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**Aggression in children with ADHD: a comparison between specific
profiles**

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INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterised by a persistent pattern of inattention and/or impulsiveness and excessive motor activity. Symptoms appear prior to age 12 and persist for at least 6 months, causing impairments socially, at school, and at work (DSM-5, *American Psychiatric Association*, 2013). ADHD occurs approximately in 5% of children and 2,5% of adults, and boys are twice as likely to be diagnosed than girls (DSM-5, APA, 2013). This study aims at exploring the relationship between ADHD and aggression, specifically proactive and reactive aggression. Aggression is defined as any behaviour whose purpose is to cause harm to another person who does not want to be harmed (Baron & Richardson, 1994). Proactive aggression refers to planned acts of aggression carried out in order to obtain a reward, while reactive aggression comprises impulsive acts of aggression in response to perceived or real threats. More specifically, the research focuses on investigating whether there are significant gender differences in aggression among children with ADHD by comparing their scores on questionnaires and tests to those of non-diagnosed (ND) children; moreover, the prevalent type of aggression, either proactive or reactive, is identified and highlighted. The four children selected for the present research have been carefully matched on the basis of gender, age, and intelligent quotient (IQ) level, in order to limit third-variable problems.

The first chapter defines ADHD and describes its history and diagnostic criteria as found in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, APA, 2013) and in the International Classification of Disease-11th Edition (ICD-11, OMS, 2019); the principal models for understanding the disorder, aetiology, comorbidity, and developmental course will then be presented. To conclude the first chapter, the main treatments currently available are illustrated.

In the second chapter, aggression is defined along with the main types, theories behind the construct, developmental aspects, gender differences, and the relationship between aggression and ADHD.

The third chapter is dedicated to the research, illustrating the participants, study design, screening, and experimental instruments, and the procedure adopted.

Finally, the fourth chapter presents the results of the research. First, the clinical cases of the children with ADHD are described, and then their scores in the screening tests and experimental tests are presented, along with those of the ND children. The results are thus discussed in light of the current literature on the subject by comparing the children with ADHD with the ND children, and boys with girls. Finally, the limits of the research are highlighted, and possible future directions are suggested.

CHAPTER 1. ATTENTION DEFICIT/HYPERACTIVITY DISORDER

1.1 The disorder and its history

Attention-deficit/hyperactivity disorder (ADHD) is a syndrome characterised by a persistent pattern of difficulties in sustaining attention and/or impulsiveness and excessive or exaggerated motor activity. Although presenting behavioural components, the DSM-5 (APA, 2013) classifies ADHD as a neurodevelopmental disorder where symptoms generally start showing in the early stages of development. In order to be diagnosed, these problems have to be numerous, persistent, and causing impairment at home, school, or the workplace.

The first mention of a disorder resembling ADHD traces back to 1798 with the publication of Sir Alexander Crichton's "*An inquiry into the nature and origin of mental derangement: comprehending a concise system of the physiology and pathology of the human mind and a history of the passions and their effects*". Here, the Scottish physician describes a disorder of inattention as "the incapacity of attending with a necessary degree of attention to any one object" specifying that it can become "evident at a very early period in life" (Crichton, 1798). This depiction resembles the current understanding of ADHD in the symptoms of inattention and their early onset. Other testimonies of the disorder were later on recorded by the German physician Heinrich Hoffmann in the 1844 storybook "*Struwwelpeter*". In his work, Hoffman includes the character "Fidgety Phil" ("Zappelphilipp"), a child which shows persistent signs of inattention and hyperactivity and who represents an early depiction of ADHD. The start of the scientific study of ADHD, however, is considered to be the Goulstonian Lectures of Sir George Frederic Still in 1902. The British paediatrician discusses "the particular psychical conditions (...) which are concerned with an abnormal defect of moral control in children" (Still, 1902). In particular, children with a defect of moral control but without a "general impairment of intellect" are considered historical descriptions of ADHD. Around the same time, scientists were noticing correlations between early brain damage and subsequent behaviour problems or learning difficulties, and findings were later supported by the encephalitis epidemic, which spread around the world in the 1920's. Many of the children that survived the encephalitis showed significant abnormal behaviours (Rafalovich, 2001)

and these effects, termed “postencephalitic behaviour disorder” (Barkley, 2006), included some characteristic symptoms of ADHD. Although most of the affected children would not have met the current ADHD criteria, the disorder sparked a broad interest in hyperactivity in children, like the 1932 study of German physicians Franz Kramer and Hans Pollnow on a hyperkinetic disease of infancy marked by motor restlessness. In the meantime, pharmacological treatments were also starting to be developed. American physician Charles Bradley noticed how the use of the stimulant Bensedrine on children with “emotional problems” and learning difficulties (some of which would be possibly diagnosed with ADHD today) resulted in both behavioural and academic improvement (Bradley, 1937). Following this, further investigations on stimulants brought to the synthesis of Methylphenidate, better known as Ritalin, in 1944 by Leandro Panizzon, which is currently the most prescribed drug treatment for ADHD. With the advent of in the Diagnostic and Statistical Manual of Mental Disorders (DSM) by the American Psychiatric Association (APA), a more rigorous and systematic classification of mental disorders was put into place. Starting from the second edition (DSM-II) dated 1968, the concept of hyperactivity is first labelled as “hyperkinetic reaction of Childhood” (American Psychiatric Association, 1968). With the publication of DSM-III in 1980, the APA renamed the disorder “Attention Deficit Disorder” (ADD) (with or without hyperactivity) as the focus slowly shifted from the hyperactivity to the attention deficit in affected children. In the 1987 revision of the third edition, the concept of the two subtypes was removed and the disorder was renamed to “Attention Deficit-Hyperactivity Disorder”. The symptoms of inattention, impulsivity, and hyperactivity were combined into a single list of symptoms with a single cut-off score. The main advancement in the fourth edition is represented by the identification and description of three subtypes of ADHD: a predominantly inattentive type, a predominantly hyperactive-impulsive type, and a combined type with symptoms of both dimensions (American Psychiatric Association, 1994). It is worth noting that the DSM-IV was based on a much larger field trial than any predecessors, making it the most empirically based in the history of the disorder (Barkley, 2006). In the 2000 revision to the fourth edition, only descriptive text was changed, and the description of ADHD was made to correspond with the definition of hyperkinetic syndrome in the World Health Organisation’s classification of diseases ICD-10 (WHO, 1992). Finally, in the fifth and current version of the DSM (DSM 5, APA

2013), ADHD is defined as a neurodevelopmental disorder, as opposed to the previous edition which considered it a disruptive behaviour disorder (American Psychiatric Association [APA], 2013). Children with ADHD score approximately 7 to 15 points lower on intelligence quotient (IQ) tests than average, possibly also as a consequence of their behavioural issues (Berkley, 1997), and are at a higher risk of a range of school difficulties which are, again, in large part due to their disruptive behaviour problems (Kessler et al., 2014). Besides the academic challenges children with ADHD face, symptoms of the disorder can also lead to serious social impairment. Hyperactive children can find it more difficult to have a good relationship with their parents because they often fail to obey rules and their behaviour problems can also lead to being viewed negatively by their peers (Hoza et al., 2005). ADHD is rather prevalent, occurring in approximately 9% of children and adolescents (Merikangas et al., 2010). Among these, boys are more than twice as likely to be diagnosed than girls, with a rate of respectively 13% and 4% (Merikangas et al., 2010). ADHD is recognized similarly across all cultures, and children with the disorder have been shown to have analogous impairments across a broad range of domains, according to a study of 1,573 children from 10 European countries (Bauermeister et al., 2010).

1.2 Diagnosis and assessment

The diagnostic criteria for Attention-Deficit/Hyperactivity Disorder as detailed in the DSM-5 (APA, 2013) are:

A. A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, as characterized by (1) and/or (2):

1. *Inattention*: Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:
 - a. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities (e.g., overlooks or misses details, work is inaccurate).

- b. Often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during lectures, conversations, or lengthy reading).
 - c. Often does not seem to listen when spoken to directly (e.g., mind seems elsewhere, even in the absence of any obvious distraction).
 - d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., starts tasks but quickly loses focus and is easily side-tracked).
 - e. Often has difficulty organizing tasks and activities (e.g., difficulty managing sequential tasks; difficulty keeping materials and belongings in order; messy, disorganized work; has poor time management; fails to meet deadlines).
 - f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (e.g., schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing lengthy papers).
 - g. Often loses things necessary for tasks or activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).
 - h. Is often easily distracted by extraneous stimuli (for older adolescents and adults, may include unrelated thoughts).
 - i. Is often forgetful in daily activities (e.g., doing chores, running errands; for older adolescents and adults, returning calls, paying bills, keeping appointments).
2. *Hyperactivity and impulsivity*: Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:
- a. Often fidgets with or taps hands or feet or squirms in seat.

