>M</i>	<i>SD</i>	Mindfulness	Perceived Restorativeness	Reported Restoration
Mindfulness	1.71	0.68	1	.23***	0.11
Perceived Restorativeness	6.3	1.70	.23***	1	.52***
Reported Restoration	6.34	1.29	0.11	.52***	1

Note : *** = $p < .01$; *M* = means; *SD* = standard deviation.

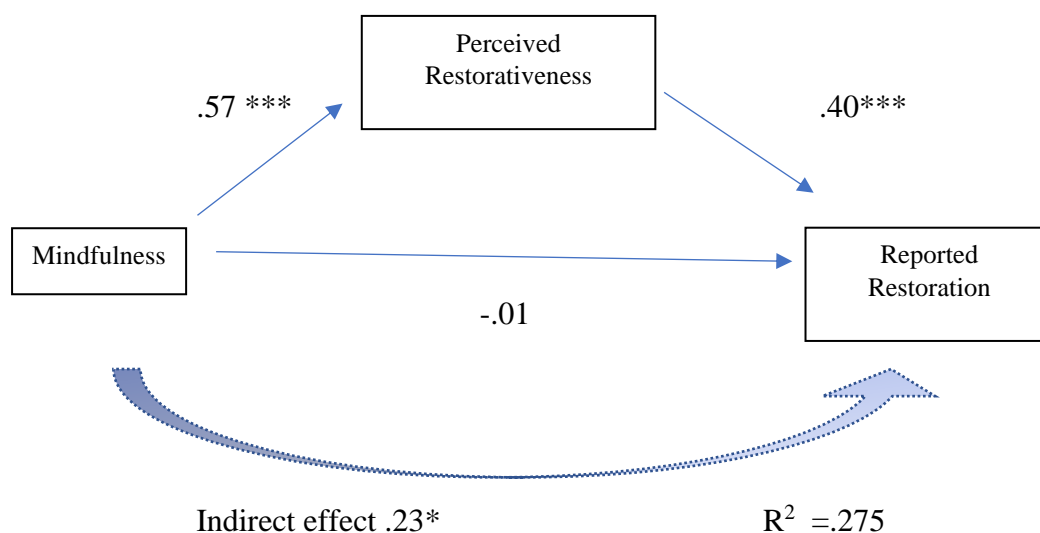


Figure 20. Mediating model which shows the effect of mindfulness on reported restoration after the visit through perceived restorativeness

Note: * $p < .05$; *** $p < .001$.

5.5 Discussion

The aim of the present study is to empirically address whether a relation exists between being mindful (a trait rather than a state) or having mindful abilities and (reported) restoration after contact with Nature through the mediation of perceived restorativeness. The model is inspired to the Kaplan's fascination-meditation hypothesis (2001) which basically states that fascination and meditation (a mean to cultivate the mindfulness) are crisscrossed. Natural environment holds the power of soft fascination, since it "has a special advantage in terms of providing an opportunity for reflection, which can further enhance the benefits of recovering from directed attention fatigue" (Kaplan, 1995, p. 172). Such opportunity for reflection constitutes the third level of restoration (Herzog et al., 1997; Kaplan, 2001), a deeper level compared to first and second (respectively elimination of cognitive noise and inactivity of directed attention). Meditation, to use author's definition (in the present study the word mindfulness is used, which is the state reached by the meditation practice), is the process to learn working on involuntary mode, enhancing the effects of Nature contact. Although mindfulness is learnable, practice is effortful. However, as Lymeus, Lindberg and Hartig, (2018) suggest, a meditation course conducted in a natural environment (named Restoration Skills Training; ReST) is less effortful than conventional meditation courses hence people can learn working on involuntary mode without struggling, as usually happens in the first phases of practice. The underlying hypothesis was that adolescents' mindfulness abilities would predict their reported restoration through the mediation of adolescents' perceived restorativeness. In other words, adolescents' mindfulness abilities were expected to predict adolescents' reported restoration through participants' perceived restorativeness.

Findings first revealed that there was a positive weak correlation between mindfulness (independent variable) and perceived restorativeness (mediator), $r = .23$, $p < .001$, and a positive moderate correlation between the perceived restorativeness (mediator) and reported restoration (dependent variable), $r = .52$, $p < .001$. However, mediation analyses were successful. Such analysis

first showed that mindful personality was a significant predictor of perceived restorativeness, $\beta = .57$, $SE = .182$, $p < .001$, ($R^2 = .055$), and that perceived restorativeness was a significant predictor of reported restoration, $\beta = .40$, $SE = .051$, $p < .001$ ($R^2 = .275$).

Yet, mindfulness abilities were not a significant predictor of reported restoration after controlling for the mediator, perceived restorativeness, $\beta = -.01$, $SE = .127$, ns. ($p = .92$). However, although analyses did not reveal a total effect between predictor and dependent variable, based on Hayes (2009) and Shrout and Bolger (2002), it is legitimate to conclude that M mediates the relationship between IV and DV even if the total effect (c) is not significant, therefore this suggests that perceived restorativeness mediates the association between mindful personality and reported restoration. Approximately 28% of the variance in reported restoration was accounted for by the predictors ($R^2 = .275$), showing that being mindful is related to reported restoration, yet with the influence of perceived restorativeness. In other words, this finding suggests that if a person approaches Nature in a mindful way, by being present to what happens in the surroundings and to the several characteristics that natural environments hold, or by fully perceiving the restorative characteristics intrinsically present (perceived restorativeness), feeling restored or recovered after the visit is an expectable outcome (reported restoration).

Finally, to confirm the hypothesis of the study, the mediation analyses also revealed an indirect effect of predictor on dependent variable $\beta = .23$, $SE = .081$, 95% CI = .0944, .4097, which shows that mindfulness abilities was associated with approximately .33 points higher reported restoration scores as mediated by perceived restorativeness. This study gives an insight into the exploration of fascination-meditation hypothesis (Kaplan, 2001) suggesting that being mindful - acting with awareness (the opposite of automatic responding) moment by moment, observing the surroundings with openness and curiosity, without giving a judgement and without an automatic reaction to them (Baer, 2003) - leads to perceived restorativeness and hence feeling restored.

6. GENERAL DISCUSSION

Attention deficit hyperactivity disorder is a childhood onset disease of the neurodevelopment that can persist across the lifespan (Barkley, 1997, 1998; Brodeur & Pond, 2001) and is mainly manifested through inattentiveness, hyperactivity and impulsivity. Although the onset of this disease is widely considered as neurobiological, psychological factors play an important role in the maintenance of the disease (Fabio, 2001). Many researchers agree that the ADHD aetiology relates to a multi-factored hypothesis, in which neurobiological predisposing factors are strictly associated to stressors such as those regarding environmental and educational aspects (Marzocchi, 2003) of family and school settings. More specifically, a multi-factored approach takes into consideration cognitive, motivational, behavioural, genetics components and self-regulation deficits (Fabio, 2001). Some of the triggering factors include the family's lifestyle and education. An excessively rigid or permissive style, with too many or few and unclear rules, can favour behaviours associated with the deficit, as well as media exposure since it is considered a variable linked to sustained attention (Fabio, 2001; See Hutton, Dudley, Horowitz-Kraus, DeWitt, & Holland, 2019; McIlwraith, 1998). If subjects with hyperactivated arousal (hyperactive sub-type) are exposed to environmental and relational structural disorganization, in other words too chaotic and disordered environments, the risk of developing or maintaining ADHD increases. Based on data, international prevalence of the disease in developing areas is around 5.29% (Polanczyk et al., 2014), whereas in Italy the range is between 0.4% and 3.6%, depending on geographical areas and, assuming the lowest value, the pathology affects about thirty thousand children and adolescents. Moreover, the 88,5% of those affected is constituted by males (Maschietto et al., 2012). However, literature suggests that children from traditional societies, those that traditionally keep in constant contact with Nature, might also suffer from ADHD. In fact, indigenous children from the Brazilian Amazon, as well as aboriginal children from Canada, Australia and Taiwan seem to be affected by the western concept of ADHD (Azevêdo et al., 2010; Baydala et al., 2006; Chan et al., 2016; Loh et al., 2016). Usually, traditional societies keep contact

with Nature by considering it sacred and children still roam freely (Chawla, 2015). This is because Nature is part of cultural heritage and such value is passed from generation to generation. Nevertheless, it is worth noticing that even though traditional societies tend to have much greater contact with Nature than western population, ADHD (in western terms) seems to affect children from traditional societies. This would probably confirm the neurobiological origin of the disease, and although symptoms can be partially alleviated through behavioural therapies such as environmental ones (with Nature contact), they cannot be fully treated. Future investigation should address whether any statistics on ADHD among indigenous populations exist and deepen any relation with Nature contact, from cultural values to lifestyles adopted by the communities, from pregnancy to adulthood with the purpose to broaden the conceptualisation of ADHD.

In general, this dissertation aims at achieving a deeper understanding of ADHD symptoms severity whilst children are experiencing Nature, through two main objectives or central points. The first one, which concerns the major part of this research project, consists in investigating if and how symptoms are alleviated after walking in different built and natural environments through addressing three sub-objectives: (1) evaluating the recovery effect of different types of outdoor environments (natural and built, the latter historical-urban and standard-urban), (2) evaluating the recovery effect of two different types of natural environments, (3) evaluating the recovery effect by considering the frequency of contact with Nature and the system of relations that involves the child. The second one, consists in investigating whether being mindful leads to fully perceive the restorative characteristics of a natural environment and finally report feelings of restoration. In general, Studies 1, 2 and 3 addressed the first central point whereas Study 4 addressed the second central point.

