The relationships among genes, psychological traits, and social behavior

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

by

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DECLARATION

I here by declare that the thesis entitled "The relationships among genes, psychological traits and behavior" submitted by me, for the award of the degree of *Doctor of Philosophy* to the University of Trento is a record of *bonafide* work carried out by me under the supervision of Prof. Gianluca Esposito, Associated Professor at the Department of Psychology and Cognitive Science, University of Trento, Italy and Dr. Bruno Lepri, Principal Investigator of the Mobile and Social Computing Lab, Fondazione Bruno Kessler, Trento, Italy.

I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or University.

Place: Rovereto (Trento)

Date: January 10th 2020 **Ilaria Cataldo**

ABSTRACT

In just over ten years, internet-based technologies revolutionized several aspects of daily human life, including social interactions. Social media sites (SNSs), such as Facebook, Instagram and Twitter, have dramatically changed the way people keep in touch or make new acquaintances. On the flipside, recent research have highlighted the risk for and inappropriate use of SNSs, that might result as a personal discomfort or a mental disorder. For this reason, it is important to understand how these issues develop starting from the diverse contexts and individual features. The main aim of the present Ph.D. project is to identify to which extent the interaction between psychological components, like as perceived parental warmth, and genetic susceptibility to familiar environment can describe the social behavior online and offline. The underlying hypothesis is that sensibility to familiar context will represent a positive factor, if the person recalls a good perception of parental care, leading to confident psychological mechanisms in adulthood, hence to more optimal neural responses to social stressors in real life, and to an appropriate use of social media. To this aim, three studies have been performed:

- Study 1. Analysis of the impact of perceived early social experience on the formation of interactional patterns in adult social interaction in two different countries (Italy and Singapore);

- Study 2. Investigation on how interaction between genetic features of oxytocin receptor gene polymorphisms and perceived early social experience affect the neurophysiological responses to cries;

- Study 3. Exploration of the link between adult psychological dimensions related to social behavior and metrics of usage on Instagram platform.

The experimental activities have been performed in two different laboratories: as for the Italian samples, questionnaires and genetic information were collected at the Affiliative Behavior and Physiology Laboratory in Rovereto; with regards to the Singaporean sample, participants completed the questionnaires, then were tested for genetics, Near InfraRed Spectroscopy (NIRS), Electrocardiogram (ECG) at the Social and Affective Neuroscience set in Nanyang Technological University. One of the purposes of the overall project was the construction of a rich database, which aims to include information about genetic polymorphisms proved to be sensitive to social environment (oxytocin receptor gene rs53576, rs2254298 and serotonin rs25531), recalled parental warmth, main dimensions of adult attachment, neural and physiological responses to social distress, like listening to cries, and behavior on two mail social media platforms, such are Facebook and Instagram. This complex design gives to the project several strengths, such as the possibility to focus on the contribution of diverse factors within a bio-psycho-

social frame, that is claimed to be the more appropriate by scientific community standard, in order to have a wider and deeper understanding of human behavior. Secondly, results generated from studies based on this database would allow to fill the present gap about social media usage and psychological mechanisms, providing a further comparison with offline behavior. Lastly, results might be helpful when implemented in clinical work to understand if and how social media can become a useful mean in clinical work. The temporary fragility of this project is related to genetic sample size, as a broader sampling would be necessary to have a comparable amount of the different variants and generate more reliable explanations. However, this data collection represents a starting point, as it resents of temporal constraints. Future efforts are necessary to enrich the dataset and to find appropriate methodologies to examine in depth the interaction between all the factors

Keywords: *parental bonding*, *oxytocin*, *gene-environment interaction*, *NIRS*, *Instagram*.

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STRUCTURE OF THE THESIS

My Ph.D. experimental activities have been performed in Rovereto (Italy), at the Affiliative Behaviour and Physiology Lab, Department of Psychology and Cognitive Science, and in Singapore (Singapore), at the Social and Affective Neuroscience Lab. Data collection represented the most onerous phase of my Ph.D., as it required a very rigorous process, starting with the submission of the project to the Ethics Committees both in Italy and Singapore, and ending with the creation of a rich database, that includes psychosocial, genetic, neurophysiological, and behavioral measurements. In the present dissertation, only three subset of data will be discussed, in the attempt to describe the relationships among genes, psychological traits, and social behavior online and offline.

The present thesis consists of five chapters:

- The **first chapter** provides an analysis of the literature related to the interaction between oxytocin and parental care in psychiatric disorders onset. This chapter includes papers elaborated and published during my Ph.D.

- The **second chapter** presents an general frame on the state of art in the role played by social media sites in the development of psychological related issues in childhood and adolescence, including sections focused on specific web platforms.

- The **third chapter** describes the mediation effect of individual interpersonal mechanisms over the relationship between recalled parental warmth and close relationships in adulthood; the chapter also includes a comparison between two different countries (Italy and Singapore).

- In the **fourth chapter**, neurophysiological responses to social cues are analyzed within the gene-by-environment interaction frame; specifically, the study reports how the interaction between perceived parental care and two polymorphisms of the oxytocin receptor gene influences the variation of oxygen flow in the prefrontal cortex in responses to cries.

- The **fifth chapter** aims the attention at how psychological mechanisms of interpersonal behavior can explain the diverse usage of social media sites, with regards to Instagram main indexes (number of pictures, of followers and following profiles) .

The overall objective of my experimental activities was to provide a deep focus on two different and complementary sides of social behavior, both in "real" and "virtual" relationships, starting from the interaction between two specific polymorphisms of oxtytocin receptor genes and individual features, such as experienced parental care and protection, psychological mechanisms of interpersonal behavior, and main dimensions of social relationships. In order to pursue this aim, some methodological choices were made: with regards to the genetic factors, we investigated on targeted single nucleotide polymorphisms (SNP) instead of opting for a genome wide association (GWAS) procedure. This decision resulted to be more compatible with our goals; although GWAS approach provides more information as an output, it is usually adopted in the context of binary phenotypes and it requires a very large sample size (¿1,000) to obtain reliable results, while to test a SNP a lower number of participant (300) is sufficient (Hong and Park, 2012). The decision to utilize different kind of cries as a stimulus to elicit neurophysiological responses was dictated by the necessity to find a relevant social cue with a strong emotional valence

in the context of real life situations. In light of the above, we performed three experimental studies to assess the objective of the experimental project:

study 1. individual psychological mechanisms underlying social relationship perform as mediator between recalled parental cares and the levels of anxiety and avoidance experienced in relevant social relationship; this mediation effect follows a parallel pattern in two different countries;

study 2. the interaction between allelic variants of two polymorphisms of oxytocin receptor gene susceptible to environmental and optimal patterns of perceived parental warmth will results in higher recruitment of prefrontal cortex brain area;

study 3. tree based model regression analyses explain that psychological mechanisms related to anxiety in adult attachment are linked to higher social media activity, while dimensions related to avoidance reflect lower indexes.

All the chapters include data and manuscripts elaborated and/or published during my Ph.D.

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List of Terms and Abbreviations

ASQ   Attachment Style Questionnaire

DeoxyHb Deoxygenated Hemoglobin

ECR-R Experience in Close Relationships - Revised

FB   Facebook

IG   Instagram

NIRS   Near InfraRed Spectroscopy

OXT   Oxytocin

OXTr   Oxyotcin receptor gene

OxyHb Oxygenated Hemoglobin

PBI   Parental Bonding Instrument

SNP   Single Nucleotide Polymorphism

SNS   Social Network Sites

URL   Uniform Resource Locator

5HTTLPR Serotonin Transporter Linked Polymorphic Region

CHAPTER 1

The Influence of Oxytocin Receptor Gene and Parental Care in the Development of Psychiatric Disorders

1.1 Introduction

Human social behavior involves two or more people and includes any interaction within which one person affects the other(s). The individual features of the actors and the contextual factors can exert an impact on the quality of the interaction. Therefore, social behavior can be considered as a result of the interaction of multiple variables. Concerning individual characteristics, specific neuropeptides can modulate social behavior, through their effects on brain mechanisms. For example, numerous studies highlighted the association between oxytocin and medial prefrontal cortex, amygdala, and anterior cingulate cortex and emotional valence of social cues like faces and infant cry or laughter (for a review, see (Bethlehem et al., 2013). Alongside oxytocin, oxytocin receptor gene caught the interest of researchers in psychological and behavioral fields. The oxytocin receptor (OXTR) gene is a protein that acts as a receptor for the broadly expressed oxytocin, which operates both as hormone and neurotransmitter. OXTR encodes 389 aminoacids, and it is present as a single copy in the human genome mapped to the gene locus 3p253p26.2. The gene spans 19.2 kb on chromosome 3 and contains three introns and four exons (Consortium et al., 2007). Notably, the oxytocin system exerts its effects on biological functions, in both humans and animals, such as on reproduction, parturition, and breastfeeding (Mandelli and Serretti, 2013; Xu et al., 2018), body weight and metabolism regulation (Blevins and Baskin, 2015; Ho and Blevins, 2012; Klockars et al., 2015) and, according to recent studies, on the processes underlying eating disorders (Giel et al., 2018; Kim et al., 2015; Smearman et al., 2016a). Though the effects are not limited to biological processes alone. Articulated social behaviors like parenting (Esposito et al., 2017b; Feldman et al., 2013; Klahr et al., 2015; Leerkes et al., 2011; Senese et al., 2017; Ainsworth, 1967; Smearman et al., 2016a); affiliative behavior (Feldman et al., 2016; Smearman et al., 2016a; Mileva-Seitz et al., 2013; Bakermans-Kranenburg and van IJzendoorn, 2008), construction of interpersonal bonds (McInnis et al., 2015; Kumsta and Heinrichs, 2013; Krueger et al., 2012; Poulin et al., 2012; Chen et al., 2011; Kogan et al., 2011; Bartz et al., 2011; Insel and Young, 2001; Feldman et al., 2012; Rodrigues et al., 2009), romantic relationships (Walum et al., 2012; Schneiderman et al., 2013; Sturge-

Apple et al., 2012; Chang et al., 2013) and responses to stressful social situations (Bonassi et al., 2017; Unternaehrer et al., 2015; Feldman et al., 2012; Rodrigues et al., 2009; Heinrichs and Domes, 2008; Domes et al., 2007; Kirsch et al., 2005) resent of the implication of OXTR regulatory mechanisms.