- b. Often leaves seat in situations when remaining seated is expected (e.g., leaves his or her place in the classroom, in the office or other workplace, or in other situations that require remaining in place).
- c. Often runs about or climbs in situations where it is inappropriate. (Note: In adolescents or adults, may be limited to feeling restless.)
- d. Often unable to play or engage in leisure activities quietly.
- e. Is often “on the go,” acting as if “driven by a motor” (e.g., is unable to be or uncomfortable being still for extended time, as in restaurants, meetings; may be experienced by others as being restless or difficult to keep up with).
- f. Often talks excessively.
- g. Often blurts out an answer before a question has been completed (e.g., completes people’s sentences; cannot wait for turn in conversation).
- h. Often has difficulty waiting his or her turn (e.g., while waiting in line).
- i. Often interrupts or intrudes on others (e.g., butts into conversations, games, or activities; may start using other people’s things without asking or receiving permission; for adolescents and adults, may intrude into or take over what others are doing).

B. Several inattentive or hyperactive-impulsive symptoms were present prior to age 12 years.

C. Several inattentive or hyperactive-impulsive symptoms are present in two or more settings (e.g., at home, school, or work; with friends or relatives; in other activities).

D. There is clear evidence that the symptoms interfere with, or reduce the quality of, social, academic, or occupational functioning.

E. The symptoms do not occur exclusively during the course of schizophrenia or another psychotic disorder and are not better explained by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder, substance intoxication or withdrawal).

To be specified is the subtype:

Combined presentation: If both Criterion A1 (inattention) and Criterion A2 (hyperactivity-impulsivity) are met for the past 6 months.

Predominantly inattentive presentation: If Criterion A1 (inattention) is met but Criterion A2 (hyperactivity-impulsivity) is not met for the past 6 months.

Predominantly hyperactive/impulsive presentation: If Criterion A2 (hyperactivity-impulsivity) is met and Criterion A1 (inattention) is not met for the past 6 months.

and current severity:

Mild: Few, if any, symptoms in excess of those required to make the diagnosis are present, and symptoms result in no more than minor impairments in social or occupational functioning.

Moderate: Symptoms or functional impairment between “mild” and “severe” are present.

Severe: Many symptoms in excess of those required to make the diagnosis, or several symptoms that are particularly severe, are present, or the symptoms result in marked impairment in social or occupational functioning.

In partial remission: When full criteria were previously met, fewer than the full criteria have been met for the past 6 months, and the symptoms still result in impairment in social, academic, or occupational functioning.

As previously mentioned, the DSM-5 (APA, 2013) identifies three different subtypes of ADHD: predominantly inattentive type (ADHD-I), predominantly hyperactive/impulsive type (ADHD-HI) and combined type (ADHD-C). The first one is characterised by difficulties in sustaining attention for extended periods of time, absent-mindedness, troubles in focusing on and committing to a task, and the tendency to appear more anxious, confused, and shyer than the hyperactive/impulsive type. On the other hand, the hyperactive/impulsive type struggles with controlling impulsive behaviours, like interrupting a conversation without waiting for one’s turn, and finds any type of waiting challenging. Finally, the combined type shows symptoms from both of the other types. The ICD-11 (WHO, 2019), similarly to the DSM-5 (APA, 2013), characterises ADHD as “a persistent pattern (at least 6 months) of inattention and/or hyperactivity-impulsivity

that has a direct negative impact on academic, occupational, or social functioning.” The degree of inattention and hyperactivity-impulsivity lays outside the limits expected for age and level of intelligence, symptoms should arise prior to age 12, typically by early to mid-childhood, and be evident in multiple situations and settings. Consistent with the DSM-5 (APA, 2013), the ICD-11(WHO, 2019) also recognises three subtypes: predominantly inattentive, predominantly hyperactive-impulsive and combined.

1.3 Models

The literature proposes numerous theories of ADHD. Here are presented the four major ones: Executive function (EF) disorder, cognitive-energetic model (CEM), the Dual-Pathway Model (DPM) and the Dynamic Developmental theory (DDT). EF disorder explains the symptoms of ADHD as being the result of impairments in response inhibition which in turn disrupt specific executive functions (Barkley, 1997). Response inhibition is the ability to control an inappropriate response in a certain context in favour of a more appropriate alternative and is a key component of goal-directed behaviour. Executive functions like working memory, task switching and maintenance, and planning have been identified as being atypical in the disorder (Barnett et al., 2001; Clark et al. 2000; Karatekin and Asarnow 1998). A meta-analysis by Willcutt and colleagues (2005), found that, although ADHD is indeed associated with these impairments, EF weaknesses are not enough to explain all cases of ADHD. The cognitive-energetic model holds that there are three levels that contribute to information processing: computational mechanisms of attention, state factors, and management/executive function (Sergeant, 2004). These processes necessitate of an optimal arousal and activation rate to operate, which seems to be undermined in people with ADHD. Limitations of this model stem from the difficulties in measuring the energetic pools on which the model is largely based on. Sonuga-Barke (2005) proposes an alternative model by combining two other hypothesis: delay aversion and inhibition failure. The first one deals with motivation and comes for the prediction that children with ADHD favour shorter delays for rewards. Inhibition failure accounts for deficits in EFs that lead to impulsive choices. An experiment by Solanto and colleagues (2001) with children with ADHD showed how they preferred a modest reward (1 point) but immediate (after three seconds) compared to a higher value one (2 points) but delayed in time (after 30 seconds). Therefore, regardless of type and amount, future

rewards seem to be less desirable than immediate ones (Figure 1.1). Finally, the dynamic developmental theory (Sagvolden et al., 2005) is based on animal models and tries to explain the symptoms of ADHD from a neurotransmitter level as stemming from dopaminergic functions and their modulation of non-dopaminergic signal transmission.

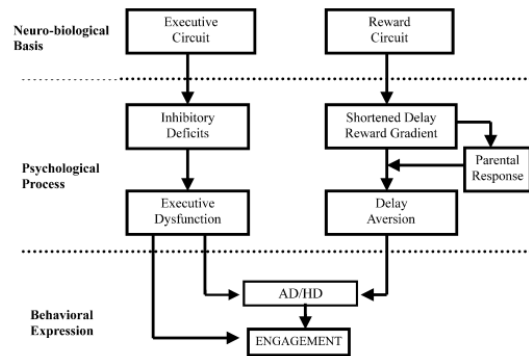


Figure 1.1 The Dual Pathway Model of ADHD by Sonuga-Barke

1.4 Aetiology

Clinical presentation of ADHD is heterogenous in its manifestation and so are the possible causes. As with most disorders, available evidence points to both genetic and social-environmental factors. It can be argued that biological aspects influence the emergence of the disorder while the way the symptoms are presented depends on the environment, which determines its severity and duration (Figure 1.2). These factors are explained below.

1.4.1 Genetic and biological factors

With regard to the genetic aspects, evidence collected through EEG, MRI and fMRI studies suggests the involvement of specific areas of the brain such as the prefrontal cortex, the caudate nucleus, the globus pallidus and the cerebellum. These regions, which are responsible for attention management, behavioural planning, movement control and emotional and motivational regulation, appear to be smaller in subjects with ADHD than in control groups (Castellanos et al., 1994; Giedd et al., 1994). Moreover, dopamine receptors, abundant in these areas, have been shown to be responsible for the manifestation of symptoms of ADHD. Dopamine has an inhibitory function, and an excessive reuptake can reduce its presence in the inter-synaptic space, which in turn limits the ability to inhibit inappropriate behaviours. For this reason, studies on the transmission of the disorder have focused on the genes associated with the dopaminergic pathways.

Specifically, the receptor DRD4 has sparked interest as a genetic mutation of the dopamine receptor D4 has been found to be far more prominent in subjects with ADHD (Faraone, et al., 2001). Other studies have highlighted the involvement of the gene responsible for the transmission of the DAT1 dopamine, as its mutation could result in the premature removal of the transmitter before it gets a chance to link to the receptor (Cook et al., 1995). People with this mutation have an increased risk to develop the disorder of 20-40%. Much research has been conducted on the heritability of ADHD. First degree relatives of those with the disorder are two to eight times more likely than relatives of unaffected individuals to also show ADHD (Faraone et al., 2005). Twin studies in different countries show high heritability rates for ADHD of around 71–90% (Faraone et al., 2005; Nikolas & Burt, 2010; Thapar et al., 1999) with evidence of shared familial/inherited risks for combined and inattentive type symptoms (Willcutt, 2012). Stevenson (1994) claims that ADHD is determined for up to 80% by hereditary factors.