Study 1 addressed objective 1.1, which aimed at evaluating the recovery effect of different types of outdoor environments (natural and built, the latter historical-urban and standard-urban). Findings showed that ADHD children and adolescents recovered attention only after walking in the natural environment (historical vs. urban conditions) and that the natural environment was perceived

as significantly more restorative than the urban-historical (and the latter significantly more restorative than the standard-urban environment). In addition, the treatment (a twenty minutes individually guided walk) itself (without environmental effects) revealed to be effective to reduce impulsivity. These findings are consistent with literature, such as Faber Taylor and Kuo (2008) and Van den Berg and Van den Berg (2011) yet give new insights, for instance on the role of historical sites. In fact, perceived restorativeness of the historical environment was higher than the standard-urban, suggesting that historical sites offer potential restoration also amongst ADHD children and adolescents. Other insights offered by Study 1 regard the type of natural environment that elicited recovery on ADHD children, which was a large open field rather than a wood or an urban park and the simple activity that alleviated impulsivity (a twenty minute walk). Moreover, the thoughts of the participants during treatment (reported after treatment) were more focused on the here and now in the natural environment than in the two built settings. This demonstrates that the fascination-meditation hypothesis (Kaplan, 2001) was effective on them and that, in other words, they could experience the first and second level of restoration, respectively elimination of cognitive noise and directed attention recovery (Herzog et al., 1997). This outcome is related to the general objective or central point no. 2 and is another innovative point of Study 1. In addition, and as a marginal result, perceived restorativeness was negatively correlated with emotions, showing that the more an environment is perceived as restorative, the less negative emotions are experienced by individuals. This outcome is in accordance to Van den Berg and Van den Berg (2010). A limitation of Study 1 is the sample size. Future investigations should include more participants. Implications are varied yet rely on the same point: promoting Nature contact is not only preventing disease but also promoting health. In the case of ADHD, Nature contact does not only prevent from additional issues related to the disease but also promotes health by ameliorating symptom severity. Moreover, daily contact with Nature comes at zero costs and offers benefits to the entire family (as suggested by Study 3).

Study 2 addressed objective 1.2, which aimed at evaluating the recovery effect of two different types of natural environments, one characterised by high prospect and low refuge (the palms area) and the other characterised by low prospect and high refuge (the Mediterranean area). In other words, a comparison of an area with a clear visual field with another without clear visual field and potential hiding places. Both aspects influence the perception of security (Appleton, 1975). Findings show that there were no differences between the two environments and, paradoxically, treatment worsened their performance. Furthermore, about 30% of participants displayed behaviours of inattentiveness and impulsivity during treatment in both environmental conditions, showing that they could not engage with Nature hence experience restoration. Treatment could not be effective on them.

Although it is not clear yet what caused the depletion, some interpretations are given. Amongst several interpretations mentioned in the discussion section of Study 2, one relies on the characteristics of the testing site, a Botanical garden, which is an example of urban Nature (Carrus et al., 2017), yet not only simple urban Nature. Infact, it shows a great human intervention by being a place where collections of plants and trees are grown for scientific study and exhibition, a well-tended area. Considering that some people define Nature as places “unaltered by human beings” (Vining et al., 2008 p. 8) and feel connected to such places, it is arguable that maybe a Botanical garden is not as restorative as a place characterised by wild and pristine Nature (see Berto et al., 2018) and maybe this could be true for ADHD children and adolescents. Infact, accordingly, in Study 1 children and adolescents were recovered after being exposed to quite pristine Nature, a large open cultivated field with high prospect (on tens of hectares) located in a natural reserve, with low human intervention. Conversely, although the palms condition in the Botanical garden was selected for representing a high prospect (and low refuge) condition, the field of vision could be widely extended only up to some tens of meters rather than tens of hectares like in the large open field. Hence, Nature altered by human beings (Vining et al., 2008) and field of vision could be taken into account as preventing factors for restoration.

Another interpretation relies on the often-cited concept of nearby Nature (Ekkel & de Vries, 2017; Wells, 2000), which is likely to be in contrast with the idea of far-away Nature. In fact, the testing site was about one hour driving from where the participants reside. This could have affected their resources, the children and adolescents who participated in the study could have been more easily tired, among other factors. Although there were no significant differences between the two conditions on ADHD symptoms, tendencies of the medians showed that palms area led overall towards more restoration than the Mediterranean area. Moreover, in the palms area the majority of participants reported restoration thoughts (related to the here and now), suggesting a certain potential degree of restoration (Kaplan, 2001). This outcome is more related to the second main objective of the present thesis. In general, Study 2 attempted to experimentally address a topic under researched: a comparison of natural environments rather than a comparison of a natural versus built environment. Overall, literature shows the benefits of Nature contact (Chawla, 2015; Franco et al., 2017) without suggesting which types of natural environments lead to which level of restoration. Comparison of natural environments has been scarcely addressed with a few exceptions (please see Berto, Barbiero, Barbiero, & Senes, 2018) which do not include ADHD samples. Therefore, Study 2, overall, addresses an innovative point. Limitations of Study 2 rely mainly on the numerosity of the sample which was too small for testing the hypotheses and obtaining outcomes that could be generalized. Moreover, the setting constituted an additional important limitation. As mentioned, a botanical garden represents urban Nature and human involvement and maybe these are the reasons why it seems not to have led to restoration. Another limitation of Study 2 (and Study 1 for the same reason) is the 10 minutes fatigue provoking task through the implementation of puzzles, “scattories” and maths problem that would probably increase the tiredness already experienced by the participants. The purpose of the task was to provoke mental fatigue prior recovery (Kaplan, 1995). Nevertheless, researchers designing future investigation could consider the possibility to avoid a fatigue provoking task in the schedule of the procedure since the sustained attention tests as well as the impulsivity tests

require a prolonged use of attention indeed mental fatigue (Kaplan, 1995) has already occurred as a direct consequence.

Future research attempting to compare natural environments with the purpose to find the adapted setting for alleviating ADHD symptoms, might consider these points as well as the distance that has to be covered to reach the testing site, which might predispose the (ADHD) participants to tire out faster. In addition, further investigation should better consider the need of ADHD children (especially those diagnosed with hyperactivity prevalence) to be in constant physical movement, and the importance of the ART compatibility factor (Kaplan, 1995) which states that the environment should be compatible to one's needs in order to be restorative. Indeed, as for Study 1, researchers should investigate a treatment that allows ADHD children to freely move in the provided space, for instance through free play in Nature (conversely to a low pace walk as in Study 1 and Study 2). Furthermore, future research should compare characteristics of different natural environments, though diverse natural environments and evaluate the recovery effects on ADHD children in order to understand which natural areas are more compatible to their needs (Faber Taylor et al., 2001; Faber Taylor & Kuo, 2011; Kuo & Faber Taylor, 2004).

Study 3 addressed objective 1.3 which aimed at evaluating the recovery effect by considering the frequency of contact with Nature and the participant's system of relations. Main findings showed that the mothers' connection to Nature correlated with the fathers and children's connection to Nature and that mothers' connection to Nature correlated with the frequency of contact with Nature the children had. Moreover, children's frequency of contact with Nature was negatively correlated with symptoms, suggesting that the more children engage with Nature, the less they report inattentiveness and impulsivity. Overall, these findings showed that children's frequency of contact with Nature is related to a wider familial system that concerns both the frequency of contact and the connection to Nature. Integrating these aspects would in turn influence ADHD symptoms, alleviating them. It is important to consider that joint attention – the one concerning the processing of social aspects of

attention or the social cognition - seems to be impaired among ADHD children and adolescents (Marotta et al., 2013), indeed, engaging with Nature as a group (family or school) not only might have an impact on the frequency of contact but also on the quality of relations, by indirectly improving joint attention. Limitations of Study 3 mainly consists in the numerosity of the sample and the low reliability of some scales. Implications of Study 3 relies on the importance to promote Nature contact on the family system (and school system based on outdoor pedagogies and green breaks) rather than only on individual basis, since it seems to be more effective (Amicone et al., 2018). This point is even more important when considering ADHD and the fact that the main settings in which it is manifested, and though are more challenging for the individual, are household and school. However, both contexts can become Nature contact promoters and an integrated or joint approach might enhance the benefits.

Up to this point, the thesis has focused on ways of alleviating ADHD symptoms, through exposure to certain types of outdoor environments as well as on certain types of natural environments, on the frequency of contact and the social context involved. This main objective was reached by involving ADHD participants. However, Study 4 was not conducted among ADHD participants. It addressed objective 2 which investigated whether being mindful leads to fully perceive the restorative characteristics of a natural environment and finally report feelings of restoration.