1.1.1 Single Nucleotide Polymorphisms (SNPs) of Oxytocin Receptor Gene

Results from studies in the last decade began to illustrate that people have the tendency to inherit a genetic predisposition to a specific disorder rather than the disorder itself. Hence, this vulnerability is related to the phenomenon of gene expressions (Schroeder et al., 2010; Murgatroyd et al., 2009; Poelmans et al., 2013). Starting from the introns and exons of the OXTR encoding gene, it is possible to extract information about over 5000 single nucleotide polymorphisms (SNPs) which are basically variations of genetic material, that could present a different nucleotide (Consortium et al., 2007). Since SNPs are located in the intronic region of the gene that encodes for OXTR, they do not extert direct effects on the functionality of the OXTR, but some studies revealed some associations between specific polymorphisms and different biological outcomes in plasma levels of oxytocin (Feldman et al., 2012; Luo et al., 2012; Yamasue, 2013). The clue that this neurohormone is associated to a series of personal susceptibility is getting an expanding attention from many researchers (Ebstein et al., 2009; Jacob et al., 2007; Lerer et al., 2008; Liu et al., 2010; Meyer-Lindenberg and Tost, 2012; Wermter et al., 2010; Wu et al., 2005; Yrigollen et al., 2008; Gregory et al., 2009). Consequently, the amount of investigated SNPs continues to increase. Several variations have been explored not only singly but also in groups of genotypes inherited together, known as haplotypes or haploid (Beitchman et al., 2012; Lerer et al., 2008; Lucht et al., 2009; Wu et al., 2012). OXTR rs1042778 and rs237887 are recurrently examined together, propositng that this couple might be implicated in regulatory mechanisms of social stress (Kumsta and Heinrichs, 2013), and behaviors concerning pair-bonding formation (Walum et al., 2012). In this chapter, I will review SNPs separately. The figure below displays the composition of OXTR and the location of the SNPs presented in the following paragraphs (reffig:OXTr). The relative locations of seven OXTR SNPs of interest on a premature mRNA transcript are depicted as follow: rs139832701, rs53576, rs2254298, rs237887, rs237885, rs1042778, and rs11131149. These SNPs were previously found to contribute to the development of psychiatric disorders. rs139832701 (G/T) has a chromosomal base-pair (Chr.bp) location of 8773124. rs53576 (G/A) has a Chr.bp location of 8762685, while rs11131149 (G/A) is located at Chr.bp 8761165. rs2254298 (G/A) has a Chr.bp location of 8760542. Further downstream, rs237887 (G/A) has a Chr.bp of 8755356, while rs237885 (G/T) has a Chr.bp of 8753857. Nearer to exon 4, rs1042778 (G/T) is located at Chr.bp 8752859.
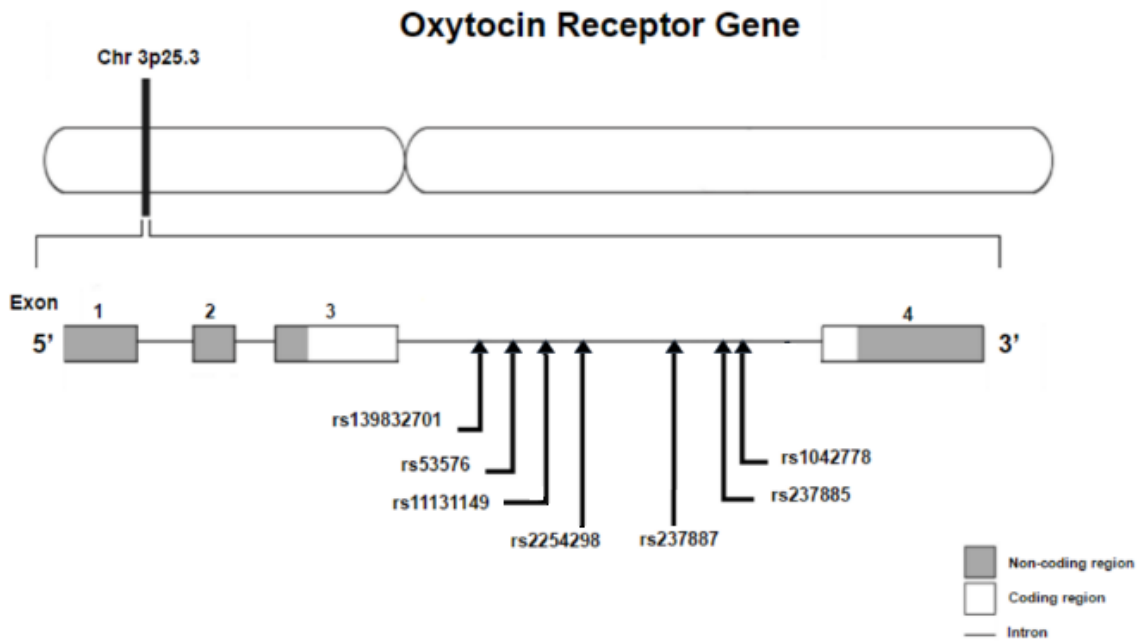
Fig. 1.1 Schema of Oxytocin Receptor Gene

1.1.2   General Functions of OXTR SNPs

Multiple studies showed that the bridge between genotype (SNPs) and phenotype (social behavior) might be represented by the activity of OXTR in the brain(Wade et al., 2015; Yamasue, 2013), especially in areas such as the amygdala, dorsal anterior cingulate gyrus and hypothalamus (Inoue et al., 2010; Tost et al., 2010; Yamasue, 2013), which are broadly involved in cognitive development and social cognition (Carter, 2014). Amongst the downstream mechanisms, OXTR is responsible for fostering stem cell differentiation and for inhibiting programmed cell death (Carter, 2014; Gutkowska and Jankowski, 2012; Leuner et al., 2012). As a consequence, modifications and variations in the expression of OXTR SNPs could potentially result in altered effects on structural and functional neuroanatomy through modulation of activity mediated by OXT (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012). In 2012, Brne posited that the A allele of the OXTR rs2254298 polymorphism might be involved in mechanisms related to neural plasticity, concerning the empowerment of the resilience in stressful social contexts, especially during early stages of life (Brüne, 2012). Other evidence in the literature indicate a link between rs2254298 polymorphisms and biological differences, such as lower plasma levels of OXT in GG-carriers (Feldman et al., 2012), while A-carriers show greater amygdala volume (Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Bethlehem et al., 2013; Furman et al., 2011; Inoue et al., 1994) and decreased volume of the hypothalamus (Tost et al., 2010). Many studies