1.4.2 Social-environmental factors

There are a number of environmental factors which can contribute to the development of the syndrome. Among these, one perinatal cause that has been identified is foetal stress, which can damage the neurons of the corpus striatum and impair the normal development of the frontal lobe and basal ganglia (Lou, 1996). Barkley (1997) distinguishes between aetiological factors of the shared and non-shared environment. The first one refers to the aspects of the environment that individuals living together share, like parental-child rearing style, diet or family income, and is responsible for the maintenance of the symptoms; the second one refers to the aspects of the environment that individuals living together do not share, like friends or teachers, and is responsible for the 15/20% for the development of the disorder. Some of the factors mentioned are familiarity with mental disorders, alcohol and tobacco use during pregnancy, inadequate quality of education or absence of a parent, health issues or delays in the development of the child, early emergence of elevated levels of motor activity and harsh parenting during the first years of life. Along with the risks, a list of protective factors has been redacted, among which

emerge high education levels in the mother, the child's good health after birth, good cognitive abilities in the child and stability of the family.

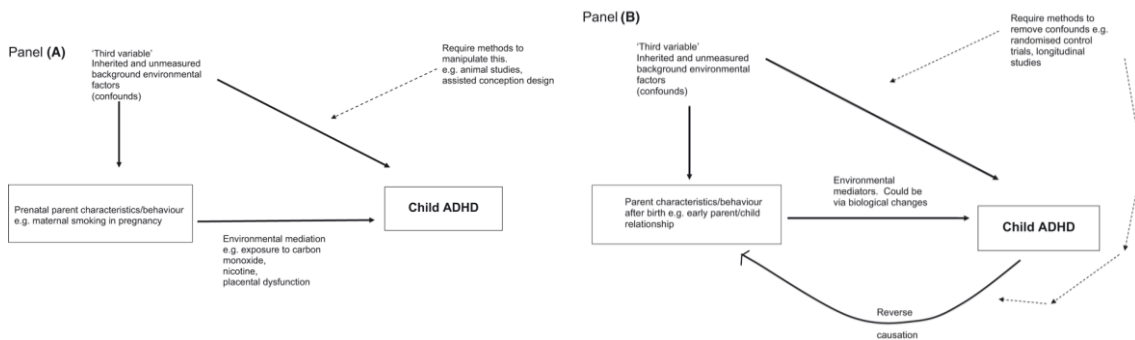


Figure 1.2: The associations of environmental risks with child attention deficit hyperactivity disorder, illustrating how environmental mediation may operate for (A) prenatal and (B) perinatal risks (Thapar, et al., 2013)

1.5 Comorbidity

Rarely does ADHD exist on its own. In an international consensus, experts from different countries advised for clinicians not to be “satisfied with a single diagnosis” but to “keep assessing to uncover likely comorbidities” (Kutcher et al., 2004), highlighting the high rates of comorbidity for the disorder. It is indeed estimated that in about 70% of subjects with ADHD other diagnosis can occur. Two of the most common comorbidities are externalising disorders like Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) (Chandler, 2010), which represent increasing severity of defiant behaviour. Learning disorders are also quite widespread, especially in the inattentive type (Rucklidge and Tannock, 2002), with problems in writing two times more common than problems in reading, math, or spelling (Mayes et al., 2000). For what concerns autism spectrum disorder (ASD), there is a good degree of overlap between symptoms, but, while the DSM-IV rejected a diagnosis for both ADHD and ASD (American Psychiatric Association, 1994), the DSM 5 (APA, 2013) allows for a double diagnosis if the right criteria are met. ADHD is also commonly comorbid in diagnosis of tic disorders, with about half of subjects with Tourette’s syndrome (TS) also being diagnosed with ADHD (Freeman, 2007). Lastly, ADHD is also often comorbid with internalising disorders. The rate of major depression in youth with ADHD ranges from 12% to 50%, more than five times higher than in youth without ADHD (Angold, 1999). Depressive disorders typically occur several years after the onset of ADHD and are independent of other comorbidities

(Blackman et al., 2005). It is generally considered that depression is an outcome of the impairments related to ADHD, but the two remain independent and distinct in course, therefore proving that ADHD related depression is not just an outcome of demoralisation (Biederman et al., 1998). The rates of comorbidity between bipolar disorder and ADHD are still being largely debated, but there is evidence on shared risk factors, distinct subtypes and weak causal relationships between the two disorders (Youngstrom et al., 2010). Anxiety symptoms in ADHD are quite prevalent and seen in all populations and in children as well. Anxiety in ADHD could change the presentation and course of the disorder considerably, exacerbating attentional problems, school phobia and mood disorders and lowering social competence (Spencer et al., 1999).

1.6 Developmental course of the disorder

The behaviours associated with ADHD are common in preschool children but become problematic when they lead to a higher rate of risky behaviours and physical injuries and unmanageable behaviours in different settings. Most preschoolers with ADHD present the combined subtype (Lahey et al., 2004). Symptoms of hyperactivity tend to decrease with age while those of inattention increase. Despite this, trajectories of the two are clearly linked to each other as high rates of one predicts high rates of the other (Galéra et al., 2011). Preschool ADHD carries on to school age in 60 to 80% of cases (Lahey et al., 2005). Here is when the disorder is most frequently diagnosed as children are often referred for classroom disruptiveness and/or academic difficulties. The rates of symptoms of inattention continues to increase while hyperactivity decreases (Lahey et al., 2004). Research estimates that up to 70% of childhood cases of ADHD persist throughout life (Barkley et al., 2002) and that the disorder is present in 4.4% of the adult population (Polanczyk & Rhode, 2007). Adults with ADHD have been described as having “the clinical “look and feel” of ADHD children” (Faraone et al., 2000). Although symptoms manifest differently throughout life, the defining characteristics of ADHD are maintained and recognisable even in the adult population: impulsiveness, inattentiveness and restlessness, a variation of hyperactivity. Specifically, symptoms can show as lack of attention to details, starting tasks without completing previous ones, poor ability to plan, difficulties in focusing and prioritising, losing things, forgetfulness, speaking without waiting for one’s turn, irritability, impatience, and carelessness. Indeed, adult ADHD has

been linked to lower satisfaction with life, higher chances of attempted suicide, more frequent job switching and higher rates of unemployment (Kessler et al., 2006; Murphy et al., 2002). Academically, patterns of difficulty carry on, and research shows that students with ADHD are less likely to finish college, have lower grades, demonstrate worse study and planning skills, and have lower IQ scores (Biederman, Faraone, et al., 2006; Biederman, Monuteaux, et al., 2006; Norwalk, Norvilitis, & MacLean, 2009; Wender, Wolf, & Wasserstein, 2001). Adults with ADHD have also been shown to have higher rates of antisocial behaviour, substance abuse and addiction, and mood and anxiety disorders (Karam et al., 2009; Murphy et al., 2002; Weyandt, Linterman, & Rice, 1995).

1.7 Current care and treatment

Although ADHD has been subject of studies for some time now, there is still no shared opinion on the best treatment for the disorder. According to NICE's guidelines for the diagnosis and management of ADHD (NICE, 2018), the best approach should entail a holistic treatment plan that addresses all of the subject's needs and is developed in conjunction with them and their family or carers. It should take into account severity of the disorder and patient's goals of treatment. Generally, we can identify three types of treatment: pharmacological treatment, psychological treatment, and a combination of the two. The pharmacological treatment involves the prescription of medications such as Ritalin (methylphenidate), Pemoline, Strattera (atomoxetine), and Adderall to reduce the symptoms of ADHD. Concerns over the use of these medications arise as there are numerous side effects, like decreased blood flow to the brain, disruption of growth hormone and insomnia, and there is the risk of substance misuse, especially among college students. Studies have shown, however, that there is a lower risk of substance use disorder among those who took stimulants during childhood compared to the usual rates for ADHD (Dalsgaard et al., 2014); similarly, the risk of car accidents and suicide attempts decreases in adults that are using ADHD medication (Chang et al., 2014; Chen et al., 2014). The psychological treatment, on the other hand, focuses on the acquisition of adaptive behaviours that can be used both at school and in the family. They include psychoeducational input, behavioural therapy, cognitive behavioural therapy (CBT), interpersonal psychotherapy (IPT), and family therapy (Taylor et al., 2004; Fonagy et al., 2002). These interventions are aimed not only at the child, but parents and teachers are

also instructed on educational strategies to put into place with the child in order to develop useful coping strategies. The child is taught organisational and planning skills and techniques to decrease distractibility and procrastination; parents and educators' training focuses on providing skills and tools to reinforce the aforementioned competences (Corcoran, 2011; Pelham & Fabiano, 2008). Studies by Fleming et al. (2015) and Sprich et al. (2016) have demonstrated that these treatments have significantly positive outcomes compared to various other control conditions. Although non-medication treatment proves less effective at reducing symptoms than medication, it is helpful in treating those problems that remain after the appropriate medication has been prescribed (Faraone et al., 2021).