This second main objective of the thesis was based on the fascination-meditation hypothesis (Kaplan, 2001) which is tightly connected to the first main objective. Infact, natural environment holds the power of soft fascination, since it “has a special advantage in terms of providing an opportunity for reflection, which can further enhance the benefits of recovering from directed attention fatigue” (Kaplan, 1995, p. 172). Such opportunity for reflection constitutes the third level of restoration, (Herzog et al., 1997; Kaplan, 2001), a deeper level compared to first and second (respectively elimination of cognitive noise and inactivity of directed attention). Some outcomes of Study 1 and 2 are related to the wider purpose of Study 4. As briefly mentioned above, Study 1 and 2 suggest that the relation between Nature and mindful states could be effective also for ADHD

children and adolescents, as resulted by participants' reported thoughts, which were mainly focused on the Here&Now in the natural conditions. However, findings of Study 1 and 2 showed that first level of restoration (eliminating the cognitive noise) did not necessarily lead to a second level of restoration (a full recovery of directed attention as mainly showed by the lack of attention recovery in Study 2). Although both studies have several limitations that need to be considered (as already listed above), such outcomes suggest that it is necessary to find a way to increase the benefits of Nature contact in order to experience the second and third level of restoration (respectively, inactivity of directed attention and opportunity for reflection), which is the more general purpose of Study 4. However, participants of Study 4 were healthy adolescents and this was because the study intended to explore a theoretical model which is under researched - with a few exceptions that slightly empirically addressed the topic (Berto et al., 2015; Lymeus et al., 2017; 2018) - with the wider purpose of applying it to ADHD adolescents in the future. Basically, the mediational model consisted of mindfulness abilities as predictor, reported restoration as dependent variable and perceived restorativeness as mediator. The sample was not constituted by ADHD participants for two reasons. The first one is that a theoretical model concerning the relation between the variables does not yet exist in literature, therefore the study intended to explore whether it exists and this needs to be done on typical samples. The second reason relies, basically, on general characteristics of ADHD that could hinder the verification of the theoretical model. Infact, the disease presupposes an incapacity to be in the Here and Now and a tendency to be distracted, impulsive, and hyperactive; therefore, such a relationship is difficult to be tested among ADHD samples. However, the core aspect of the study is showing that if the relation exists on typical samples then the theoretical model could be applied to ADHD. Practical implementation of the model is likely to be more easily applied to ADHD than the testing of its theoretical part. Infact, literature suggests that applying mindfulness to ADHD adolescents is feasible since mindfulness abilities can be cultivated through regular practice, as successfully demonstrated by Zylowska et al., (2008) who conducted an 8-week mindfulness training program among ADHD adolescents (more details below) with considerable outcomes.

Findings of Study 4 showed that the mediational hypothesis was successful: mindfulness abilities predicted reported restoration through perceived restorativeness as mediator. This is an important outcome if taking into consideration how attention functions: it processes information of stimuli that, based on Chun et al., (2011) are both exogenous (in the external world context) and endogenous (personal goals and internal mental states). Information processing is the result of exogenous and endogenous stimuli interaction, in other words, the processing of a biologically salient stimulus depends on transient internal states of the individual. Consequently, it is paramount to consider that transient internal states of the individual, whether these are mindful or not, influence the perception of the natural surroundings and hence have an impact on the level of reported restoration. If individuals mindfully engage with Nature they are likely to more fully and vividly perceive its restorative characteristics and hence feel restored.

This outcome offers an opportunity to future investigate whether ADHD children and adolescents can benefit more from Nature exposure. In fact, as happened in Study 2, ADHD participants are likely to be inattentive and hyperactive during Nature treatment, hindering the restoration process. However, although being mindful is unlikely to be expected by ADHD children and adolescents, mindfulness abilities are learnable through practice. Indeed, it is worth mentioning that Zylowska et al., (2008) demonstrated the feasibility of an 8-week mindfulness training programme for ADHD adolescents. Authors showed that, after treatment, participants reported high satisfaction, improvements both in self-reported symptoms and attention and cognitive inhibition objective tasks as well as on anxiety and depressive symptoms. It is expected that benefits found by authors might be increased by conducting the training in a natural setting (Lymeus et al., 2017; 2018). In this way, the attentional effort required during the first phases is offset by the natural stimuli of the environment. In addition, learning mindfulness allows ADHD adolescents to reap greater benefits from future Nature exposure. This is due to the fact that, restorative environments and mindfulness, both aim to break automatic thoughts (that generate mental fatigue and prevent restoration),

respectively through a passive and an active process (Barbiero & Berto, 2016). Indeed, integrating them would likely multiply the benefits.

In other words, if ADHD children engage with Nature in a more mindful (or active) way - and is done by actively engaging with the surroundings in a top-down process or from a mindful point of view (being aware of what reaches the senses etc.), rather than only in a passive way (simple exposure), then the benefits are greater. For instance, attention might be improved.

Lastly, the findings revealed by the present research programme suggest that ADHD children and adolescents can benefit from walking at least twenty minutes in a natural “wild” or pristine context such as a large open field (see Vining et al., 2008), engaging with Nature on a regular basis and by including the main social contexts (family and school). In addition, findings reveal that being mindful increases the (reported) restoration after Nature contact, thanks to the mediation of perceived restorativeness (Kaplan et al, 2001). Therefore, it is expected that being mindful during Nature contact might increase the benefits of (passive) exposure, but this aspect needs to be empirically demonstrated through future experimental research (Lymeus et al., 2017; Berto et al., 2018).

It is expected that families and schools related to ADHD children might take advantage of these outcomes and those from previous literature in order to help improve the quality of life of those affected by ADHD. At the present, everyday Nature is generally available to families and at zero costs, yet, frequency of contact needs to increase in order to offset the ADHD challenges and other challenges that effect our society, for instance sedentary life-styles and health related outcomes as well as the negative effects of videophilia (Hutton et al., 2019; Zaradic & Pergarms, 2007). Hence, it urges more research investigating how to promote Nature contact among individuals and families and hopefully health institutions will consider Nature as a buffer from daily demands amongst ADHD children and adolescents (Seltenrich, 2015; see Swinburn et al., 1998).

7 CONCLUSIONS AND FUTURE DIRECTIONS

As mentioned above, most of limitations of the findings presented in this dissertation rely on the numerosity of the sample. Recruiting ADHD children and adolescents is quite challenging, not only because it is necessary to involve health care institutions but also because of the full schedule of therapeutic commitments. Moreover, the intense therapeutic schedule these children and adolescents have experienced from the moment of their first diagnosis, could diminish their motivation to become involved in data collection, since they hardly differentiate research from therapies (at least this is something that occurred in the data collections of the studies presented in this thesis). However, these efforts are worthed since, as revealed by Faber Taylor and Kuo (2008, p. 4), the effect of Nature exposure was “roughly equal to the peak effects of two typical ADHD medications”, showing that Nature doses offer potential benefits comparable to those deriving from medications yet without side effects. Although combined treatments seem to be effective in general, many ADHD children cannot tolerate medications and Nature, or the also defined “green dose or series of green doses might conceivably reduce the need for medication by 1 dose per day” (Kuo & Faber Taylor, 2004, p. 1585).

Hopefully, future investigations will consider these challenges and will be able to overcome them and shed some more light on the relationship between ADHD symptoms severity and contact with Nature. This line of research has exciting implications for the management of ADHD. If clinical trials and additional research confirm the value of exposure to Nature for ameliorating ADHD, daily doses of “green time” might supplement medications and behavioural approaches to ADHD. These “doses” might take a variety of forms: choosing a greener route for the walk to school, doing class work or homework at a window with a relatively green view, or playing in a green yard or ball field at recess and after school (Kuo & Faber Taylor, 2004, p. 1585). From the time Kuo and Faber Taylor’s study (2004), fifteen years ago, more studies addressed the importance of Nature contact for ADHD children (Donovan et al., 2019; Faber Taylor & Kuo, 2008; Markevich et al., 2014; Van den Berg & Van den Berg, 2010) as this present research programme. However, implications remain the same

and, hopefully, ADHD health cares will take findings like those presented in this thesis into consideration and use Nature as a treatment to be combined with current treatments (Seltenrich, 2015). Overall, this thesis shows that walking at least twenty minutes in a natural environment reduces inattentiveness and impulsivity therefore it is arguable that regularly walking at least twenty minutes might alleviate ADHD symptoms and, maybe, for a longer time. In fact, it is unknown what the duration of the effect is. For sure, it was long enough to be measured. Nevertheless, it would be interesting to investigate whether being in contact with Nature on regular basis increases the duration of the effect. Moreover, if inattentiveness and impulsivity are alleviated, individuals are more able to deal with daily activities: from doing school homework to better family and social relations. Therefore, the importance that researchers take into consideration a longitudinal study on ADHD children and adolescents that keep contact with Nature on regular basis is evident.

Furthermore, because being inattentive and impulsive might hinder academic performance, it is expected that the present findings are considered by teachers and those working on pedagogies programmes and school schedules. Greening the school environment, both indoor – for instance by considering the biophilic design (see Berto & Barbiero, 2017) - and outdoor, and/or building schools next to green areas, could be a practical way to include Nature in the daily school life. Moreover, walking for twenty minutes in a natural environment at some time during school daily programme (or free play in Nature for those affected by the ADHD combined type or with hyperactivity prevalence so that the environment is more compatible – *ART compatibility* factor - to their needs) might reveal to be an easy and effective way of fostering attention and peer relations. In addition, this could be done during break time (see Amicone et al., 2018; see Amicone, Petruccelli, & Bonaiuto, 2017). In addition, advantages of outdoor pedagogies could refer to fostering Nature connectedness and improvements of academic performance (Humberstone & Stan, 2012). Consequently, satisfaction among children, teachers and parents might be achieved.

Moreover, although ADHD children and adolescents might benefit from Nature contact, such benefits might be decreased by their poor engagement with Nature, due to inattentiveness and hyperactivity symptoms. Indeed, it is expected that future research offers insights on the relationship between mindfulness, perceived restorativeness and reported restoration among ADHD children. In addition, future research should take into consideration an environmental approach to mindfulness studies, for two purposes. Firstly, to increase the benefits of Nature contact since engaging with Nature in a mindful way is likely to lead to greater restoration and, secondly, to obtain restoration when Nature is temporarily unavailable, due for instance to a crowded city with scarce greenness. As showed by Berto et al., (2015), psychological restoration works similarly both among children and adults. Moreover, authors demonstrated that restoration following mindful activities (i. e. mindful silence practice) is comparable to restoration following Nature contact (Kaplan, 2001).