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unveiled the involvement of OXTR rs2254298 over parenting (Senese et al., 2017), social cognition (Micali et al., 2017; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Brüne, 2012; Feldman et al., 2012; Bickart et al., 2011; Furman et al., 2011), and specific mental disorders such as depression and anxiety (Costa et al., 2009; Smearman et al., 2016b; Thompson et al., 2011; Chen et al., 2011; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Kawamura et al., 2010), eating disorders (e.g., bulimia nervosa) (Kim et al., 2015; Acevedo et al., 2015; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012), and autism (Cataldo et al., 2018a; Zhang et al., 2017; Wu et al., 2005; Liu et al., 2010; Kinney et al., 2008; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012). Taking these consideration together, it appears that the A variant of this polymorphism confers to its carrier a stronger susceptibility to unfavorable environmental factors (e.g., prenatal complications) (van Roekel et al., 2013; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012), with a possible development of autistic-like phenotype, or, contrariwise, to better sociability. Likewise, rs53576 GG-carriers have been found to be linked to increased emotional dysregulation in adulthood (Bradley et al., 2011), depressive symptoms in people who experienced abuse and unfavourable conditions during childhood (McQuaid et al., 2013; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012), and psychopathology, such as depression (Adrian et al., 2015; Hostinar et al., 2014; Bethlehem et al., 2013; Thompson et al., 2014; McQuaid et al., 2013; Bradley et al., 2011; Saphire-Bernstein et al., 2011); despite the evidence, it is possible to find discrepancies in literature (Tollenaar et al., 2017). Concerning parental attitudes, Senese and colleagues found higher positive implicit association to infant faces in G/G homozygotes carriers than in A-carriers (Senese et al., 2017), while in 2008, Bakermans-Kranenburg and van Ijzendoorn showed that people with the A allele variation of this SNP displayed lower parental sensitivity (Bakermans-Kranenburg and van IJzendoorn, 2008). Generally, many studies suggested that in early life stages, rs53576 might modulate the sensitivity to familial environment, like parental care, and social interactions. Results from other studies promoted that this polymorphism is associated with a reduced ability to benefit from interpersonal support (Hostinar et al., 2014; Chen et al., 2011; Kim et al., 2010) and resilience (Bonassi et al., 2017; Myers et al., 2014; Bradley et al., 2013; Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Rodrigues et al., 2009), leading sometimes to mental health issues in adulthood (McInnis et al., 2015; Bethlehem et al., 2013; Hostinar et al., 2014; Belsky et al., 2009). These findings suggest that G-carriers are more sensitive to the environment, both in favorable or negative contexts. This susceptibility may affect neural plasticity of mechanisms involving the oxytocin system (Lin et al., 2012). With regard to children and teenagers with behavioral dysregulation (Sakai et al., 2012) or callous-unemotional traits (Beitchman et al., 2012), rs237885 had a higher association than other SNPs or haplotypes; so far, the lack of further evidence does not permit

to claim that this variation is strictly correlated to aggressive behavior, as the behavioral outcome could be the effect of a whole haplotype. In 2014, Myers and colleagues were the first authors to investigate the association between early exposure to stress and increased risk to develop mental issues like anxiety and depression in adulthood. They found a significant correlation between individuals with the OXTR rs139832701 variant, who were also exposed to stress, and increased severity of symptoms related to anxiety, depression and stress (Myers et al., 2014). Likewise other SNPs, this genotype variant appears to increase the sensitivity to stressful contexts, leading to a higher possibility to develop a temperament with anxious and depressive traits. An analogous idea that has been gaining recognition in scientific research refers to the epigenetic modification of OXTR through DNA methylation. This process varies from one individual to another, and results in changes in gene transcription. Some studies report results at an epigenetic level, but implications on targeted social behaviors remain unknown. Investigations on psychiatric disorders (Smearman et al., 2016a; Unternaehrer et al., 2015; Cecil et al., 2014) found alteration in brain areas modulated by OXTR functionality; specific results will be further discussed. As aforementioned, there is a considerable amount of literature about OXTR and its several SNPs. In this chapter, the focus will be on OXTR SNPs rs2254298 and rs53576, reviewing findings of the last decades for a wider understanding of the clinical implications of OXTR variations.

1.2   OXTR and Parental Care: Modulation of Psychiatric Disorders

Within the growing interest in the interaction of oxytocin with environmental factors, the area related to parental care is receiving lots of attention. Adults emotional response to infant cues has been shown to predict later attachment style of the child and security (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Leerkes et al., 2011; Chen et al., 2011), shape resilience against the adverse effects of stressors (Sippel et al., 2017; Cohen and Wills, 1985; Thoits, 2011) and have long-term consequences (Joosen et al., 2012; McElwain and Booth-LaForce, 2006). Given that parenting exerts an enduring effect on lifelong development, parental care remains a pivotal topic in gene-by-environment studies concerning oxytocin. Early contextual elements leave persisting consequences in their wake. Over the past few decades, a robust bridge has been drawn between childhood adversities, and resulting mental health related issues in adulthood (Paolucci et al., 2001). This connection appears to last due to a fundamental dysregulation of emotion processing pathways and systems involved in stress responses upon being exposed to early unfavorable events (Bethlehem et al., 2013; Paolucci et al., 2001; Repetti et al., 2002), partially mediated by oxytocin (Heinrichs and Domes, 2008). Variation in OXTR differentially regulates sensitivity to the social environment (Kumsta and Heinrichs, 2013), such that those more susceptible to adverse social factors are more prone to develop psychological symptoms of psychopathology (Belsky et al., 2009; Brüne, 2012). For instance, OXTR variants seems

to exert an effect over youths' responses to parental behavior, and moderate the effects of perceived early parental warmth (Bonassi et al., 2017; Esposito et al., 2017b). Amongst adolescents, G/G homozygotes of rs53576 were found to be most responsive to parental support and intervention (Smearman et al., 2016a). A-carrier males of this polymorphism with a history of paternal overprotection seem to be more susceptible to social distress, exhibiting greater increases in heart rate and nose temperature changes, than those with G/G genotype (Esposito et al., 2017b). Since early adverse experiences often manifest in the context of inadequate parental care, studies on gene-by-environment interactions between OXTR and parental care represents a crucial area of research that could strengthen the framework of how gene and environment jointly contribute to etiologies underlying psychological disorders (Wermter et al., 2010).

1.3   Risk for Psychopathology

Recently, Burkhouse pointed out that children with the OXTR rs53576 G/G genotype, reared by mothers with a history of major depressive disorder (MDD), displayed an increased tendency to detect sad faces and diminished sensitivity in identifying happy faces, as compared to those reared by non-depressed mothers. Difficulties in recognizing emotions were not evident in A-carriers and surfaced in children with G-homozygotes variation only when exposed to maternal depression (Burkhouse et al., 2016). These results might indicate that people with rs53576 G/G genotypes, who are more affected by their social context (Merrill et al., 2017; McQuaid et al., 2013; Pollak, 2003)(the quality of parental care in this case) are more prone to develop preferential processing of recurring subtle cues of sadness. Receptiveness to such stimuli could have potentially permitted to children of depressed mothers to re-adapt their behavior according to their mothers internal states. However, these information-processing biases risk to evolve into unfavorable deficits associated with multiple psychopathologies (Gottschalk and Domschke, 2017; Jacondino et al., 2014; Golarai et al., 2006; Edwards et al., 2002). A family-based approach in examining OXTR revealed that rs2254298 G/G genotypes were markedly overrepresented in families with maternal depression and were associated with lower concentrations of salivary oxytocin (Apter-Levy et al., 2013). A dysregulation functioning of oxytocin in mothers with depression appeared to be the result of a combination of genetic risk (rs2254298 G/G genotypes) and lower salivary oxytocin that they borne. Within the same families, fathers showed lower levels of peripheral oxytocin (Feldman et al., 2010), which resulted in children raised in low-oxytocin conditions and who received inadequate parental care (Furman et al., 2011). Depressed mothers with a single A-allele, however, exhibited higher oxytocin levels and predicted childrens positive social development. This study demonstrates the cross-generational transfer of predispositions to psychiatric susceptibility, involving both genetic risk and detrimental parental caregiving behavior (Swain et al., 2014).

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1.4 Child maltreatment, Internalizing symptoms and Disruptive behaviors

Oxytocin interacts with parental care to modulate a fundamental cornerstone of human social development: parent-infant bond and subsequent adult attachment. High plasma oxytocin levels correlated with longer parent-infant gaze synchrony (Feldman et al., 2011, 2012). Both maternal and paternal peripheral oxytocin levels shape the infants oxytocin profile (Feldman et al., 2013; Bales and Perkeybile, 2012), and social reciprocity in multiple affiliative attachments were found to be synergistically contributed by parents oxytocin levels and early parenting practices (Cruwys et al., 2014; Feldman et al., 2013). Early life adversities, in the form of abusive parental care, lead to sociocognitive deficits that present a risk for psychopathology (Anda et al., 2006; De Pauw and Mervielde, 2010; Krueger et al., 2002), and trigger the concurrent initiation of fear and attachment responses (Bethlehem et al., 2013; Anda et al., 2006; Moriceau et al., 2009). Additionally, the continual importance of OXTR in influencing attachment security across the span of development has been illustrated (Bradley et al., 2011; Lee Raby et al., 2013). Indeed, the OXTR variant rs53576 was found to interact with the severity of childhood maltreatment to predict deficits in adult emotional regulation and attachment security (Bradley et al., 2011). Amongst individuals with OXTR rs53576 G/G genotype, but not in A-carriers, insecure childhood attachment also predicted alexithymia in adulthood, higher mentalizing-related brain activity, and an increased amygdalial grey matter volume (Schneider-Hassloff et al., 2016), while secure infant attachment reliably predicted general and romantic attachment security in adulthood (Bradley et al., 2011; Lee Raby et al., 2013). In a dose-dependent manner (Bradley et al., 2011; Anda et al., 2006), an increasing number of categories of childhood maltreatment was associated with significantly more emotional dysregulation and attachment insecurity in G/G homozygotes than in A-carriers. In line with the differential susceptibility hypothesis, the G/G genotype of rs53576 possesses a malleable characteristic (Tost et al., 2010), in that it promotes resilience in enriching environments but poses a risk under stressful or adverse circumstances (Kim et al., 2010). Interaction between OXTR and poor parental care has been made evident, especially in studies of maltreatment. Severe childhood maltreatment has been shown to interact with OXTR rs53576, subjecting G/G homozygotes, but not A-carriers, to a higher risk of emotional dysregulation and a more pronounced disorganized attachment style in adulthood (Bradley et al., 2011). Early emotional abuse was associated with higher salivary oxytocin levels and was found to modulate indirectly processing of infant expressions (Bhandari et al., 2014). A study on harsh parenting by Brody and colleagues revealed that difficult temperament in pre-adolescence forecasted harsher parenting behavior, which resulted in poorer physical health, only when both parents and children were A-carriers. In addition to long-term behavioral consequences, maltreatment interacted with the OXTR rs53576 genotype to modulate structural brain changes (Brody et al., 2017). In G/G homozygotes, but not in A-carriers, gray