CHAPTER 2. AGGRESSION

2.1 Definition

Aggression is generally defined as a wide range of behaviours that are intended to cause harm, whether physical or emotional, to another person who does not want to be harmed (Baron & Richardson, 1994; Bushman & Huesmann, 2010). The definition highlights three important characteristics to take into account. First, aggression must result in an observable behaviour; the mere act of thinking about being aggressive or feeling angry does not count as aggression. Second, the behaviour's purpose is to harm; accidentally hitting someone's head, although it can be painful, is not considered an act of aggression. Finally, the person towards whom the harm is directed to must be motivated to avoid the harm; cases of assisted suicide, for instance, do not constitute as aggressive behaviours. Although aggression is not necessarily maladaptive (in fact, all people display aggression in some form at some point in their life), maladaptive aggression can cause numerous problems, for instance, in children it has been seen to have a significant impact on social development and can predict negative outcomes like school difficulties, cognitive deficits, peer rejection and antisocial behaviour (King & Waschbusch, 2010). There exist numerous ways to categorise aggression, by focusing on different aspects of the construct. The main forms aggression can take are physical, verbal, and relational. The first one includes physical actions such as beating someone or damaging one's property; the second one involves the use of verbal behaviours like yelling and name calling; lastly, relational aggression consists in any behaviour whose intention is to harm the person's social relationships, and comprises of telling lies about a person or exclude a person from a social group. Other distinctions have been made also on the basis of whether the target is present or not during the behaviour: direct aggression consists of behaviours like hitting someone or screaming in a person's face, while indirect aggression includes spreading rumours or destroying a person's belonging. Studies show that males are more likely to use direct aggression, compared to females who adopt forms of indirect aggression more (Lagerspetz et al., 1988). A distinction based on internal drives identifies two distinct types of aggression: reactive and proactive. Reactive aggression, also referred to as impulsive, affective or "hot-blooded", is a response to a threat or frustrating event and its sole goal is to remove the source of the issue. An example is punching someone after

having been made fun of. It is associated with high emotional arousal, anxiety and anger, a rapid activation of the sympathetic nervous system, and decreased cortical regulation (Raine et. al, 1998; Siegel & Victoroff, 2009). On the other hand, proactive aggression, also called instrumental, planned or “cold-blooded”, involves thoughtful, planned acts with the goal of obtaining a reward. For instance, bullying and premeditated homicides belong to this category. It is distinguished by a lack of emotional arousal and the aggressive behaviours are only put into place once the goal can be achieved at a perceived low cost (Dodge & Coie, 1987; Crick & Dodge, 1996). Nevertheless, it is difficult to categorise aggressive behaviours as being either of one or the other type, and it is even claimed that this dichotomous approach is too reductive. Studies, however, support the differentiation, as it has been demonstrated that the two even have potentially distinct genetic and environmental contributors (Baker et. al, 2008).

2.2 Theories

Several theories have been developed in order to explain different aspects of aggression. Here are presented the main ones.

Frustration-Aggression Theory

First introduced in 1939 by Yale University psychologists, Frustration-aggression theory (Dollard et. al, 1939) poses that aggression stems from frustration. Frustration is defined as the response to an obstacle blocking the achievement of an expected or hoped for reward, rather than simply the condition of not achieving a goal. The theory claims that (1) “the occurrence of aggressive behavior always presupposes the existence of frustration” and (2) “the existence of frustration always leads to some form of aggression” (Dollard et. al, 1939, p.1). The theory, indeed, accounts for a number of everyday occurrences of aggression, nonetheless, it became apparent to the authors of the theory that not every experience of frustration predicted aggressive behaviours. Miller (1941), one of the original authors, proposed that frustration can lead to an array of responses and not just aggression.

Learning theories

Learning theories are based on operant and classical conditioning concepts. Research showed that it was possible to teach children aggressive behaviours through positive and negative reinforcement (Cowan & Walters, 1963; Patterson et al., 1967). It soon became apparent, however, that conditioning could not account for individual differences in aggression, and Albert Bandura proposed a different learning paradigm: observational learning or imitation (Bandura, 1977). According to this view, people learn to behave aggressively by observing and imitating others and make inferences that lead to the generalisation of the behaviour to different situations. Moreover, children are more likely to imitate models that have been rewarded for their aggressive behaviour (Bandura, 1965).

Excitation-Transfer Theory

Excitation-Transfer theory (Bryant & Zillmann, 1979) suggests that aggression derives from misplaced arousal. When a person experiences two events in a short amount of time, and the first one is physiologically arousing, some of that arousal can transfer to the second event. Aggression, in this view, is therefore a consequence of the heightened arousal caused from one situation which transfers to being more reactive towards another person.

Information-Processing Theories

Information-processing theories (Huesmann, 1982) have offered yet another perspective. In social cognition, attributions are the explanations people come up for why other people behave the way they do. A hostile attribution would mean explaining a certain behaviour as being motivated by the goal to hurt oneself, therefore increasing the likelihood of responding to that behaviour in an aggressive way (Dodge, 1980). A meta-analysis has demonstrated that having a hostile attribution bias consistently predicts aggressive behaviour (Orbio de Castro et al., 2002).

Cognitive Neoassociation Model

Berkowitz's (1989) model is a modification of the frustration-aggression theory and is primarily concerned with affective aggression. According to this model, the main cause of aggression is negative affect produced by unpleasant events. The negative emotion triggers two schemas: a tendency to fight and a tendency to flight; the first one produces

feelings of anger while the second one feelings of fear. Higher order cognitive processes can then come into play to further assess the situation (figure 2.1).

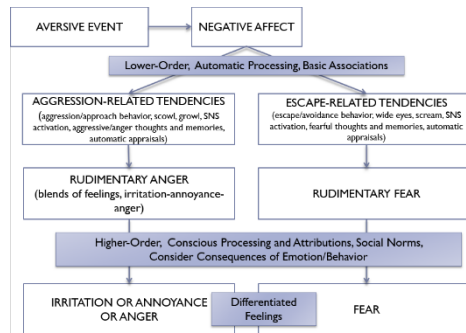


Figure 2.1 The Cognitive Neoassociation Model (Berkowitz, 2003)

General Aggression Model

The General Aggression Model (GAM; Allen et al. 2018) takes into account many of the previous theories and unifies them into a single framework. It identifies three features to understand aggression: first, the person and the inputs from the situation, second, the current internal state (arousal, affect, cognition), and lastly, the outcomes of the appraisal and the decision-making process. Through a feedback mechanism, then, future expressions of aggression are determined (figure 2.2).