Another theoretical aspect that could be addressed by future research regards an integration between Clinical psychology and Environmental psychology. Specifically, the relation between mental fatigue (Kaplan, 1995) and restoration (Collado et al., 2017) could be studied on a continuum level in which restorativeness would be the process leading to recovery, towards an integrative framework of inattentiveness and hyperactivity conceptualisations, both in clinical and non-clinical terms. Furthermore, more light should be shed on the relation between directed and undirected attention or soft fascination (Kaplan, 1995; Kuo & Faber Taylor, 2004) in the ADHD framework and whether a reification of ADHD concept is possible, since some researchers basically recognize that directed attention is the one impaired in the disease rather than the automatic attention (Chiarenza et al., 2004) or the soft fascination in Environmental psychology terms (Kaplan, 1995).

Finally, it is important to consider that soon 70% of children will grow up in cities, worldwide (Unicef, 2016), and this might have negative impacts on children's contact with Nature, included those effected by ADHD. Therefore, it urges to adequately plan and organize urban areas in order to guarantee the necessary amount of greenness, usable both during school and family activities.

Furthermore, it urges finding ways to promote Nature contact on a family level, during afterschool and weekend activities and to discover the richness of different natural areas, in order to foster children's knowledge and sensitivity toward the natural environment and promote a better development of their senses. Louv (2005) mentioned the Nature deficit disorder as a lack of Nature contact influencing the development of children, including their senses. Working on these different levels might help children develop an affective bond with Nature and act in favour of Nature for their own benefits and for the benefits of future generations. Hopefully, individuals, families and institutions can be aware of the importance of Nature contact for coping with clinical issues yet also preventing them and practically implement new solutions to guarantee contact with Nature for future generations. Hopefully, the research programme presented in this thesis might help the scientific community into achieving at least one of these aspects.

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8. APPENDIXES

8.1 APPENDIX A

The Smiley test

Instructions are reported below:

How do I feel now?



Below you will find six different sensations. Colour the circle with every feeling that best fits how you feel now. For example, if you feel happy colour a circle near the happy face, the closer the circle is, the happier you feel now. If you feel sad, colour the circle near the sad face. If you feel neither so happy nor so sad, colour the circle in the middle.

Name and Surname:



Date:

Place:



Emotion 1

	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	
happy		sad

Emotion 2

	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	
carefree		worried

Emotion 3

	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	
Full of energies		Tired



Not angry

Emotion 4



angry

Emotion 5



safe



insecure

Emotion 6



fearless



afraid

8.2 APPENDIX B

The Continuous Performance test

Instructions for experimenters and participants

The test must be administered individually and the time that each child uses for each stage of the test must be timed. It will be explained to the child that the task consists in identifying and marking the triplet of letters FZB. It is necessary to mark the triplet by placing a cross or an X on the individual letters that make up the string ("put a cross on the F, one on the Z, and one on the B"), while circling the triplet or ticking the three letters with a single sign not all right. Proceed in the same way for all three worksheets. The first line is used as an example for the child to perform ("Please look for the sequence of letters FZB. Every time you find it, please tick it"). If he/she shows he/she understands, he/she will be shown the second line and asked to proceed. The response time and therefore the number of correct answers are recorded. Once the series with the most spaced letters (CP1) is finished, you pass to the next one, saying: "Now you have to do the same thing with this card". After the second series, you immediately go to the next series saying "Now you have to do the same thing again with this card"

Here it follows a copy of the full version used in the present study that includes the notation sheet.

7. Test CP – CP1

COGNOME E NOME: _____ DATA: _____

Cerca la sequenza di lettere FZB. Ogni volta che la incontri barrala.

Esempio:
B G A F Z A P R S F Z B I C Q A

B W O Y F Z O U F R B F Z B K T E I P D
 A M Q X L F Z A Q Z A F U J F Z B J R S
 V I P N T G F Z B W C H N R K F Z Q F R
 D F Z B Z C A U F Z B N L Y M F Z X A S
 W N F K F Z H D O V F E O B X F Z B L J
 E H E P I A H Y A W F Z Y W B O G M D P
 F Z B F Z Q I V X M L F Z G P O R Q F U
 G Z C F O F Z B V F C F Z H V O S F Z B
 G J D Z B U X L F Z B D G M R V I K A N
 A W F Z E S M A G H F Z B Y J S P L X U
 D X A F Z B K F I O F Z X C H W D J F Z
 W T Y E P M G F Z B I N Z B L F J F Z B
 T M U R K L T F Z A C F R F Z B C J P Y
 E F Z B K H D S P Z L F Z S K V U F P Z
 E I F Z B I P O F M Z R F Z B L B X N U

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7. Test CP – CP2

COGNOME E NOME: _____ DATA: _____

Cerca la sequenza di lettere FZB. Ogni volta che la incontri barrala.

A Q X F Z B I S D F Z F O T W L Q V F Z M B L Y P I F Z B H
 D O G K W R E F Z B N H S O J T X A F Y Q U F Z B N W F Z C
 L R F Z P I F Z B T J X D F O M K S F Z V X D Z P G O Q W G
 U C F Z U K B F Z B V S F N C B X N A F Z B G F Y N O P T O
 M V E S C B E K F Z Q Y E F Z B A D J D H A G L H T U L K R
 F Z B R J W F H L Q A O Z F F Z G Z F Z J V F Z B S P W A U
 D S I T X N X A F Z B Q I B I H F Q C O S H U Z F O M F Z O
 P D V X F Z B D M K F U E T G R L K F Z B N A S H J F Z J S
 A F Z B F Z P M C U O F Z B L Z G S H J T B F G B F Z B V K
 M F Z U L A X F Z B Z X F Q D F Z E F A K J C L F Z B M D I

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7. Test CP – CP3

COGNOME E NOME: _____ DATA: _____

Cerca la sequenza di lettere FZB. Ogni volta che la incontri barrala.

VFZOHNKILFZDSFEJSFZBGAYQCBFWQRFZBTEJZSPXDZTAFZBEWUDGLFZBFFZ
 FZBKGLRFZKMBXIOWFZBHYJFZBPCYFATSAFZVWFHEHOXODFZGLSCAGNHNGSOC
 FZYLFDJBFZBZHBVFWFEIJSWEQFZBXUFWRSVLFZBRPBRVAFZMKTFFZBAQ
 XSXCGUVNFZBCKFZVFOTPDFZBFUDFZYLSHGPHFZBUHOFZJLIRFQZTNAIGMKG
 YJGSKYFZBOBBOSEWNSKFZBPQPCIBCZFZTWMJAFDHFZBOFZOUXDEWFZBPI

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7. Test CP1, CP2, CP3

COGNOME E NOME: _____ DATA: _____

Versione prova	Numero bersagli trovati	Numero falsi positivi	Numero omissioni	Tempo
CP1				
CP2				
CP3				

Nome _____

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8.3 APPENDIX C

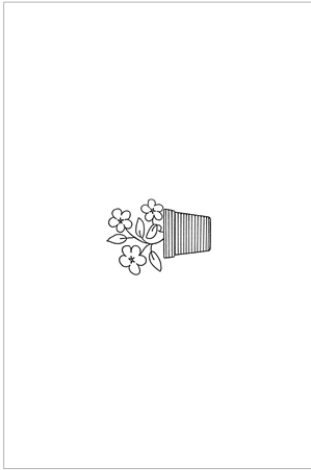
The Matching Familiar Figure Test

Instructions for experimenters and participants

The experimenters must show the child both the figures and the six alternative possibilities simultaneously. The child receives the following delivery: "Now I will show you a figure: look at it carefully because you'll have to find another identical to this among the six figures you see below. Be careful because all six alternatives are similar to the model, but only one is the same ". At this point two tests are performed (example 1 – a and b – and example 2 – a and b), with two groups of figures, in order to ensure that the child has understood. Then the actual task begins. The child is presented with one item at a time so that the model is always above the six alternatives. For each item, from the moment you show the figures you need to start recording the time. The time between the presentation of the figures and the first answer is the time that indicates the work of analysis, comparison and initial reflection of the child on the figures. The lower this latency time at the first response, the greater the probability of making a mistake.

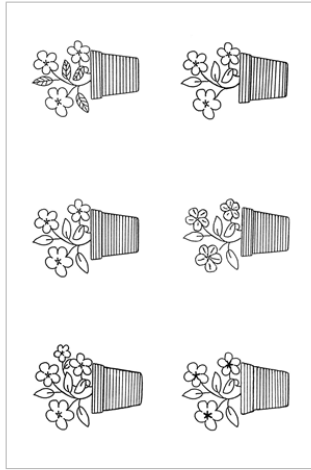
The tendency to respond hastily, and therefore to have a low latency time to the first response, is considered an index of impulsiveness. The notation sheet contains a column in which to record both the first response time and the child's response. If the first answer is correct you will go ahead, if instead it is wrong you will ask the child to try a second time and it will say: "It is not that one. Find the figure that is just like the model". When the child has provided the correct answer, he will go to the next item (if he has committed five errors for the same item, the examiner will still go to another item, showing him the correct answer). It is not necessary to record the time in attempts after the first; it is therefore sufficient to register only the time of first response. Instead, it is necessary to mark all the child's answers.