matter volume of the bilateral ventral striatum is negatively correlated with the severity of childhood maltreatment (Dannlowski et al., 2016). An epigenetic imprint of poor parental care has also been illustrated by an association between low maternal care during childhood and enhanced DNA methylation in an OXTR sequence in blood cells in adulthood (Unternaehrer et al., 2015). On the opposite spectrum of risks imposed by maltreatment, OXTR also modulates resilience to stressors. For instance, the protective effect of a positive childhood family environment was found to be associated with higher resilient coping methods amongst those with OXTR rs53576 G/G and A/G genotypes (Bradley et al., 2011); Similarly, lower cortisol response to stressors were found amongst G-carriers only if they were given social support (Chen et al., 2011). While some individuals develop psychopathological symptoms upon experiencing childhood maltreatment, others display extraordinary resilience. To investigate this differential effect, a study by Hostinar examined the interaction between OXTR rs53576 and maltreatment (Hostinar et al., 2014). A gene-by-environment interaction was illustrated by how the same objective measures of maltreatment (category, the brutality of abuse or its duration), generated significantly greater internalizing symptoms in G/G homozygotes as compared to A-carriers. Those with the G/G genotype could have also been more sensitive to adverse social occurrences (McQuaid et al., 2013; Pollak, 2003), leading them to report the perception of lower social support than A-carriers consistently. G/G homozygotes are more attuned to salient social stimuli (Kogan et al., 2011; Tost et al., 2010). However, in an abusive environment where parents frequently display anger and aggression, such an empathic trait might subject G/G homozygotes to greater distress (Rodrigues et al., 2009). Internalizing symptoms might inhibit these individuals from forming healthy adult relationships, making them more susceptible to psychopathology (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Bolger et al., 1998; Rodrigues et al., 2009; Rogosch et al., 1995). Conduct disorder (CD) is a moderately inheritable disorder (Rhee and Waldman, 2002) identified in youth and characterized with low social competence (Brotman et al., 2008; Drugli et al., 2007; Rhee and Waldman, 2002), disregard towards the rights of others and disobedience towards legal or societal rules. Sakai examined OXTR variants from family-based probands of youths diagnosed with substance abuse. However, OXTR variants failed to distinguish between families of patients with and without CD (Sakai et al., 2012). In a related study, Cecil and collaborators investigated the interaction between parental care and methylation of DNA, near the OXTR gene locus, in modulating callous-unemotional traits (CU) (Cecil et al., 2014). CU is characterized by a deficit in prosocial emotions, such as empathy or guilt, and is associated with CD (Dandreaux and Frick, 2009; Rowe et al., 2010), and psychopathy (Frick and Viding, 2009). Higher methylation has been shown to be associated with lower oxytocin levels (Dadds et al., 2014), which has subsequently been correlated with low prosocial behaviors (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Insel, 2010; Kumsta and Heinrichs, 2013). Amongst adolescents with low internalizing symp-

toms, the study found higher prenatal parental risk (e.g., delinquent conduct, psychopathology) to be associated with higher OXTR methylation at birth. Although it remains to be elucidated whether the relationship between prenatal parental risk and OXTR is causal or correlational (Johannes et al., 2009; Richards, 2006), such an interaction nonetheless plays a contributing role in the development of CU and CD. Lastly, strong comorbid relationships have been previously found between oppositional defiant disorder (ODD) and affective disorders (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Angold et al., 1999). Employing a Bayesian mixture modeling technique, Adrian and colleagues found that this comorbidity was not modulated by an interaction between OXTR and family support (Adrian et al., 2015).

1.5 Autism Spectrum Disorder

Many studies pointed out an association between OXTR gene variations and autism spectrum disorder (ASD) (Horvath et al., 2001; Yrigollen et al., 2008; Bakermans-Kranenburg and Van Ijzendoorn, 2014; LoParo and Waldman, 2015; Hammen et al., 2015; Zhang et al., 2017; Cataldo et al., 2018a). Concerning to OXTR rs53576, this variant has been linked to vulnerability in developing the autistic-like features (Tost et al., 2010; Liu et al., 2010; Wang et al., 2013). It has also been found to influence prosociality (Tost et al., 2010; Kogan et al., 2011; Yamasue, 2013) and affiliative behaviors (Bakermans-Kranenburg and Van Ijzendoorn, 2014; LoParo and Waldman, 2015; Zhang et al., 2017), which are social competencies that are impaired in persons with autism. A strong association between rs2254298 and ASD has been elucidated by studies across multiple populations (Wu et al., 2005; Liu et al., 2010; LoParo and Waldman, 2015). An undeveloped ToM confers individuals with difficulty in understanding that people have their thoughts, beliefs, and emotions, which places these individuals at risk of developing autism (Liu et al., 2010; Wade et al., 2014). These consistent findings linking OXTR SNPs to ASD represent some semblance of success in uncovering potential candidate polymorphisms that underpin autism. However, due to differences in methodological procedures and sample characteristics, studies involving gene-and-environment interaction of these genetic variants showed inconsistent results (Horvath et al., 2001).

1.6 Depression and Anxiety Disorders

The development depressive symptoms is highly influenced by early parent-child relationships (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Salzinger et al., 2002). OXTR also modulate interactions between non-supportive parent-child affiliations, coping styles, and severe symptoms of depression (McInnis et al., 2015). The moderating role of OXTR was particularly illus-

trated by how OXTR rs53576 A-carriers were more inclined to adopt disadvantageous emotion-focused coping styles (Matheson and Anisman, 2003; van Roekel et al., 2013) when exposed to negative social environments. Such coping strategies were found to be linked to greater symptoms of depression. In a related study, youths OXTR genotype was also found to moderate the interaction between maternal depression in early childhood and subsequent depression in adolescence (Thompson et al., 2014). Findings showed that youths who were OXTR rs53576 A-carriers, whose mothers had depression while rearing their children, were found to possess greater depressive symptoms at 15 years of age. Aside from the childs OXTR genotype, Aupperle and colleagues have also discovered that parental OXTR is associated with adolescents response to maternal praise and criticism (Aupperle et al., 2016). Similar to previous studies, increased depressive symptoms were found to be associated with stronger activation of the right amygdala in response to criticism (Beesdo et al., 2009; Guyer et al., 2008; Monk et al., 2008). However, an intriguing finding was that adolescents whose parents were OXTR rs53576 A-carriers, as compared to G/G homozygotes, were associated with significantly reduced right amygdala activation in response to criticism, and increased activation during receipt of praise. Since the A allele has been found to contribute to decreased parenting responsiveness (Bakermans-Kranenburg and van IJzendoorn, 2008), this phenomenon might be explained by how less sensitive maternal behaviors trigger an adaptive neural response pattern within the adolescents amygdala. Lastly, early-life stressors represent a critical factor in the development of depression (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Bradley et al., 2011; Preacher et al., 2007). In a study by McQuaid and colleagues, childhood maltreatment was correlated with greater symptoms of depression, with OXTR occupying a moderating role. In conditions of severe maltreatment, only G-carriers of OXTR rs53576 exhibited greater symptoms of depression, as compared to A/A homozygotes (McQuaid et al., 2013), in line with findings in literature (Bradley et al., 2011; Preacher et al., 2007). Additionally, for G-carriers, a breach of trust (i.e., neglect, abuse) was found to be a more pertinent factor in mediating childhood stressors with depression, echoing previous findings which showed that enhanced social sensitivity conferred by the G-allele renders an individual more vulnerable in adverse environments (Belsky et al., 2009). Early childhood experiences presided by tumultuous parent-child interactions often lead to adverse psychological consequences (Gouin et al., 2017; Repetti et al., 2002). A recent study by Schneider-Hassloff and colleagues led to the finding of an OXTR-CAS-sex interaction for anxiety, where childhood attachment insecurity was correlated with greater anxiety levels amongst female G/G homozygotes, but not in males or A-carriers (Schneider-Hassloff et al., 2016). Sex-specific effects of the oxytocin system have been previously reported (Bethlehem et al., 2013; Carter, 2007; Gimpl and Fahrenholz, 2001), and oxytocin has been shown to govern pair-bonding more significantly in females than in males (Bethlehem et al., 2013; Ebstein et al., 2012; Meyer-Lindenberg and Tost, 2012; Carter, 2007; Carter et al., 2009).