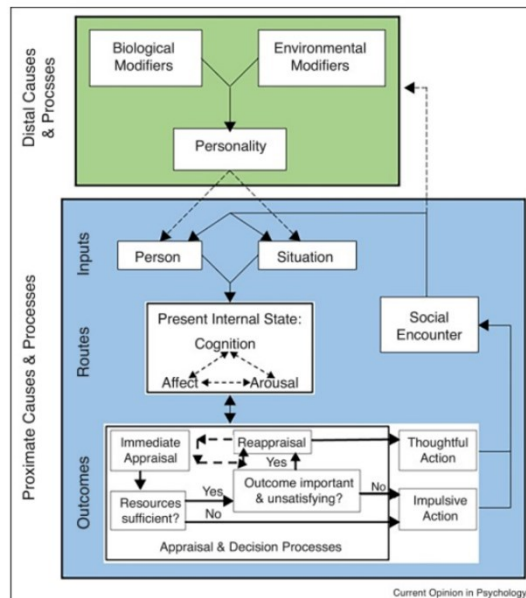


Figure 2.2 General Aggression Model (Allen et al., 2018)

2.3 Development of aggression

Several studies have shown how children between 1 and 3 years old are the most aggressive compared to any other stages in life (e.g. Cote et al., 2006). In day-cares, one out of four interactions between children involves aggressive behaviours (Tremblay, 2000). Aggression can take different forms during life and is not always considered problematic. The common rough and tumble play of toddlers can aid the subsequential learning of prosocial play; what is different between a playful fight and aggressive behaviour is the lack of intention to harm the other person. Physical and proactive aggression are the most common forms of aggression during preschool years, while reactive aggression starts appearing at around 7 years of age (Coie & Dodge, 1998). The type of aggression is also influenced by the development of motor and cognitive abilities: children start using objects to hurt and plan aggressive behaviours with more intent. Likewise, impulse control also mediates aggression. It comprises the development of physiological regulation, the mastering of attention and regulation of emotions. The significant aspects for aggression are the ability to self-soothe and seek help when upset. In pre-schoolers these self-regulatory competences may be supported by increased cognitive competence (Posner and Rothbart, 2000) or worsened by cognitive limitations. Aggression is then highly stable over the lifetime: generally, early aggressive behaviour is predictive of later aggressive tendencies (Huesmann et al., 2006). There are a number of factors that can predict the emergence and manifestation of aggression: risk factors in the environment, genetic predispositions and gene by environment interactions, and culture and context where one is raised. Dishion (2014) proposes a distinction between micro-dynamics and macro-dynamics that can explain the development of aggression and that can be targeted when implementing interventions to prevent the development of aggression. Micro-dynamics include single experiences that strengthen aggression over time, like viewing aggressive content on television. Macro-dynamics involve social dynamics through which aggressive individuals affiliate with likeminded people and increase each other's aggression over time. These are then influenced by mediators, which are emotional, social cognitive, and self-regulation mechanisms that explain how these risk factors lead to the actual expression of aggressive behaviours, and moderators, which can change the strength and direction of the mediators. For instance, a risk factor such as viewing of violent media is linked to developing an hostile attribution bias in ambiguous

situations (Bushman, 2016). This mediator can, however, be toned down in children if they view TV with a trusted adult that can guide them. Genetic risks have also been shown to contribute to the development of aggressive behaviours: research shows that between 26 and 32% of aggression in children is explainable by heritability (Tuvblad et al., 2009). There are two interactions that genetic makeup and environment can bring about: diathesis-stress and differential susceptibility. The first one refers to the fact that individuals with a particular set of genes are more at risk when faced with environmental stressors. For example, toddlers carrying the dopamine receptor gene DRD4 7-repeated allele have been shown to adopt more externalising behaviours as a result of maternal insensitivity than toddlers without the allele (King et al., 2016). Differential susceptibility, on the other hand, refers to how genetic characteristics can make an individual more susceptible not only to the negative effects of adverse life events but also to the beneficial effects of enriching experiences and lack of adverse events. A study on children with the Catechol-*O*-methyltransferase Val158Met gene, implicated in aggression traits, has shown that those who faced many serious life events displayed a higher level of aggression than children without the genetic vulnerability, however, those who did not displayed lower levels of aggression than peers without the vulnerability (Hygen et al., 2015). Finally, culture and context of upbringing can affect the development of aggression by presenting context-specific risks, like exposure to neighbourhood conflicts, and protective factors, like the implementation of social safety policies.

2.4 Gender differences

Although traditionally males have been regarded as more aggressive than females, when the difference in forms of aggression is taken into account evidence suggests that, generally, they are both just as aggressive (Moretti and Odgers, 2002). Females tend to engage more in indirect aggression while males tend to display physical aggressive behaviours, and verbal aggression is seen equally often in both genders. These findings hold true across different nations, ages, and ethnic groups (Österman et al., 2000). There are, however, differences in the onset and development of aggression in boys and girls. In early childhood, boys tend to display more physical aggression, but their aggression levels decrease over time. On the other hand, girls tend to display low levels of aggression during early childhood, but their aggression levels increase and peak much later. This can

be due to the fact that indirect aggression requires social intelligence to understand and manipulate social situations, therefore it gets refined with age. A study by Österman et al. (2000) showed that 8-year old children were able to be indirectly aggressive, but girls aged 15 used indirect aggression much more frequently than their younger counterparts. Research has started focusing on the relationship between hormones and gender differences in aggression. It is well known the link between testosterone and aggression; indeed, high levels of testosterone predict higher levels of aggression (Archer, 1991). Furthermore, high testosterone levels change a person's body increasing physical strength and height, which help with physical aggression (Cosmides & Tooby, 2006). On the other end, high levels of oestradiol and progesterone, hormones typically found in women, seem to be associated with lower levels of aggression (Denson et al., 2018). Studies relating different forms of aggression and the 2D:4D finger length ratio suggest that both physical and indirect aggression can be linked to prenatal exposure to hormones. Low 2D:4D ratio (associated with masculine behaviour) correlates with physical aggression in men but not in women (Bailey & Hurd, 2005), while indirect aggression correlates with low 2D:4D in women (Coyne et al., 2017). These findings are an interesting perspective on the biological basis of gender differences in aggression.

2.5 Aggression and ADHD

Research shows that there is a significant association between aggression and attention deficit/hyperactive disorder and that children with ADHD seem to frequently display aggressive behaviours, even when comorbid conduct problems are accounted for (Waschbusch, 2002). Indeed, aggressive behaviours are often the reason children with ADHD are brought to medical attention in the first place and determine the type of treatment they will be administered (Jensen et al., 2007). Furthermore, aggressive behaviours exhibited by children with ADHD seem to be more preponderant than those without ADHD (Carlson et al., 1997). The reason for this link between the two has been attributed to emotional dysregulation. Barkley (2010) proposes that emotional dysregulation is one of the manifestations of impulsivity seen in children with ADHD: behavioural, cognitive and emotional impulsivity, therefore, stem from the same principle. Emotional impulsivity, or dysregulation, is usually expressed with maladaptive behaviours like temper tantrums and being easily angered, which are both antecedents of

aggression. More specifically, the type of aggression more strongly associated with ADHD is reactive aggression, supporting the idea that impulsivity and dysregulation explain, at least partly, aggression in this population. For instance, one study found that children with higher levels of reactive aggression also display more inattention and impulsivity problems than children high in proactive aggression or non-aggressive children (Dodge et al., 1997). Another research compared children with ADHD and/or ODD and CD, and reactive aggression and found that between 66 and 72% of children high in reactive aggression met criteria for ADHD and ODD/CD, while 15% met criteria for ODD/CD only and 6% for ADHD only (Waschbusch et al., 1998). Among girls with ADHD, the majority are diagnosed with the inattentive subtype, raising questions on whether there exist gender differences as aggression is more often associated with the hyperactive/impulsive subtype. Albeit, girls with ADHD display higher levels of physical and relational aggression than typically developing girls (Zalecki & Hinshaw, 2004). Also similarly to boys, comorbidity with CPs influences levels of aggression in girls too: those with ADHD and CPs show higher levels of aggression compared to controls and ADHD only (Ohan & Johnston, 2007). Research is still limited, especially regarding the focus on relational aggression which girls seem to generally adopt more, nonetheless, the link between ADHD and aggression holds true in both genders.

CHAPTER 3. THE RESEARCH

This study's objective is to analyse and describe aggression in two 9-year-olds with ADHD and investigate their potential gender differences. The results will then be compared to those of two 9-year-old children non-diagnosed (ND). This study is part of a larger research project involving children and adolescents between the ages of 8 and 16 which investigates also other constructs like prosocial behaviours and emotional competence. For the purposes of this study, only a limited number of subjects have been selected and only the relevant tests have been considered.

3.1 Participants

The participants selected are two children (a boy and a girl) ND and two children (a boy and a girl) with ADHD. To maintain their privacy, they have been given fictitious names with which they will be identified from now on: Anna to the girl ND, Elisabetta to the girl with ADHD, Lorenzo to the boy ND, and Tommaso to the boy with ADHD. ND and ADHD participants have been paired based on gender, age, and intelligent quotient (IQ), in order to limit these variables' influence on the results. Table 3.1 sums the data relative to the participants.