6. Test MF Esempio 1a



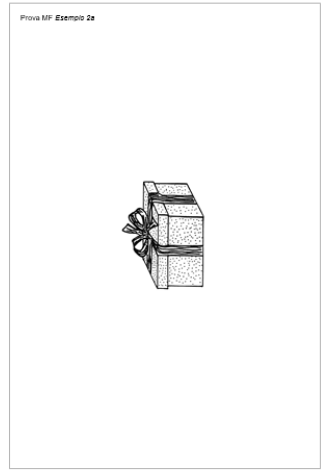
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6. Test MF Esempio 1b



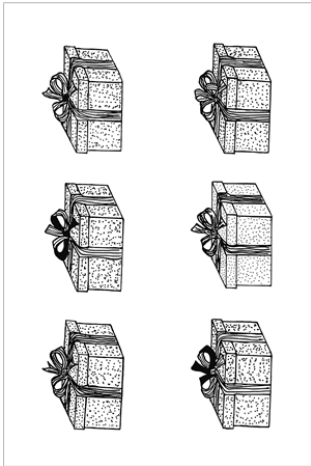
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6. Test MF Esempio 2a



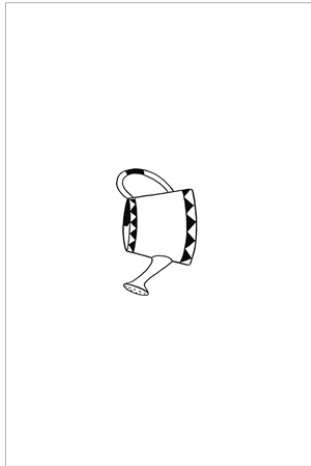
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6. Test MF Esempio 2b



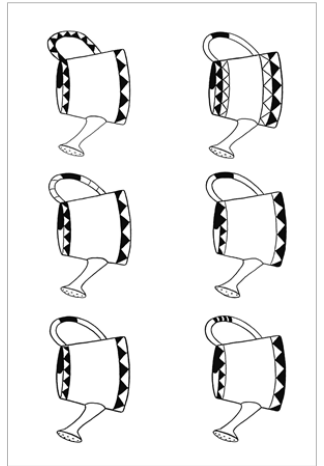
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6. Test MF 1a



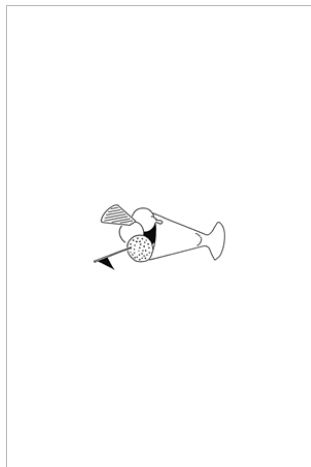
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6. Test MF 1b



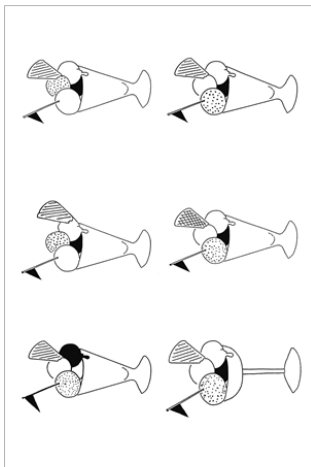
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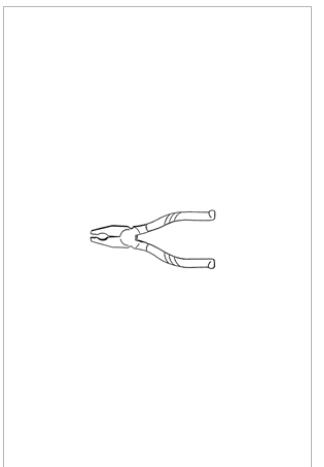
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6. Test MF 2b



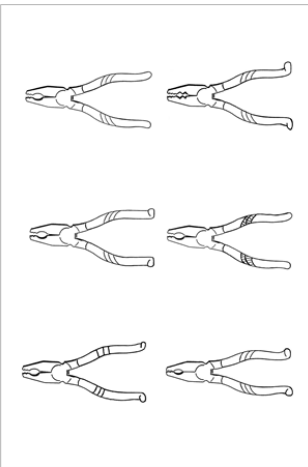
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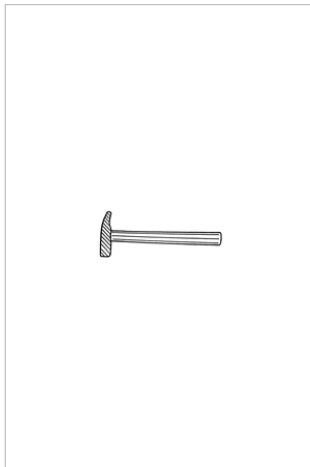
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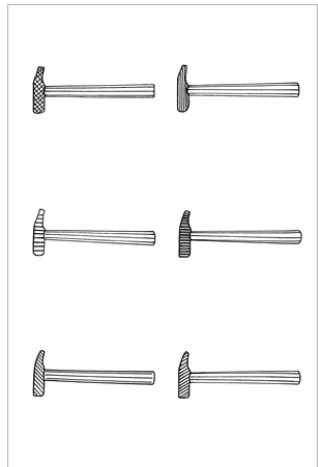
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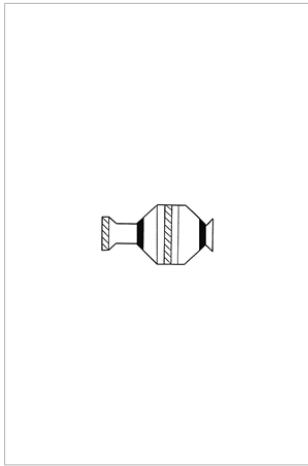
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6. TestMF 4b



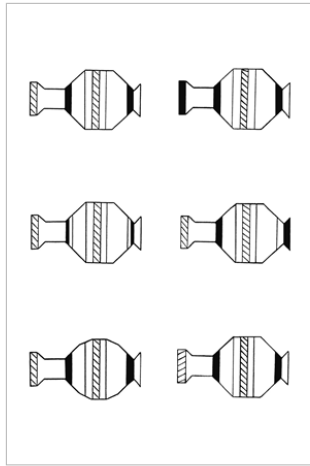
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6. TestMF 5a



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6. TestMF 5b



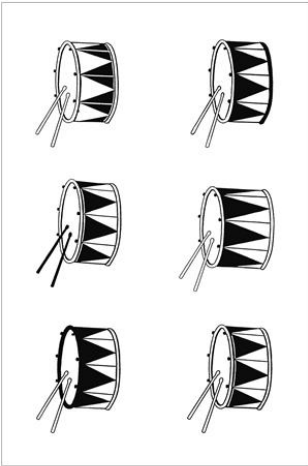
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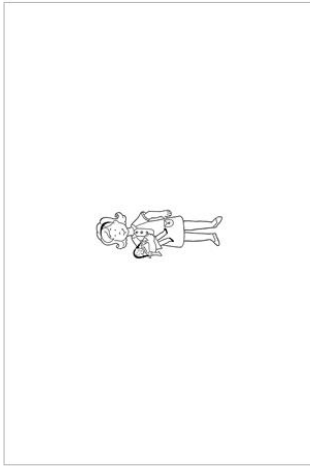
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6. TestMF 6b



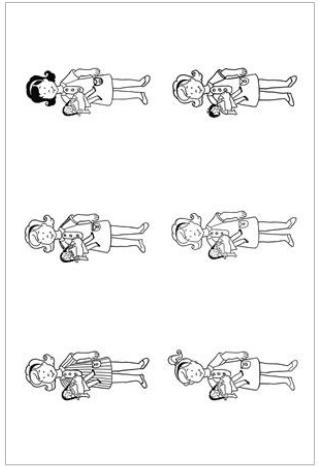
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6. TestMF 7a



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6. TestMF 7b



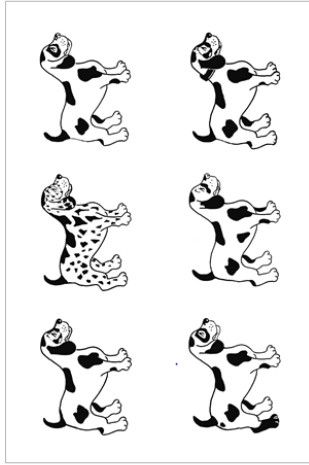
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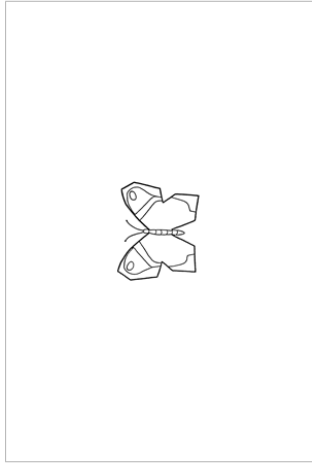
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6. Test MF 8b



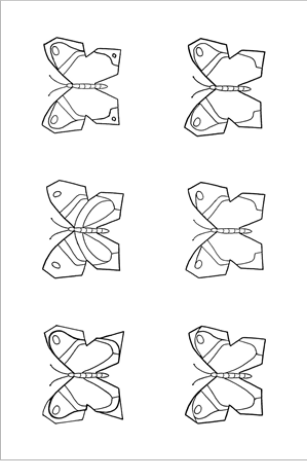
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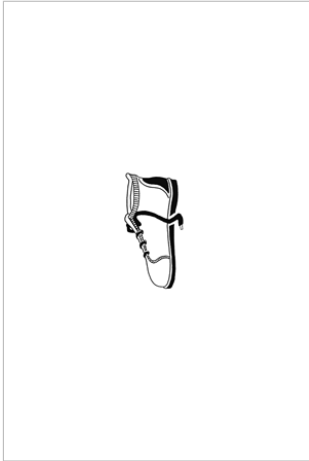
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6. Test MF 9b



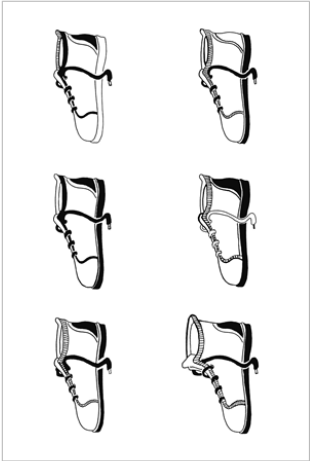
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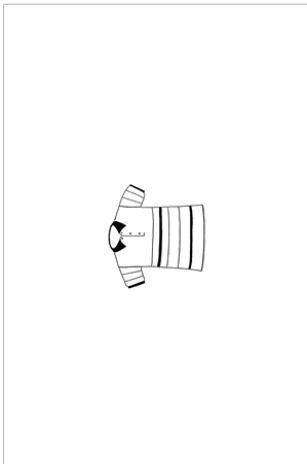
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Pagine fotocopiables ad esclusivo uso interno!