Epigenetics has also elucidated gene-by-environment mechanisms associated with anxiety (Gottschalk and Domschke, 2017). In the past decade, an increasing number of studies unveiled the role of oxytocin in conferring genetic predispositions to eating behaviors (Bethlehem et al., 2013; Sabatier et al., 2013; Leng et al., 2008). Employing a gene-by-environment framework, Micali and colleagues investigated the interaction of two OXTR polymorphisms, rs53576, and rs2254298, with the quality of maternal care received (Micali et al., 2017). Similar to previous studies, they showed that the A-allele of rs53576 possesses a protective effect as it was inversely correlated with eating disorders, and the G/G genotype was associated with binging and purging behaviors (Kim et al., 2015). A/A genotype of rs2254298, on the other hand, was found to be associated with restrictive eating habits. Most interestingly, they found that A/A or A/G genotypes of OXTR rs2254298 interacted with inadequate maternal care to jointly increase the risk of purging and binge eating behaviors. Socially dysfunctional relationships have been established to be the hallmark of borderline personality disorders (BPD) (Stanley and Siever, 2009; Bethlehem et al., 2013; Clarkin et al., 2007). Examining the role of OXTR in propagating this condition, it has been found that OXTR rs53576 moderated the relationship between the quality of intimate family relationships and BPD (Hammen et al., 2015; Sharp and Kim, 2015). In line with the differential susceptibility model, A-carriers exhibited BPD symptoms to a greater extent only in disharmonious family settings with poor child-parent relationships, and low levels of BPD symptoms were seen when individuals were in supportive family environments. Conversely, amongst G/G homozygotes, no correlation was evident between symptoms of BPD and harsh family conditions (Zhang et al., 2017).

1.7 Conclusion

The interaction between parental care and oxytocin plays a crucial role in shaping constantly our socio-emotional pathways, protecting us from or imperiling us to psychological distress, accordingly to the unique interplay of OXTR variants and individual perception of parental bonding. Sifting through the different articles, it is possible to interpret how oxytocin acts as a bridge that links gene, context, and behavioral outcome across the whole lifetime, starting from very early experiences. In the review summed in this chapter, we reported broad evidence showing how the interaction between oxytocin and parental care increases the possibility to develop a mental disorder, especially one of those involving an alteration of the social functioning. Discrepancies in the literature might be explained by the complexity of the regulatory system of this neurohormone, that involves several mechanisms, as genetic variants in the promoter region still needs to be identified, and studied individually. (Ebstein et al., 2012). Environmental measures, such as self-report questionnaires, retrospective design, and individual variability, are a challenge to research methodology that need to be overcome in future studies. The latest technological tools are providing novel ways to assess social interactions and individual behaviors, like smartphones,

that allow researchers to gather an enormous amount of data with a breadth and depth that was previously inconceivable. These devices can remotely collect information such as location, movement, and physiological parameters (Lane et al., 2010; Miller, 2012). In the last few years, several works have started to use smartphone activity data in order to detect and predict mood states (LiKamWa et al., 2013), and daily stress levels (Bogomolov et al., 2014; LiKamWa et al., 2013). These devices facilitate researchers, since participants can complete brief psychological and social questionnaires on a daily, weekly, or monthly frequency. Recently, some large-studies were designed to measure human behaviors and interactions using multiple sources of data (Aharony et al., 2011; Centellegher et al., 2016; Eagle and Pentland, 2006; Stopczynski et al., 2014). In the last decade, the increasing use and popularity of social media platforms, such as Facebook, Twitter and Instagram, provided plenty information about social behavior and patterns of interaction in a virtual environment. Further researches may clarify how to leverage these platforms to gather further measures that can be associated with environmental, genetic, physiological assessments and how virtual interactions differ from offline social activity in the same individual. Moreover, with the parallel growing interest in epigenetic processes, another critical gear in gene-environment interactions includes how life experiences can alter molecular transcription and affect the development of social psychological mechanisms (Kundakovic et al., 2015).

In this context, parental care might become a significant topic of interest in developmental and behavioral neuroscience, but despite the consensus of the findings, some discrepancies are still present (Leerkes et al., 2011; Tollenaar et al., 2017). Presently, the implication of this area of study in clinical practice looks encouraging, especially for psychopathology that involves severe social impairment, such as autism, schizophrenia, and depression. While the focus of this review has been on psychiatric disorders, it is indisputable that this field transcends beyond unraveling the etiologies of disorders and may also uncover new clues to understand the mechanisms better underlying parenthood, or merely improving the wellbeing of everyday life.

CHAPTER 2

Influence of Social Media Sites on the development of Psychological Disorder

2.1 Social Network sites: an increasing phenomenon in human social behavior

In our global digital world our social connections are embedded between the external environment we are constantly engaged and the life 2.0 that we share on the Social Media. Social Media have been defined as a class of mobile and Internetbased applications that allow people to receive information, to build and share of usergenerated contents: through the creation of a virtual profile, it is possible to interact with real-life friends, meet new people from all over the world, connect with one's favourite celebrities, and to maintain both online and offline relationships. Since 2004, the use of Social Network Sites (SNSs) has being growing exponentially, thanks to the possibility to be connected to the internet anytime, anywhere. According to the nature of the content, the user can chose, from a wide range of applications, the platform that better suits the purpose of his/her communication: Facebook or Google+ are more focused on real-life friends and relatives and encourage interactions through services like sharing pictures, video, status and joining groups on specific interests. Other social networks like Twitter, which are also know as "microblogs" are all about brief communication. Mobile applications, like Instagram or Snapchat, provide photo and video-sharing services, together with the possibility to like, comment and re-post preferred contents. Figure 2.1 shows the popularity of the main SNSs, ranked by worldwide number of active users (source Statista.com).

Facebook alone counts more than 1.5 billions of daily users worldwide, and 4 million "likes" are generated every minute (statistics updated to the 2nd quarted of 2019) (source: Statista.com. This only index partially reflects the constant presence of SNSs in the users' lives, which turns to have a decidedly strong social impact. Although SNSs offer a tremendous potential to express oneself personality and to keep in touch with a network of friends, some studies highlighted the risk for negative consequences of excessive SNSs usage (Kuss and Griffiths, 2011). Online social interaction, the line between offline and virtual life, and the concept of digital identity have become topic of great interest in psychology and mental health fields. Apparently, feedback from people belonging to the virtual social community can affect individual self-esteem and, generally, well-being (Twenge, 2019; Kuss and Griffiths, 2011; Valkenburg and Peter, 2008). An immoderate use of SNSs can also have a negative impact on other
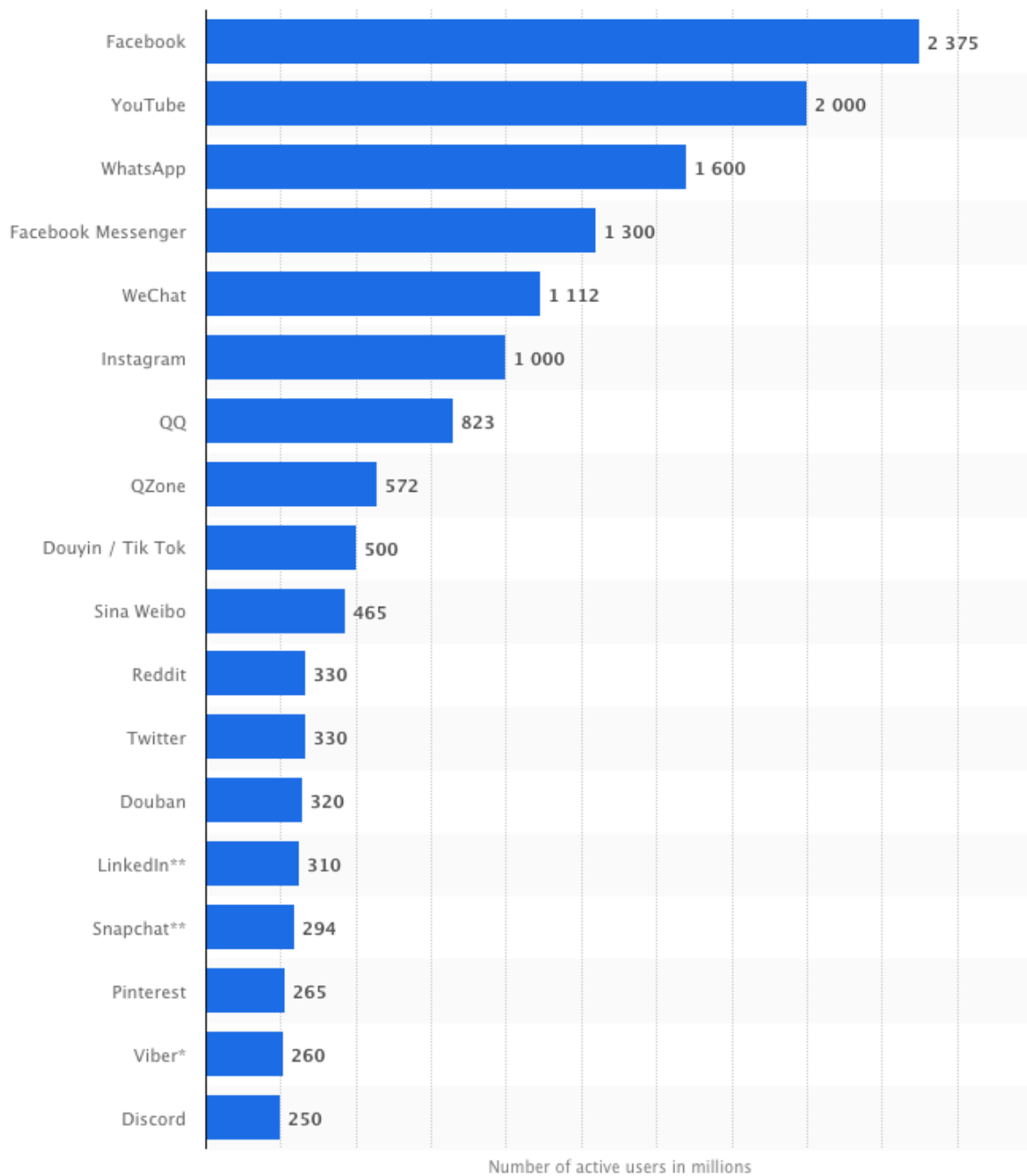
Fig. 2.1 Number of active users (in millions) on most popular social networks in 2019