	<i>Age</i>	<i>Gender</i>	<i>Group</i>
<i>Anna</i>	9 years, 0 months	F	ND
<i>Elisabetta</i>	9 years, 0 months	F	ADHD
<i>Lorenzo</i>	9 years, 1 month	M	ND
<i>Tommaso</i>	9 years, 0 months	M	ADHD

Table 3.1 Research participants

3.2 Study design

The research comprised two stages: first, questionnaires were administered to both children and parents, among which were the Reactive-Proactive Aggression Questionnaire (RPQ, Raine et al., 2006) and, only for the parents, the Conners' Parent Rating Scale-Revised: Short Form (CPRS-R:S, Conners, 1997). The RPQ was used to

measure levels of proactive and reactive aggression in the children as self-reported from themselves and as reported from their parents. The CPRS-R:S was employed to confirm inattention and hyperactivity traits in children diagnosed with ADHD and ensure the lack of there in children ND. In the second stage, children were tested individually: first their IQ was estimated using two subtests of the WISC-IV scale (Wechsler, 2012), namely the block design and vocabulary, and then the experimental tests were administered. The first two tests were conducted in order to evaluate cognitive development, while the experimental tests were used to assess, among other things, the levels and type of aggressivity. Specifically, the computerised tests Cyberball (Williams et al., 2000) and dictator game (a modification of the ultimatum game [Güth et al., 1982]) were used in order to recreate various conditions of social exclusion; the children were then asked how they felt and presented with a sticker distribution task.

3.3 Instruments

The questionnaires and tests described in the next paragraph are a selection of those administered during the research that are relevant to the construct being analysed.

3.3.1 Screening instruments

The screening instruments employed are the block design and vocabulary, two subtests of the intelligence test WISC-IV (Wechsler, 2012) and the Conners' Parent Rating Scale-Revised: Short Form (CPRS-R:S, Conners, 1997).

3.3.1.1 Block design

The block design test is part of the Perceptual Reasoning subscale of the WISC-IV scale (Wechsler, 2012) and it assesses the child's ability to analyse and synthesise an abstract design and reproduce it accurately with a set of coloured blocks (Figure 3.1). These blocks are composed of 6 faces: two red, two white, and two half red and half white. The child is shown the figures to replicate from the stimulus booklet, which includes 14 items that increase progressively in difficulty. First, only two blocks are utilised, then, as the designs get more complex, four blocks and finally nine blocks are used to replicate the figure. The test has got two starting points based on the age of the child: for children 8 years old and up, as it is the case for this study, the starting point is item 3. If the child gets one of the first two items wrong, a reversion rule is applied where the preceding items are

administered until full points are scored in two consecutive items. Time spent on each figure is also considered: every item has got a time limit and, starting from item 10 onwards, bonus points can be added for completing the figure before certain time frames. The child gets zero points when either the figure is completed outside of the time limit, or the figure is replicated incorrectly. After three instances of zero points, the test is discontinued. The raw score is calculated by adding together the points scored by the child which is then converted into the scaled score using the tables included in the manual.

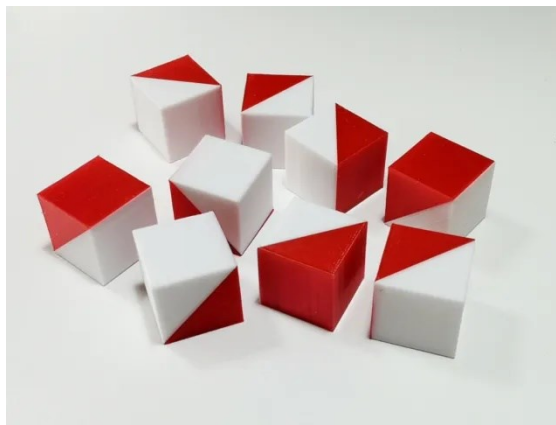


Figure 3.1 Block Design (WISC-IV, Wechsler, 2012)

3.3.1.2 Vocabulary

The vocabulary test is part of the Verbal Comprehension subscale of the WISC-IV scale (Wechsler, 2012). It consists of 36 items wherein the first four are images that the child must name, while the rest are words that the child must define (Figure 3.2), and they get progressively more difficult. The points vary between 0 and 2 and are given depending on how accurate the child is, where zero is a completely wrong definition and two is an exhaustive definition of the word. As with the previous test, the starting item is based on the age of the child, with children between 6 and 8 years old starting from item 5, and children between the ages 9 and 11 starting from item 7. The test is discontinued after five instances of zero points. The reversion rule is applied similarly to the previous test: when the child does not reach the full two points in one of the first two items, the previous items are to be administered until full points are gotten in two consecutive items. Once the test is completed, the points are added to obtain the raw score which is then converted in the scaled score using the tables provided by the manual.

reactions to social exclusion through the computerised game Cyberball (Williams et al., 2000) and dictator game, a modification of the ultimatum game (Güth et al., 1982).

3.3.2.1 RPQ

The RPQ (Raine et al., 2006) is a tool to assess aggressive behaviours in children, adolescents, and adults, which distinguishes between reactive and proactive aggression. It consists of 23 items concerning how often certain proactive and reactive aggressive behaviours are observed/enacted, rated on an ordinal scale between 0 (never) and 2 (often); the mean score for each type of aggression is then calculated. For the purposes of the research, only the parent form has been used (Figure 3.4).

RPQ
Genitori

Quante volte capita a suo/a figlio/a quello che è descritto nelle affermazioni seguenti? Rispondi con "0" se non gli/le capita mai, "1" se gli/le capita a volte, "2" se gli/le capita spesso.

1. Urlare agli altri quando gli/le danno fastidio	0	1	2
2. Litigare con gli altri per mostrare che è lui/lei il migliore	0	1	2
3. Reagire con rabbia quando gli altri lo/la provocano	0	1	2
4. Prendere cose ad altri studenti (senza che loro lo sappiano)	0	1	2
5. Arrabbiarsi quando non riesce a fare qualcosa	0	1	2
6. Rovinare qualcosa per divertimento	0	1	2
7. Fare capricci che portano a scoppi di ira	0	1	2
8. Danneggiare cose perché si sente arrabbiato/a	0	1	2
9. Fare a botte in gruppo per sentirsi forte	0	1	2
10. Ferire gli altri per riuscire a vincere un gioco	0	1	2
11. Arrabbiarsi o essere fuori di lui/lei quando non ottiene ciò che vuole	0	1	2
12. Usare la forza fisica per convincere gli altri a fare quello che vuole	0	1	2
13. Arrabbiarsi o infuriarsi quando perde a un gioco	0	1	2
14. Arrabbiarsi quando gli altri lo/la minacciano	0	1	2
15. Usare la forza per ottenere denaro o cose dagli altri	0	1	2
16. Sentirsi meglio dopo aver picchiato o urlato contro qualcuno	0	1	2
17. Minacciare o bullizzare qualcuno	0	1	2
18. Fare telefonate oscene per divertimento	0	1	2
19. Colpire gli altri per difendersi	0	1	2
20. Convincere gli altri a coalizzarsi contro qualcuno	0	1	2
21. Portare un'arma da usare in una lite	0	1	2
22. Arrabbiarsi o colpire gli altri quando viene preso/a in giro	0	1	2
23. Urlare agli altri in modo che facciano le cose per lui/lei	0	1	2

Figure 3.4 Reactive-Proactive Aggression Questionnaire (RPQ, Raine et al., 2006)

3.3.2.2 Cyberball and Dictator Game

The Cyberball game is a computerised ball-tossing game which investigates social exclusion, where participants are told they are playing online with other real people (figure 3.5). The game allows for different conditions to be tested; in this study two situations were presented: a neutral condition where the participants were included in the game and a social exclusion condition where they were excluded by the other participants. Afterwards, participants were given a questionnaire on how they felt during the game and in relation to the other players to be sure the different conditions of the cyberball game elicited different feelings and emotions. To conclude the round, a sticker distribution task akin to the dictator game was presented (figure 3.5): participants had to decide how to divide some stickers between themselves and the other players. They could either choose

to divide the stickers equally (neutral choice), give more to the other player (prosocial choice), or keep more for themselves (aggressive choice).