6. Test MF 10b



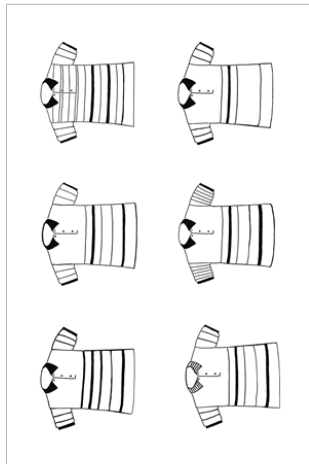
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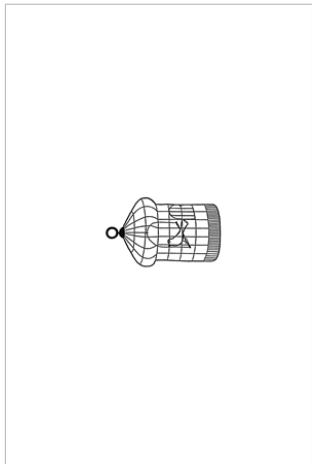
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6. Test MF 11b



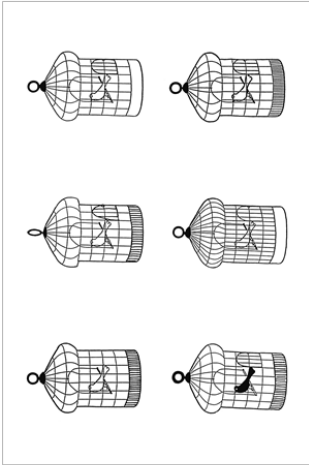
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6. Test MF 12a



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6. Test MF 12b



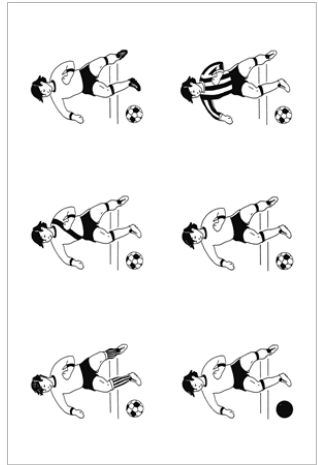
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6. Test MF 13a



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 (Pagine fotocopiables ad esclusivo uso interno)

6. Test MF 13b



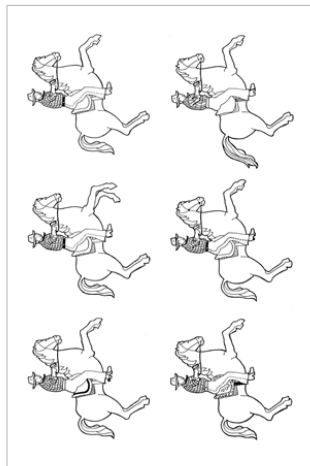
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6. Test MF 14a



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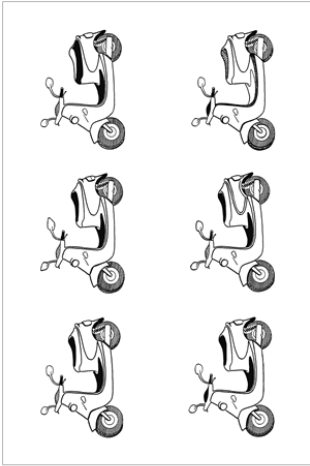
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6. Test MF 15a



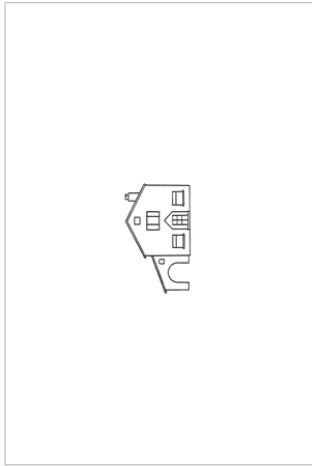
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 (Pagine fotocopiables ad esclusivo uso interno)

6. Test MF 15b



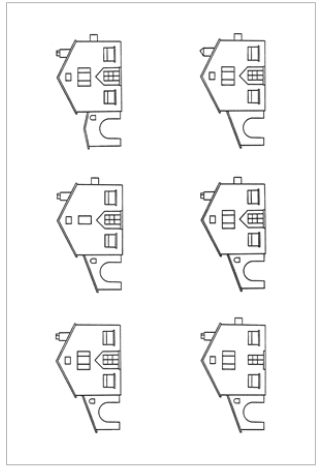
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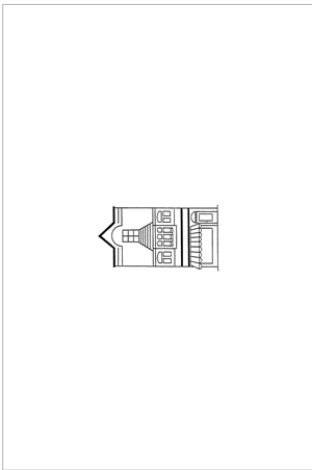
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6. Test MF 16b



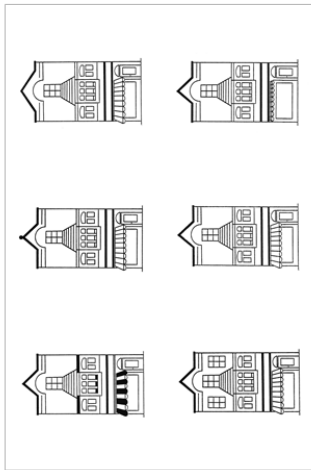
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6. Test MF 17a



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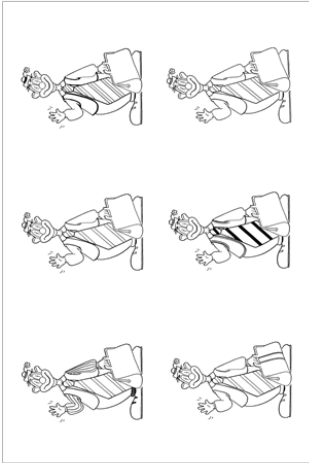
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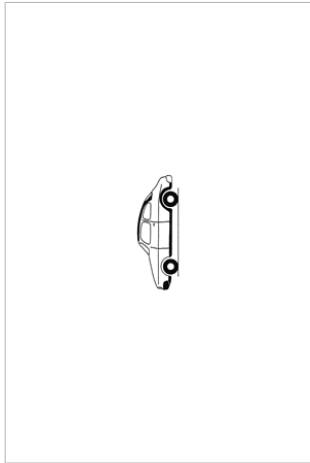
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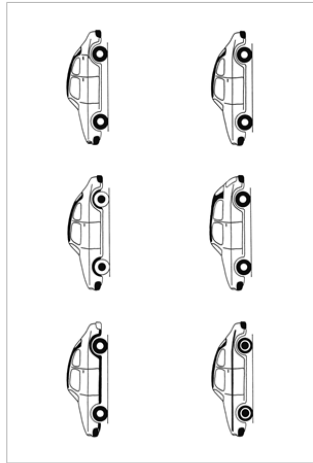
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6. Test MF 19a



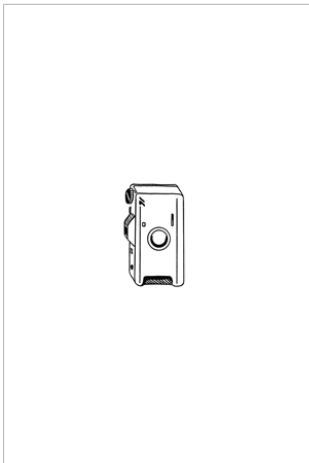
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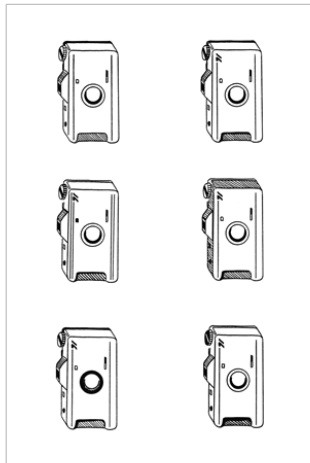
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6. Test MF 20a



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6. Test MF 20b



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6. Test MF

COGNOME E NOME: _____ DATA: _____











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Paese		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
1. Assorbibile		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
2. Galateo		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
3. Pesca		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
4. Martello		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
5. Vaso		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
6. Tamburo		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
7. Bombina con lancetta		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>
8. Cune		01 02 03 04 05 06 07 08 09 10	<input type="checkbox"/>

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(20/10/10)

6. Test MF

(continua)

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4	5	6							
9. Scarpa 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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4	5	6							
10. Maglietta 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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11. Gabbia 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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13. Cowboy 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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14. Vespa 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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15. Casa 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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16. Palazzo 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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17. Pugiaccio 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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18. Automobile 		<table border="1"> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> </table>	1	2	3	4	5	6	<input type="checkbox"/>
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8.4 APPENDIX D

Notation sheet for puzzle and behavioural checklist – Fatigue task

Name _____ Surname _____

Condition:

- Nature
- Historical-urban
- Standard-urban

Instructions

Please ask the participant the following questions:

1. What experience do you have of puzzles?
2. How often do you do them?
3. How many pieces of puzzle do you normally do?

Answers given by the participant:

- 1 _____
- 2 _____
- 3 _____

Please make sure that the chosen puzzle is suitable for the age of the child.