fields of daily life, such as, in the case on youth and teenager, academic performances, causing poor organization of time, procrastination and distraction Kirschner and Karpinski (2010). Given the continuous exposure to social media, it is important to understand the impact that online social relationships have on mental health and interpersonal functioning.

2.2 Internet use, Social Media and personality traits

Since the proliferation of social media, the scientific community has put efforts in try to understand the mechanisms underneath the success of SNSs, in terms of communication and social behavior. Although a large number of theories and models have been used in the attempt to study and explain the psychological processes related to human interpersonal behaviors on social media platforms, the Five Factor Model of Personality Traits is mostly referred as the conceptual framework that better explains users' features (Ngai et al., 2015). Individual characteristics have been broadly compiled in five main traits - openness, conscientiousness, extraversion, agreeableness, and neuroticism (Digman, 1990) - which are possible to asses using the Five-Factor Model (McCrae and Costa Jr, 1997). Each factor is considered in its bipolar directions, positive and negative (e.g., extraversion vs. introversion) and summarized in specific concepts (e.g., sociability), which in turn describe more detailed traits (e.g., talkative, outgoing). Among these five dimensions, extraversion, openness to experience and neuroticism were identified as possible predictors in studying the correlation between Facebook usage and personality traits (Zywica and Danowski, 2008; Ross et al., 2009). Early studies report that diverse modulations of these features can describe, and subsequently predict, the user's behavioral intentions on social media (Amichai-Hamburger, 2002; Correa et al., 2010; Andreassen et al., 2017; Staiano et al., 2012). Studies by Amichai-Hamburger have found extraversion and neuroticism to be related to online activities, and with levels of perceived loneliness (Amichai-Hamburger and Ben-Artzi, 2003); specifically, individuals, mainly women, with low scoring of extraversion and high neuroticism were more active on the internet (Amichai-Hamburger et al., 2002). The authors explained that this trend might be due to specific characteristics of the virtual environment, such as anonymity, which allow less self-confident users to get easier in touch with others. As for SNSs, extraversion/introversion axis has been considered as an important component in understanding distinct online behaviors; for instance, people with higher levels of extraversion were found to be more prone to join virtual groups and to use internet mainly for social interactions (Ebeling-Witte et al., 2007). With regards to more recent evidence, some association between personality traits and patterns of Internet usage have changed; this tendency might be due to changes related to anonymity restrictions on SNSs and some Internet applications. Contrary to the past decade, social media platforms, especially those that include instant-messaging services, seem to attract people with high levels of extraversion, since the interaction occur more with familiar people than strangers (Lampe et al., 2006). Specific features of SNSs, such as Facebook, and personality factors have been found to be correlated to levels of self-esteem. Since online interactions can represent a more protected environment for self-expression and disclosure, people with low levels of self-confidence might find interactions set within a virtual frame more attractive compared to offline interactions Forest and Wood (2012), with on one hand the possibil-

ity of a positive outcome, like overcoming low life satisfaction (Ellison et al., 2007), and on the other hand the risk to develop symptoms referable to addictive behavior (Andreassen et al., 2017). Conversely, people with high traits of extraversion tend to have lots of connection with other people both offline and on the internet, they also show higher degrees of self-esteem (Zywica and Danowski, 2008; Andreassen et al., 2017). A study by Ross and colleagues highlights a positive association between extraversion and participation in Facebook groups, though the type of communication was not specified (Ross et al., 2009). Neurotic traits were found to be linked to a greater instant-messaging services use (Ehrenberg et al., 2008; Correa et al., 2010) and a preference for online contact compared to interaction *de visu* (Ross et al., 2009). A possible explanation may consist in the distinctive aspects of virtual conversation, like the possibility to delay a reply, giving to the user more time to write a response and, as a result, facilitating the communication with others for people with high levels of neuroticism. With regards to the dimension "openness to experience", people who displayed high scores in the traits were found to be frequent users of SNSs (Ross et al., 2009) and to be more prone to create online profiles (Correa et al., 2010). As for agreeableness, conscientiousness, and social media usage, results in literature are not consistent. In early reports, the former resulted in mixed effects, while in a recent study by Gil de Zuñiga and colleagues that compared personality traits and social media use in twenty Countries, and agreeableness emerged as a reliable predictor, while conscientiousness, contrarily to previous outcomes, turned out to be less informative (Gil de Zuñiga et al., 2017). They also found "openness to experience" to be less predictive for virtual social behavior and explained that this last results might be related to the concept of "openness to experience" itself: as already mentioned, social media sites have become and integrated part of people's daily life, hence they are not seen as a novelty anymore (Gil de Zuñiga et al., 2017).

2.3   The dark side of Social Media: risk for development of Psychiatric disorders

Although usage of SNSs can bring positive outcomes, by giving the possibility to maintain relationships with the other even to a long distance, or to connect with new people in a safer environment, also according to common interests, negative outcomes could appear and, if prolonged, can become highly impactful, with the further risk to develop psychiatric disorders (Hussain and Griffiths, 2018). As internet and social media are a recent phenomenon, it is more likely that the effect of excessive or problematic usage will affect individuals during more fragile temporal frames, such as childhood and adolescence. Data collected from a survey in the United States in 2018, report that 45% of the teenagers interviewed says they are almost constantly online, without differences among sexes, ethnicities, familiar incomes and parental level of education (for the full report, see Teens, Social Media and Technology 2018. As always more people all over the world spend an increasing amount of time on the internet and social

media, it is essential to find out how online experiences are linked to personal well-being and mental health, in order to understand if and, in case, to which extent social media usage can be a cause to psychological disorders, a symptom, or a helpful tool for therapy. To do this, disorders will be to discussed in three distinguished macro-categories: depression, social media addiction, and suicidal risk.

2.3.1 Depression

Depression is a prevalent mood disorder, which symptoms include a persistent sadness and a loss of interest in activities that the person normally enjoys, together with the inability to carry out daily activities, for at least two weeks. Depression can also be manifest through a set of physical changes such as alterations in appetite, sleep habits, restlessness, loss of energy, and through negative contents of personal belief systems like hopelessness, worthless, sense of guilt, indecisiveness as reported in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorder, (Association et al., 2013). According to the World Health Organization, depression is the leading cause of disability worldwide, with increasing number of diagnosed people by 20% every year, resulting as a major contributor to the overall global burden of disease (estimated prevalence rate in 2015 is around 4.4%, see World Health Organization). As in the last decades depression rates have increased, it is important to question if social media usage is directly linked to this. Some authors found that higher levels of engagement in SNSs is associated with negative emotional and relational outcomes (Andreassen et al., 2017), with lower perceived quality of life and depressive symptoms (Brooks and Longstreet, 2015; Frison and Eggermont, 2016). If one side SNSs provide users with a range of possible activities, it is possible to identify specific patterns of usage. For instance, a set of actions like browsing other users' photos, or scrolling through comments or news feeds has been labeled as passive social media use (PSMU). Recent research indicates that PSMU and depression are linked in both directions. PSMU could directly aggravate depressive symptoms, like loss of interest or blue mood, and thwart personal well-being (Hussain and Griffiths, 2018; Aalbers et al., 2018; Frison and Eggermont, 2016; Brooks and Longstreet, 2015), or act indirectly through mediators such as reduced sense of belonging Tobin et al. (2015), hence increasing levels of loneliness first (Van Rooij et al., 2017) and, subsequently, of depressive mood and stress(Hussain and Griffiths, 2018), which, in turn, reinforce each others (Aalbers et al., 2018). Moreover, PSMU and depression might be mediated by sense of inferiority and feelings of worthlessness, due to social comparisons with other people lives, as they appear on their personal profiles (Chou and Edge, 2012; Davila et al., 2012; Steers et al., 2014; Appel et al., 2016; Bollen et al., 2017). Conversely, depressive symptoms, loneliness, and high levels of stress can increase PSMU. In a longitudinal study, Kross and colleagues demonstrated that the sense of loneliness is a predictor for a more intense usage of social media (Kross et al., 2013), as it might represent a solution to alleviate depressed mood, reinforcing PSMU (Aalbers et al., 2018).