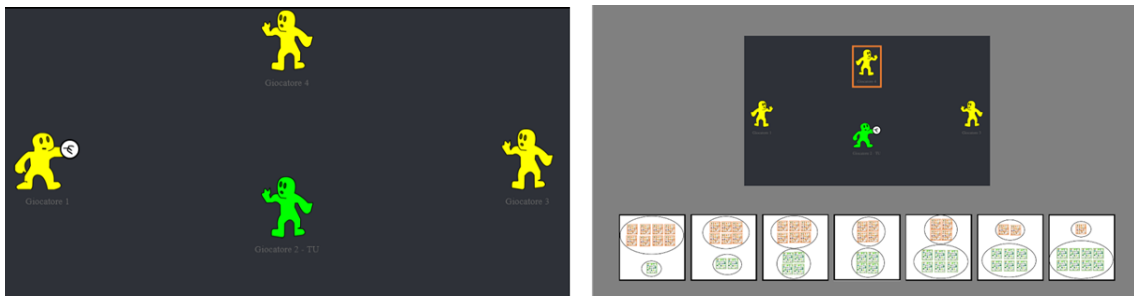


Figure 3.5 Cyberball and Dictator Game

3.4 Procedure

The present study involves four nine-year-old children, two diagnosed with ADHD and assessed in clinical centres, and two non-diagnosed, chosen after a careful screening. Participants have been paired on the basis of age and IQ score, so that differences in performance could not be attributed to these variables, but to gender differences and the disorder. The administration of the tests was spread out in multiple occasions, as not to exhaust the children, and participants were made to feel as comfortable as possible and thoroughly instructed each time. Prior to the administrations, children's parents were asked to sign an informed consent form. Tests were given in a different order for every participant, to account for fatigue effects. Once the tests administration was completed and scores were recorded, the data was analysed and compared.

CHAPTER 4. RESULTS

This research aims at investigating aggression in children with ADHD and potential gender differences. Four 9-year-olds children have been accurately selected: a boy and a girl with a clinical diagnosis of Attention Deficit/Hyperactivity Disorder (ADHD) and a non-diagnosed (ND) boy and girl. Aggression will be compared between ADHD and ND, and between the boy and girl with ADHD, and the ND boy and girl. Additionally, there will be a focus on the type of aggression put into place, and whether it can be categorised as proactive or reactive. The children have been selected based on similarity of age, gender, and intelligent quotient (IQ) level, in order to limit third-variable problems. The diagnosis of ADHD was confirmed by administering the Conners' Parent Rating Scale-Revised: Short Form (CPRS-R:S, Conners, 1997) to the parents of children with ADHD. Likewise, parents of ND children also completed the questionnaire to exclude the presence of oppositional, cognitive problems/inattention, hyperactivity, and ADHD traits. Finally, aggression was measured by administering the Reactive-Proactive Aggression Questionnaire (RPQ, Raine et al., 2006) to the participants' parents, and testing the children on the game Cyberball (Williams et al., 2000) and Dictator Game. In the RPQ test, we expected higher values in the clinical group compared to the non-diagnosed group, and, as a whole, boys to score higher than girls. Furthermore, children with ADHD were expected to score higher on reactive aggression than proactive aggression. Likewise, in the computerised test, we expected a confirmation of the data form the questionnaire by experimentally revealing what level and kind of aggression the participants would put into place in a neutral and a social exclusion condition. If participants behaved aggressively, by giving few stickers to the other participants and keeping most to themselves, in the neutral condition the type of aggression will be categorised as proactive; on the other hand, if they behaved aggressively in the social exclusion condition, the aggression will be defined as reactive.

4.1 Analysis relative to the sample

Participants have been carefully paired on the basis of:

- estimated IQ (Sattler, 1998) (normal for all participants: >90)
- Age (+/- 6 months)

- Gender

In the following paragraphs, clinical children's profiles are described.

4.1.1 Tommaso's case

Tommaso was born in 2014, is 9 years and 5 months old at the time of testing and attends elementary school. He started showing signs of hyperactivity and inattention during his earliest years and, for this and other reasons, was entrusted with a foster family early in life, where he still lives. As shown by his score in the CPRS-R:S (Conners, 1997), Tommaso is diagnosed with a combined type of ADHD. This became apparent during the administration of the tests, when he showed difficulties in keeping still and anxiety for the situation, needed numerous breaks and often quickly lost interest in the tests.

4.1.2 Elisabetta's case

Elisabetta was born on the 7th of March 2014, is 9 years and 1 month old at the time of testing and attends the third year of elementary school. Her profile, as further confirmed by the CPRS-R:S (Conners, 1997), is prevalently inattentive. Inattentive symptoms were evident also during the administration of the tests, as Elisabetta lost track of tasks easily, and often needed to be reminded to keep focused.

4.2 Results

In the following paragraphs, the results of the participants in the screening and experimental tests will be compared.

4.2.1 Screening tests

4.2.1.1 WISC-IV

Estimated IQ (Sattler, 1988) was measured by administering the two subtests block design and vocabulary from the WISC-IV battery (Weschler, 2012). As reported in Table 4.1, Lorenzo (ND) has an IQ of 103, Tommaso (ADHD) of 103, Anna (ND) of 115, and Elisabetta (ADHD) of 112. As expected, all participants have a normal estimated IQ (over 90) and there are no significant differences between ND children and ADHD, nor between genders. Therefore, participants are correctly paired with respect to their cognitive functioning.

Name	Group	IQ
Lorenzo	ND	103
Tommaso	ADHD	103
Anna	ND	115
Elisabetta	ADHD	112

Table 4.1 WISC-IV (Wechsler, 2012) results

4.2.1.2 Conner's Parent Rating Scale-Revised: Short Form (CPRS-R:S)

In order to confirm the presence of ADHD traits in the children diagnosed with ADHD and control for their presence in ND children, the Conners' Parent Rating Scale-Revised: Short Form (CPRS-R:S, Conners, 1997) was administered to the participants' parents. As expected, participants with ADHD scored higher in all indexes compared to ND children. In particular, Lorenzo scores above the cut-off point (fixed at 65 T points) on all indexes, confirming his combined-type diagnosis, while Anna scores above cut-off only on cognitive problems/inattention and ADHD, confirming her diagnosis of ADHD with a predominantly inattentive presentation. On the other hand, as reported in Table 4.2, ND participants score under the cut-off on all indexes.

Name	Group	Oppositional Behaviour	Cognitive problems/inattention	Hyperactivity	ADHD
Lorenzo	ND	43	41	43	45
Tommaso	ADHD	71	81	76	80
Anna	ND	52	56	47	57
Elisabetta	ADHD	42	74	52	65

Table 4.2 CPRS-R:S results

4.2.2 Experimental tests

4.2.2.1 RPQ

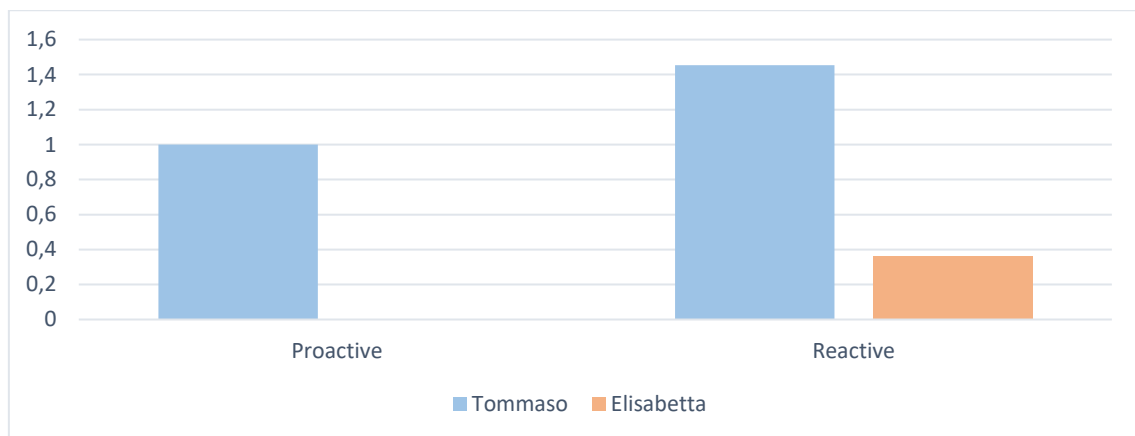
The levels of proactive and reactive aggression were evaluated by administering the RPQ (Reactive-Proactive Aggression Questionnaire, Raine et al., 2006) to the parents of the children. As detailed in Table 4.3, it can be noticed how all participants score higher on reactive than proactive aggression, and how boys generally result all around more

aggressive than girls. In particular, it is evident how, among boys, Tommaso (ADHD) scores higher in both proactive and reactive aggression compared to Lorenzo (ND). On the other hand, among girls, both score the same on the two scales.