Please tell the child:

"Now let's play a game! I give you this puzzle and you have 10 minutes to do it! I will record the time, so you have to try to put together as many pieces as possible. For every 10 pieces you will have a gift card!!"

(Please help the child make the puzzle only if necessary, in order to redirect his attention to the game... motivate him and persuade him without forcing him... if oppositional, please fill in the behavioural checklist).

Please record the time from the moment the child starts, for 10 minutes.

Total number of pieces ____

Total number of pieces assembled by the participant ____

Time: opening time ____ end time ____

Child behaviour during the puzzle (1 to 5 scale, 1 = very little 5 = very much)

BEHAVIOURAL CHECKLIST TO BE FILLED DURING THE PUZZLE ASSEMBLING:

1	2	3	4	5
---	---	---	---	---

1. absorbed__
2. frustrated__
3. oppositional __
4. distracted__
5. restless__
6. concentrated __
7. interested__
8. inadequate__
9. angry____

8.5 APPENDIX E

Invalsi and “Scattegories” – Fatigue task

Two exercises to be completed in maximum 5 minutes

Name _____ Surname _____ Date _____

Condition:

Nature

Historical

Standard

1) INVALSI TASK:

The Rossi family and the Bianchi family organize a trip to the “Onda blu” water park. The Rossi family consists of parents and two children, the Bianchi family consists of parents and a child. Mr. Rossi makes tickets for everyone and pays 117.00 euros. On which day of the week was the trip organized? This is the price list.

Note for the experimenter: the amount is to be amended among conditions.

"ONDA BLU" WATER PARK - DAILY PRICE LIST PER PERSON		
	From Mondays to Fridays	Saturdays and Sundays
ADULTS	€ 22	€ 25
CHILDREN	€ 12	€ 17
FAMILY PACKAGES – DAILY PRICELIST		
	From Mondays to Fridays	Saturdays and Sundays
2 adults + 1 child	€ 50	€ 60
2 adults + 2 children	€ 61	€ 75
2 adults + 3 children	€ 72	€ 91

- A. Any day of the week
- B. Any day from Mondays to Fridays
- C. Saturdays or Sundays
- D. the price paid does not correspond to the rates in the table

2) “SCATTEGORIES“

Following there are 7 letters on your left side. For each one you will need to identify 5 words belonging to the chosen category.

	Names	Things	Animals	Cities	Countries	Plants or Flowers
F						
N						
R						
S						
I						
E						
L						

8.6 APPENDIX F

During treatment: Behavioural checklist and short interview

20' WALK

(Short interview + Behavioural checklist)

NAME _____ SURNAME _____

Condition:

Nature

Historical

Standard

During the way back, the experimenter will ask the participant the following questions and annotate the answers

A. "How was this walk, pleasant or boring?" Let the child explain and then annotate here.

B. "What did you think about the most during the walk?"

BEHAVIORAL CHECKLIST DURING THE WALK (and possibly during the entire procedure if the child is particularly oppositional). Answer using a scale from 1 to 5 where 1 corresponds to "very little" and 5 to "very much".

During the walk the child:

1 He/she Followed the instructions given

1	2	3	4	5
----------	----------	----------	----------	----------

2 He/she could not walk beside the experimenter / perform the required task

1	2	3	4	5
----------	----------	----------	----------	----------

3 He/she showed an internal restlessness, running or climbing everywhere / shaking himself with his hands or feet on the chair

1	2	3	4	5
----------	----------	----------	----------	----------

4 He/she had difficulty maintaining attention to the activity

1	2	3	4	5
----------	----------	----------	----------	----------

5 When spoken to, he/she didn't seem to listen

1	2	3	4	5
----------	----------	----------	----------	----------

6 He/She had difficulty in carrying out the activity in a quiet way (for the walk: in engaging in a slow walk)

1	2	3	4	5
----------	----------	----------	----------	----------

7 He/She could not be silent, he spoke excessively

1	2	3	4	5
----------	----------	----------	----------	----------

8 He/She was easily distracted by external stimuli

1	2	3	4	5
----------	----------	----------	----------	----------

9 He/She interrupted or behaved in an intrusive way with the experimenter or other people

1	2	3	4	5
----------	----------	----------	----------	----------

10 He/She avoided or was unwilling to engage in activities that required continuous effort

1	2	3	4	5
----------	----------	----------	----------	----------

8.7 APPENDIX G

The Perceived Restorativeness Scale for Children

Instructions:

“Now that we have just returned from the walk, please imagine that you are still there and think on how true each statement is for you. Then please circle the answer that suits you the best”.

Perceived Restorativeness Scale for children

1) In this place I don't think at my worries.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

2) In this place everything is just where it should be.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

3) This place is interesting.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

4) In this place I think about other things, not everyday things.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

5) In this place interesting things happen.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

6) In this place I am free to play, run and move.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

7) In this place I can relax mentally and physically.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

8) This place is big enough to be explored.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

9) In this place I don't think about things I have to do.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

10) This place awakens my curiosity.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

11) In this place nobody tells me what to do or think.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

12) In this place I only think about things I like.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

13) In this place there are lots of things to discover.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

14) In this place there are lots of things that awaken my curiosity.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

15) In this place it is easy to see what's around me.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

16) In this place I don't get bored.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

17) In this place everything seems to have its own place.

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

18) I like this place (Preference item).

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

None ---- a little ---- a bit ---- a lot ---- much ---- very much

APPENDIX H

Frequency of Contact Scale (Child version)

(used in Study 3)

(FoC Child version)

SECTION A

INSTRUCTIONS

For every question, please give the answer that is true among the options suggested. You can answer by using a scale from 1 to 5 where 1 corresponds to "very little" and 5 to "very much".

1) In the last 12 months, how many times have you been in natural places like countryside, beach, mountains etc.?

1	2	3	4	5
----------	----------	----------	----------	----------

2) In the last 12 months, how often have you visited places like zoos and aquariums?

1	2	3	4	5
----------	----------	----------	----------	----------

3) After going to school, do you go to play in natural places like the park or the garden?

1	2	3	4	5
----------	----------	----------	----------	----------

4) In the weekend do you play outdoors in natural places like the park or the garden?

1	2	3	4	5
----------	----------	----------	----------	----------

SECTION B

Open question:

" What do you do when you're in a natural place near your home?"

APPENDIX I

Frequency of Contact Scale (filled by the parent)

Used in Study 3

FoC scale (parent version)

SECTION A

INSTRUCTIONS

For every question, please give the answer that is true among the options suggested. You can answer by using a scale from 1 to 5 where 1 corresponds to "very little" and 5 to "very much".

1) In the last 12 months, how many times has your child been in natural places like countryside, beach, mountains etc.?

1	2	3	4	5
----------	----------	----------	----------	----------

2) In the last 12 months, how often has your child visited places like zoos and aquariums?

1	2	3	4	5
----------	----------	----------	----------	----------

3) After going to school, does your child go to play in natural places like the park or the garden?

1	2	3	4	5
----------	----------	----------	----------	----------

4) In the weekend does your child play outdoors in natural places like the park or the garden?

1	2	3	4	5
----------	----------	----------	----------	----------

SECTION B

Open question:

" What does your child do when he/she is in a natural place near home?"

APPENDIX J

Connection with Nature scale (Child version)

(Used in Study 3)

CNS - child version

INSTRUCTIONS: Please answer each of these questions in terms of the way you feel in general. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can, what you generally feel.

You can answer by using the scale from 0 to 4 where 0 corresponds to "not at all" and 4 to "always".

0 – 1 – 2 – 3 – 4

Not at all -----Always

Not at all -----Always

1) I feel connected to the natural world around me. 0 – 1 – 2 – 3 – 4

2) I feel I am part of the same world as the plants and animals. 0 – 1 – 2 – 3 – 4

3) I think animals are intelligent. 0 – 1 – 2 – 3 – 4

4) I feel connected to plants and animals. 0 – 1 – 2 – 3 – 4

5) I feel I belong to Nature and Nature belongs to me. 0 – 1 – 2 – 3 – 4

6) I feel part of the natural world. 0 – 1 – 2 – 3 – 4

7) I feel part of the natural world like a tree is a part of the forest. 0 – 1 – 2 – 3 – 4

APPENDIX K
Connection with Nature Scale for adults (Mother)
(used in Study 3)

CNS – Adult/Mother version

INSTRUCTIONS: Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers.

Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you generally feel.