2.3.2 Social Media Addiction

With the first studies on the negative consequences of internet excessive usage in the late '90s, the term "Internet addiction" was coined. More recently, this term has been criticized as it gathers different contents under the same category. As a consequence, researchers and practitioners have suggested to split the content-related addictive behaviors in specific subcategories, like "net compulsions" (which includes online shopping, gambling), "information overload", "cybersexual addiction", "computer addiction" (e.g. videogaming) and "social media addiction" (Young, 1999). Even though it is not formally acknowledged as a diagnosis, "social media addiction" it is meant a set of criteria, that share parallelism and similarities with those of other addictions. This array includes manifested preoccupation for user's activity on SNSs (*salience*), increased usage of social media to get the same amount of satisfaction (*tolerance/craving*), usage of social media to diminish negative feelings (*mood modification*), distress when the user is prevented/not allowed to access to SNSs (*withdrawal*), failing to meet obligations/responsibilities with consequences in important areas of personal functioning due to social media usage (*functional impairment*), and willing to control the usage of social media with subsequent failure (*relapse/loss of control*) (Andreassen, 2015). With regards to the general risk to develop social media addiction, evidence in the field shows that younger people score higher levels on specific scales (e.g., the Bergen Facebook Addiction Scale created by Andreassen and colleagues (Andreassen et al., 2012, 2017)), pointing out the central role of SNSs in youth and teenagers social lives and leisure time. In fact, virtual environment represent an opportunity for young people to explore, test and develop their identities, personalities and culture without parental intrusion (Andreassen, 2015). Furthermore, younger people showed higher abilities to adapt to new technologies compared to the older ones. Just as like as other addictions, social media can operate as behavioral reinforcement: on one side, positive feedback, amusement and social acceptance from members of online communities may support and promote the activity on social media; on the other side, social networking can act as a medium to avoid negative outcomes, like boredom, and foster the social networking behavior as well (Andreassen, 2015). But the more people share their lives on SNSs, the higher is the risk to be afraid of missing updates, and feel the urge to check their profiles for feedback (Hussain and Griffiths, 2018; Oberst et al., 2017). This specific phenomenon has been labeled "fear of missing out" (FoMO) and defines the pervasive anxiety experienced by a user when thinking that other people might be enjoying gratifying experiences online while absent, pushing him/her to will or to be constantly connected, hence fostering the addictive behavior circuit (Przybylski et al., 2013; Andreassen, 2015; Hussain and Griffiths, 2018; Dhir et al., 2018). Among the multiple features that characterize social media and virtual human behavior, FoMO one of the concept that better represent the struggle with handling online and offline realities, and the potential impact of social media on general mood and life satisfaction in general (Przybylski et al., 2013).

2.3.3 Suicidal risk

Amid the potential negative outcomes that derive from a non-adaptive usage of SNSs, cyberbullying is configured as one of the possible worrisome phenomenon, with devastating consequences of the person's life, occasionally lethal. Cyberbullying can be defined as an intentional use of information and communication technologies such as electronic mail, smartphone, short message services, and social media platforms that is carried out repeatedly by a group or an individual, to support deliberate, repeated, and hostile behaviors against a victim who cannot easily defend him or herself. (Pettalia et al., 2013; Barlett et al., 2018). Recent statistics point out that cyberbullying is most prevalent of platforms based on visual contents, like Instagram (42%), Facebook (37%) and Snapchat (31%) (see Petrov C. on `https://techjury.net/stats-about/cyberbullying/`, February 28th 2019). As the contents are shared and spread quickly via SNSs, the victim can experience, besides a lack of control, a series of highly negative psychological consequences, like social anxiety, depression and suicidal ideation and attempt, especially when bullying behavior is perpetrated in time Chatzakou et al. (2019); Plemmons et al. (2018). Social media-related suicidal behavior is a topic of increasing interest and heavy importance, that has reached the attention of newspapers and newscasts all over the world. Although researchers attempted to study in deep the extent of social media on suicidal behaviors, complexities derive from legal and privacy issues, as well as from the indirect association between the usage on web-based platforms and the suicide itself (Luxton and Fairall, 2012). However, social media started adding to their options, the possibility to report inappropriate contents, comments and to block users, in order to stem violent and inappropriate behaviors. Furthermore, targeted services for suicidal prevention have been predisposed on the most popular SNSs, providing users with links to websites, hotlines, and with information about how to detect warning signs of suicide. Web communities focused on suicide prevention have been founded, giving to their members the opportunity to share their own direct or indirect experience in an anonymous way, and to support support each others, without the constraints of physical boundaries (Luxton and Fairall, 2012).

2.4 Rewiring the brain in the internet era: social media and neural correlates

Social media sites are wired to several important aspects of human life, such as personality, social needs, relationships, mental health and general well-being. Hence, it is fundamental to understand how human brain reflects all these aspects, as communication is related to visual contents and text. Within the frame of the debate "is social media usage good or bad for mental health?" results are not fully consistent and studies utilized self-report surveys, claiming the lack and the need for evidence on moderating effects of underlying neural mechanisms (Sternberg et al., 2018). Together with the

flourishing body of literature focusing on the effects of social media over the quality of life, some researchers started investigating brain correlates of behaviors linked to social media usage. Specifically, and fMRI study conducted by Meshi and colleagues reports that social media engagement (SME) is linked to activity in the ventral striatum (vSTR) and adjoining structures of the nucleus accumbens (Meshi et al., 2013). More precisely, the authors found an association between levels of activation of these areas and in response to social feedback identified relevant for participants social reputation (a surrogate for "likes" on Facebook). Another study describes a greater recruitment of the vSTR in relation to more popular shared pictures compared to the less socially endorsed (Sherman et al., 2016). As for structural evidence on gray matter volume and social media habits, striatal region was found to be linked to daily smartphone checking (Montag et al., 2017) and heavy social media usage (He et al., 2017). With regards to impulsive control, reduced gray matter volume in the anterior cingulate cortex was found in "multitasking" users, suggesting that the combined use of plural electronic devices can affect directly the structure of this region, which is highly involved in the control of inhibitory mechanisms (Loh and Kanai, 2014). A further relevant study by Moisala and colleagues on media multitasking showed increased activity in the right side of the prefrontal cortex (PFC) while participants were subjected to a cognitive task; this result was explained by the authors as a reflection of mental struggle in recruiting resources in executive control (Moisala et al., 2016). This result has been confirmed in a study that combined EEG (electroencephalography) and TMS (transcranial magnetic stimulation) to test evoked potential in excessive social media users, finding weaker responses when the right PFC was stimulates in excessive multitasking users (Hadar et al., 2017). With regards to the white matter, a very recent study pointed out, consistently with previous researches, an association between discounting future rewards and higher engagement in smartphone use and that this preference was correlated to a higher higher connectivity between the vSTR and the ventro-medial PFC (see Figure 2.2) (Wilmer et al., 2019).

2.5   Communication, social media and genetic contribution

Evidence deriving from neuroscientific field reveals a link between online social behaviors and regulation of control in brain structures. This diversity in individuals ability to endeavour goal-directed control over behavioral impulses might also be affected by genetic susceptibility or vulnerability to develop a certain habit. The hypothesis that genetic features influence behavior and communication has been corroborated in several studies and so it is the notion that human behavior and psychological traits are modulated by the interaction between genetic variation (through neuroanatomical differences) and environmental factors (Cataldo et al., 2018b). A common methodological approach to investigated to which extent the genetic component plays a role in target phenotype (e.g. social media usage) is twin
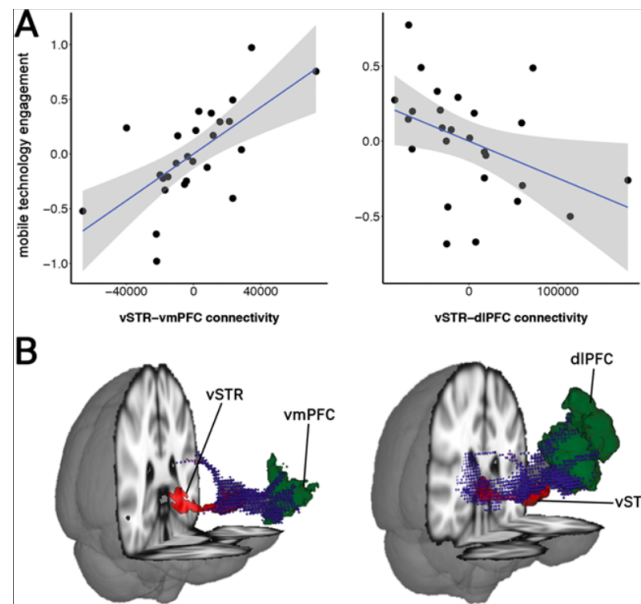
Fig. 2.2 Results from Wilmer and colleagues (2019) showing the association between MTE (mobile technology engagement) and brain connectivity in vSTR and vmPFC

studies. So far, few evidence reports results about genetic contribution in internet-related usage. Two studies on Turkish twin on communication and media report that problematic internet usage (PIU) resents of genetic influence, especially in male twin-pairs (Deryakulu and Ursavaş, 2014), while computer self-efficacy (which is defined as "*an individual perceptions of one's ability to use computers in the accomplishment of a task*" (Deryakulu et al., 2016) seems to be modulated more by environmental factors. (Deryakulu et al., 2016). Another twin study highlighted the impact of genetic correlates on mobile phone use (Miller et al., 2012), which results have been corroborated by a more recent investigation by York, who focused specifically on social media use (e.g. contact friends, contact family) even after controlling for demographic factors (York, 2017). Lastly, a new research by Deryakulu1 and Ursava examines to which extent nomophobia (described as the fear of not being able to use the mobile phone) can be explained by genetic and environmental factors, revealing that the dimensions that were more explained by genes were "losing connectedness" and "giving up convenience", while environmental factors were more related to other two dimensions, which were "not being able to communicate" and "not being able to access" (Deryakulu and Ursavaş, 2019).