Name	Group	RPQ - Proactive	RPQ - Reactive
Lorenzo	ND	0	0.73
Tommaso	ADHD	1	1.45
Anna	ND	0	0.36
Elisabetta	ADHD	0	0.36

Table 4.3 RPQ (Reine et al., 2000) scores

As highlighted in Graph 4.1, for what concerns gender differences, children with ADHD confirm the expected trend that boys are more aggressive than girls, both in proactive and in reactive aggression.



Graph 4.1 Comparison between Tommaso and Elisabetta (ADHD)

4.2.2.2 Cyberball and Dictator Game

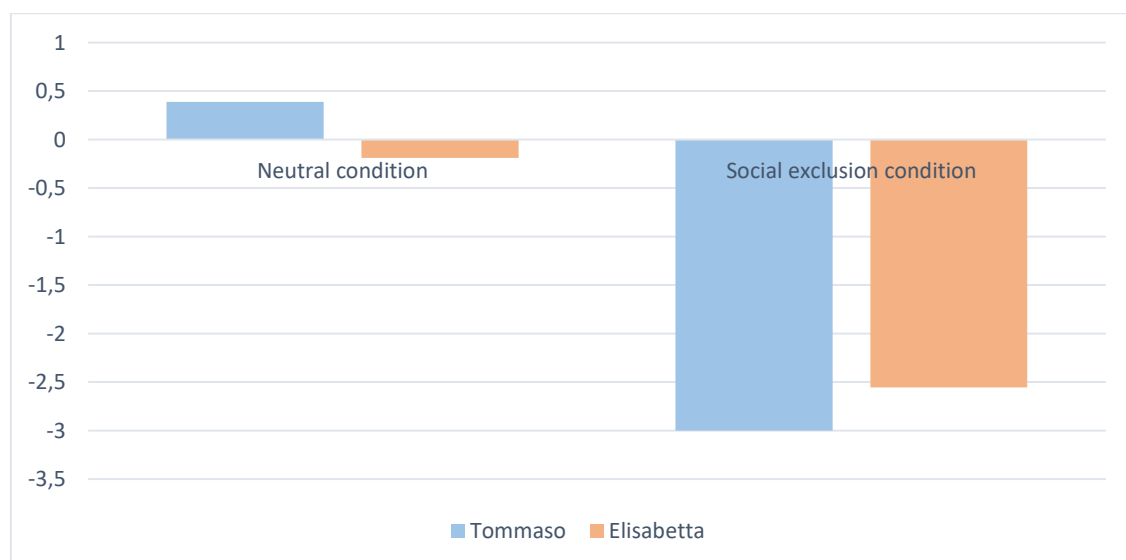
Through the game Cyberball (Williams et al., 2000) and Dictator Game, children had the chance to show how they would behave in a real-life situation. After having played a virtual ball-tossing game with other supposedly real peers, they were asked how they would divide some stickers between themselves and the other players. Table 4.4 shows how the stickers were distributed, with positive numbers indicating more stickers given to others than kept for themselves (representing prosocial behaviours), and negative numbers indicating more stickers kept than given (representing aggressive behaviour). In the neutral condition, where all players throw and receive the ball the same number of

times, as expected, ND children put in place prosocial behaviours, giving more stickers to the other players than themselves, while children with ADHD behave mostly neutrally, keeping and giving the same number of stickers. On the other hand, and also in line with predictions, in the social exclusion condition all children keep more stickers to themselves and give less to the players who excluded them, with boys giving somewhat less stickers than girls. In both conditions, children with ADHD behave more aggressively than ND children. What is surprising, perhaps, is how girls score almost the same as boys in this condition, apparently disproving that boys are generally more aggressive than girls.

Name	Group	Neutral condition	Social Exclusion condition
Lorenzo	ND	1	-0.12
Tommaso	ADHD	0.39	-3
Anna	ND	3	-1.93
Elisabetta	ADHD	-0.19	-2.56

Table 4.4 Cyberball and Dictator Game results

By specifically comparing the profiles of the two ADHD children (Graph 4.2), we can see how, in the neutral condition, the two behave mostly neutrally. In the social exclusion condition, however, both Tommaso and Elisabetta are highly aggressive and score almost the same in reactive aggression.



Graph 4.2 Comparison between Tommaso and Elisabetta

4.3 Discussion

In this section, the results of the questionnaires and tests will be discussed in light of the existing literature on the subject. This research involved four 9-year-old children, two with ADHD and two ND, paired according to age, IQ level, and gender. Screening tests show that all children fall in the range for normal cognitive development, and there are no significant differences in scores between them. Parents completed the Conners' Parent Rating Scale-Revised: Short Form (CPRS-R:S, Conners, 1997) to confirm the presence of the disorder in the clinical group and exclude it in the typical group. Indeed, the results supported the data: the boy with ADHD scored above the cut off on all indexes, confirming his diagnosis of ADHD combined type, while the girl with ADHD scored above the cut off only on cognitive problems/inattention and ADHD, confirming her diagnosis of ADHD with a predominantly inattentive presentation. Both ND children scored in the non-clinical range on all indexes.

To measure aggression, a questionnaire and a computerised test have been used. Participants' parents have been asked to complete the RPQ (Reactive Proactive Aggression Questionnaire, Raine et al., 2006), which measures the frequency with which proactive and reactive behaviours are observed. As highlighted in Table 4.3, both differences between diagnosis and gender emerge. In particular, with respect to the diagnosis, Tommaso (ADHD) scores higher on both types of aggression compared to Lorenzo (ND), while Elisabetta (ADHD) scores the same as Anna (ND). Both Tommaso and Elisabetta score higher on reactive aggression than proactive. This is in line with the literature, as children with ADHD display aggressive behaviours more often than those without ADHD (Carlson et al., 1997). The reason why Elisabetta and Anna score the same could be attributed to the predominantly inattentive presentation of Elisabetta's diagnosis: Barkley (2010) proposes that the higher level of aggression in children with ADHD is caused by the emotional dysregulation as a result of impulsivity traits in children with ADHD. As aggression is more often associated with the hyperactive/impulsive subtype, children diagnosed with the inattentive subtype could show lower rates of aggression. For what concerns gender differences, aside from the issue of the subtype of ADHD, the differences in levels of aggression between Tommaso and Elisabetta can also be explained by the fact that, when types of aggression are not taken into account, males display more aggressive behaviours than females.

Results in the Cyberball game (Williams et al., 2000) and Dictator game show even more interesting results. As detailed in Table 4.4, further differences between diagnosis and gender emerge. For what concerns diagnosis, it holds true that participants with ADHD score higher on aggression overall, with both Tommaso and Elisabetta putting into place more aggressive behaviours than their ND counterparts. Furthermore, both show higher levels of reactive aggression, behaving aggressively only when provoked (social exclusion condition). The most striking finding emerges when comparing the two children with ADHD: Tommaso and Elisabetta show almost the same level of aggression, finding that not only seems to clash with the previous results in the RPQ, but with the literature as well. There are a few explanations that could account for this. First of all, by the nature of the test, which aims at instilling feelings of exclusion in the participant, and measures aggression through a stickers-distribution task, the type of aggression that participants put into place can be defined as relational, or indirect, aggression. This type of aggression is more often encountered in girls than boys (Lagerspetz et al., 1988). In this case, the feeling elicited by the situation were the same, but Elisabetta reacted more aggressively. An alternative explanation could come from the feelings resulting from social exclusion. It has been shown how females seem more susceptible to social exclusion than males (Benenson et al., 2013) and how girls exposed to social exclusion show poorer cognitive performance than boys in the same condition (Hawes et al., 2012). Therefore, it is not that Elisabetta acted more aggressively than Tommaso, but she only felt more ostracised than Tommaso, and acted accordingly.

4.4 Limitations and future directions

Although the research revealed some promising results, there are some limitations that have to be taken into account. First, the very small sample size, only composed of four participants. External validity is compromised with a sample this small, and findings could be attributed to the specifics of these children and not to an actual general effect. Second, questionnaires have well known limitations that must be kept in mind when using them in research, like social desirability bias and possible misinterpretation of questions. Finally, the game Cyberball and Dictator game can represent a limitation insofar as it potentially measures only a specific type of aggression, relational aggression, elicited from social exclusion. Still, these results that have the potential to be further explored.

For example, future studies could use different methods to measure aggression in children with ADHD and report if the gender differences still hold true. Additionally, it would be interesting to investigate better the reason behind the high levels of reactive aggression, which was beyond the scope of this study. Finally, as it emerged in this study as well, girls seem to show more reactive aggression than boys, therefore future research could examine relational aggression in girls with ADHD in more detail.

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