1	2	3	4	5
Strongly disagree		Neutral	Strongly agree	

1. I often feel a sense of oneness with the natural world around me. ____
2. I think of the natural world as a community to which I belong. ____
3. I recognize and appreciate the intelligence of other living organisms. ____
4. I often feel disconnected from nature. ____
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living. ____
6. I often feel a kinship with animals and plants. ____
7. I feel as though I belong to the Earth as equally as it belongs to me. ____
8. I have a deep understanding of how my actions affect the natural world. ____
9. I often feel part of the web of life. ____
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'. ____
11. Like a tree can be part of a forest, I feel embedded within the broader natural world. ____
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. ____
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees. ____
14. My personal welfare is independent of the welfare of the natural world. ____

Appendix L
Connection with Nature Scale for adults (Father)
(used in Study 3)

CNS – adult/father version

INSTRUCTIONS: Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers.

Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1	2	3	4	5
Strongly disagree		Neutral		Strongly agree

1. I often feel a sense of oneness with the natural world around me. ____
2. I think of the natural world as a community to which I belong. ____
3. I recognize and appreciate the intelligence of other living organisms. ____
4. I often feel disconnected from nature. ____
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living. ____
6. I often feel a kinship with animals and plants. ____
7. I feel as though I belong to the Earth as equally as it belongs to me. ____
8. I have a deep understanding of how my actions affect the natural world. ____
9. I often feel part of the web of life. ____
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'. ____
11. Like a tree can be part of a forest, I feel embedded within the broader natural world. ____
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. ____
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees. ____
14. My personal welfare is independent of the welfare of the natural world. ____

Appendix M

SDAB (Child version) – Scale per la disattenzione e iperattività in età scolare

(Used in Study 3)

SDAB – Child version

Evaluate, for each of the behaviours listed below, the frequency with which they appear. We recommend you proceed with order and to answer for all behaviours, even if for some cases you feel very uncertain.

You can answer by ticking on the square corresponding to “never”, “sometimes”, “quite often”, “very often”.

never sometimes quite often very often

1 At school, do they tell you that you make careless mistakes?

never sometimes quite often very often

2 Is it difficult for you to remain composed in the chair? Do you like to swing your feet or have something in your hands to fiddle with?

never sometimes quite often very often

3 When parents or teachers assign you a task, is it usually easy for you to carry it out?

never sometimes quite often very often

4 Can you easily sit at the table or at the counter?

never sometimes quite often very often

5 Do you get what your parents or teachers ask you in time?

never sometimes quite often very often

6 Is it difficult for you to engage in quiet games?

never sometimes quite often very often

7 Can you easily organize yourself, for example, do you prepare all things for school or for a task before starting?

never sometimes quite often very often

8 Did you ever hear yourself say that you never stop?

never sometimes quite often very often

9 Can you engage in a game or activity for a long time without frequently interrupting yourself to move on to other things?

never sometimes quite often very often

10 At school you happen to hear yourself say "why don't you think before you answer the questions?"

never sometimes quite often very often

11 Do you happen to not find your things?

never sometimes quite often very often

12 Is it easy for you to wait your turn when you're in the classroom or while you play?

never sometimes quite often very often

13 When you are doing homework do they distract you from the noise or presence of other people?

never sometimes quite often very often

14 Before intervening in a conversation or in a game, do you wait for the right moment?

never sometimes quite often very often

Appendix N

SDAG (parent version) – Scale per la disattenzione e iperattività in età scolare

(Used in Study 3)

SDAG (parent version)

The parent must evaluate, for each of the behaviors listed below, the frequency with which they appear. It is recommended to proceed in the presentation order and to answer for all behaviours, even if in cases of uncertainty. Answers can be given by ticking on the square corresponding to “never”, “sometimes”, “quite often”, “very often”.

never sometimes quite often very often

1 The child has difficulties in performing activities that require some care.

never sometimes quite often very often

2 During the performance of tasks at the table or at the desk, the child often shakes his/her hands (for example toying with the objects that are close by or grabbing things in a clumsy way) or with his/her feet, squirms on the chair.

never sometimes quite often very often

3 The child has difficulty maintaining attention to the tasks or games he/she is engaged in, repeatedly interrupting or frequently switching to different activities.

never sometimes quite often very often

4 The child can't sit up when circumstances require it.

never sometimes quite often very often

5 When spoken to, he/she seems not to listen.

never sometimes quite often very often

6 The child shows an internal restlessness, running or climbing everywhere.

never sometimes quite often very often

7 The child does not perform what is required or struggles to complete it.

never sometimes quite often very often

8 The child has difficulties in engaging in quiet activities or games.

never sometimes quite often very often

9 The child has difficulty into organizing him/herself in tasks and activities.

never sometimes quite often very often

10 The child moves continuously as if he/she had the "living silver" on.

never sometimes quite often very often

11 The child avoids or is unwilling to engage in activities that require continued effort.

never sometimes quite often very often

12 The child can't be silent, by talking excessively.

never sometimes quite often very often

13 The child does not keep his/her things in order and therefore loses them.

never sometimes quite often very often

14 The child often responds hastily.

never sometimes quite often very often

15 The child is easily distracted by external stimuli.

never sometimes quite often very often

16 The child can't keep his/her turn.

never sometimes quite often very often

17 The child neglects or forgets the tasks or tasks of each day.

never sometimes quite often very often

18 The child often interrupts or behaves in an intrusive way with other people (brothers, parents, friends) engaged in a game or conversation.

never sometimes quite often very often

Appendix O

SDAI (Teacher version) – Scale per la disattenzione e iperattività in età scolare

(Used in study 3)

SDAI (Teacher version)

The teacher must evaluate, for each of the behaviors listed below, the frequency with which they appear. It is recommended to proceed in the presentation order and to answer for all behaviours, even if in cases of uncertainty. Answers can be given by ticking on the square corresponding to “never”, “sometimes”, “quite often”, “very often”.

never sometimes quite often very often

1 The child has difficulty in focusing attention on details or makes mistakes of negligence.

never sometimes quite often very often

2 The child often shakes himself with his hands or feet, or squirms on the chair.

never sometimes quite often very often

3 The child has difficulty into maintaining attention to the tasks or games in which is are engaged.

never sometimes quite often very often

4 The child can't remain sat up.

never sometimes quite often very often

5 When spoken to, the child seems not to listen.

never sometimes quite often very often

6 The child shows an internal restlessness, running or climbing everywhere.

never sometimes quite often very often

7 Despite having understood the instructions and having no opposing intentions, the child does not perform what is required of him/her or struggles to bring it to completion.

never sometimes quite often very often

8 The child has difficulties into engaging in quiet activities or games.

never sometimes quite often very often

9 The child has difficulty organizing him/herself in tasks and in his/her activities.

never sometimes quite often very often

10 The child is in continuous movement as if he/she had a motor that does not stop.

never sometimes quite often very often

11 The child avoids or is unwilling to engage in activities that require continued commitment.

never sometimes quite often very often

12 The child speaks excessively.

never sometimes quite often very often

13 The child loses objects necessary for the activities to be performed.

14 The child responds hastily even before the question has been fully formulated.

never sometimes quite often very often

15 The child is easily distracted by external stimuli.

never sometimes quite often very often

16 The child has difficulty waiting for his/her turn.

never sometimes quite often very often

17 The child tends to forget about things to do.

never sometimes quite often very often

18 The child often interrupts or behaves in an intrusive manner with other people engaged in a game or conversation.

never sometimes quite often very often

Appendix P

Child Awareness Mindfulness Measure I-CAMM

(Used in Study 4)

CHILD AWARENESS MINDFULNESS MEASURE – I-CAMM

This section should be completed before the visit of the Botanical Garden.

INSTRUCTIONS:

Below you find a series of statements related to your daily experience. Using the scale from 0 to 4, please indicate how frequently or rarely you experience each statement. Please respond based on what really reflects your real and personal experience.

0 = Never 1 = rarely 2 = sometimes 3 = often 4 = always

1) I get angry with myself if I experience emotions that make no sense

0 - 1 - 2 - 3 - 4

2) I go around the school distractedly.

0 - 1 - 2 - 3 - 4

3) I keep busy not to pay attention to what I think and what I feel

0 - 1 - 2 - 3 - 4

4) I tell myself that I shouldn't feel the way I feel

0 - 1 - 2 - 3 - 4

5) I shoo away the thoughts that I don't like

0 - 1 - 2 - 3 - 4

6) It is difficult for me to pay attention to one thing at a time

0 - 1 - 2 - 3 - 4

7) I get angry with myself for having certain thoughts

0 - 1 - 2 - 3 - 4

8) I think about things that happened in the past instead of thinking about what's happening

now

0 - 1 - 2 - 3 - 4

9) I think some of my emotions are negative and I shouldn't feel them

0 - 1 - 2 - 3 - 4

10) I try not to feel emotions that I don't like

0 - 1 - 2 - 3 - 4

Appendix Q
Reported Restoration Scale
(used in Study 2 and 4)

REPORTED RESTORATION SCALE Child version

This section needs to be filled AFTER visiting the Botanical Garden. Infact, it makes reference to the natural environment you have just visited.

Considering the site you have just visited, please give your opinion to the following statements by using a 0-7 scale.

(1 = completely in disagreement; 7 = completely in agreement)

How are you feeling now?

1 I feel I have come to rest

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

2 I feel full of energy

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

3 I feel I am myself again

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

4 I do not feel tension anymore

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

5 I have put my thoughts in order again

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

6 I can leave all behind my shoulders.

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7

7 I am able to concentrate

1 --- 2 --- 3 --- 4 --- 5 --- 6 --- 7