2.6 Conclusion

In just one decade, individuals' lives and their social behavior have been revolutionized by the phenomenon of social media sites. Emerging technologies and platforms provide users with a wide range of activities, leisure and possibility to interact with friends, families, or strangers. Although different patterns of usage are moderated by a set of individual features concerning genetic, environment, tem-

perament, and personal needs, it is undeniable that SNSs have become an integrated part of people's daily life. This leads to the necessity, in research fields linked to human behavior, to understand if, how, and to which extent these platforms are "rewiring" our brain, our interactions and our concept of well-being. Lots of efforts have been invested in creating new tools for assess people's attitude towards SNSs, such as the creation and validation of new scales (Przybylski et al., 2013; Andreassen et al., 2012) and to interpret results within a fitting theoretical frame. If one side recent technologies permit to recruit and test more easily more participants in efficient ways, sometimes comparable to laboratory testing sessions (Casler et al., 2013), on the other side a lack of knowledge persists for that concerns the involvement of specific brain regions or genetic susceptibility to develop a certain social media-related disorder. Evidence in literature about genetic contribution only reports twin studies, though it would be of great interest to explore the role of targeted genes, notably involved in the modulation of human social behavior. New evidence in these fields would be of great support for practitioners, so that social media and new technologies could be implemented in clinical work for both a better assessment and a more user-based intervention.

CHAPTER 3

Parental bonding influences the development of adult attachment constructs: a comparison between Italy and Singapore

3.1 Introduction

Attachment refers to the biologically-based instinct of the infant to enact care-seeking strategies from an older, wiser, adult. From all the findings reported in literature, we are aware attachment involves much more than an infants response to separation from the caregiver or their reunion. However, the responses to these two specific moments in parent-child relationship have an importance that echoes in the future social performances and behavior that an individual develops later on in life, by shaping patterns of expectations about the others. Infant separation and reunion behaviours were just a preview of things to come; one indication of an underlying pattern of expectations about the self, others, and the world which would continue to evolve and persist throughout adulthood. More recently, research has shown that individual differences in adult attachment are most accurately described in terms of two independent continuous dimensions: attachment anxiety and avoidance (Brennan, Clark, and Shaver, 1998). Attachment anxiety refers to the extent to which a person worries about being rejected, fears abandonment, and doubts his/her worth in relationships. High attachment anxiety is thought to reflect a hyperactivated attachment system resulting from a history of relatively inconsistent or overprotective caregiving (Shaver and Mikulincer, 2002). In relationships, anxiously attached individuals tend to use hyperactivation strategies, such as being clingy and hypervigilant in an effort to get their attachment needs met. Anxiously attached individuals hyperactivation strategies tend to intensify their doubts about self-worth and their sense of vulnerability to rejection and abandonment resulting in a negative model of self (Mikulincer and Shaver, 2007). Their hyperactivation tendencies lead to complex, ambivalent appraisals of others and although anxiously attached people usually have a history of negative interactions with unreliable attachment figures, they usually still believe that if they intensify their proximity-seeking efforts, they may gain a partners attention and protection. This leaves them with an ambivalent model of the other. Attachment avoidance refers to the extent to which a person avoids intimacy, dislikes depending on others, and downplays the importance of relationships. Attachment avoidance is thought to reflect a deactivated attachment system resulting from a history of relatively rejecting and cold caregiving

(Shaver and Mikulincer, 2002). In relationships, avoidantly attached individuals tend to use deactivation strategies, such as being emotionally unavailable in an effort to deny attachment needs. Avoidantly attached individuals deactivation strategies, aim to suppress such needs, while working to convince the self and others that they are self-sufficient and invincible (Mikulincer and Shaver, 2007). This results in a more positive model of the self. It is suggested that in avoidant individuals, deactivation strategies encourage negative views of others and preserve them in the face of disconfirming evidence leading to a negative model of the other.

Originally, attachment specific features were considered to go beyond cultural and boundaries, or parenting practices. Despite this assumption, the ecological components of attachment have always been seen as an important factor that needed to be taken into account, together with other features that might play a role in child rearing behavior, such as socioeconomic status or ethnicity. In fact, one of the major concerns in attachment-related research fields was the limitation due to results coming from countries belonging to Western societies. Regarding this, in her canonical studies on maternal sensitivity, Mary Ainsworth studied home behavior of mothers in Uganda and Baltimore, finding that the process reflects specific universal characteristics that cross linguistic, cultural and geographic lines Ainsworth (1967). In contrast to a previous study based on a sample from Sapporo, working with a sample of Japanese mothers, Behrens and colleagues found that the maternal attachment status, assessed with the Adult Attachment Interview George et al. (1996) was predictive for the child's sub-classification, with results comparable to the global distribution Behrens et al. (2007). In some of his works, Mikulincer used Hazan and Shaver's items to assess attachment-related feelings and cognition Hazan and Shaver (1987), finding similar frequencies of the diverse attachment styles in Israeli sample compared to American populations Mikulincer et al. (1990); Mikulincer and Erev (1991); Mikulincer and Nachshon (1991). Although evidence coming from different cultures and ethnicities have been reported and discussed, concerns about the application of Western-based methodologies to non-Western environments still remains.

3.2   Current Study

The current study aims to deepen the correlation between perceived parental care during childhood and the main features of bonding in adulthood, and to analyze the differences occurring in two different countries, like Italy and Singapore. The choice of these two contexts may provide a confrontation between a Western country and a non-Western model, as the environment may impact on one side the perception of parental features in childhood and on the other side the formation of the behavioral constructs that drive social relationships in adulthood. In order to explore the perception of parental attention and protection in childhood and the features of social relationships in adulthood, we used three widely used self-report questionnaire: the Parental Bonding Instrument Parker et al. (1979), the Attachment Style Questionnaire

and the revised version of the Experiences in Close Relationships (revised) Fraley et al. (2000a). For the Singaporean sample, we used the original versions in English, as for the Italian one, participants completed the translated and validated versions Scinto et al. (1999); Fossati et al. (2003); Busonera et al. (2014).

3.2.1 Parental Bonding Instrument

The Parental Bonding Instrument is a 50-item self-report questionnaire that investigate participants' perception of both maternal (25 items) and paternal (25 items) care and protection in the first 16 years of life. It was developed by Gordon Parker, Hilary Tupling and L.B. Brown in 1979 using factor analyses from parents self-reporting experiences in childhood and yielded two factors: care and overprotection Parker et al. (1979). The care scale (PBI-C) measures the degree to which a mother or a father was empathetic and caring or cold and indifferent. The overprotection scale (PBI-O) measures the extent to which a parent was intrusive or, conversely, fostering independence in the subject. The measure has been shown to have high reliability, stability over time and no association with social desirability, neuroticism or extroversion Parker (1989).

3.2.2 Attachment Style Questionnaire

To assess individual's principal constructs in social relationships, we employed the Attachment Style Questionnaire, created by Feeney, Noller and Hanrahan in 1994 Feeney et al. (1994a), to capture the conceptual domain of attachment by Bowlby and Ainsworth Ainsworth (1978). The scale measures five dimensions that have been identified to be important category models of adult attachment: Confidence (8 items), Discomfort with Intimacy (10 items), Need for Approval (7 items), Viewing Relationships as Secondary (7 items) and Preoccupation with Relationships (8 items). Each item was being rated on a 6-point scale ranging from: 1 (Totally disagree) to 6 (Totally agree). Confidence measures the level of self-assurance and trust an individual possess in self and towards others (i.e. *"Overall, I am a worthwhile person"*). Fear of Intimacy assesses the discomfort with closeness and intimacy (i.e. *"I find it hard to trust others"*). Need for Approval measures the need for affiliation and to be validated by others (i.e. *"It is important to me that others like me"*). Relationship as Secondary measures the superficiality of relationships as a mean to an end (i.e. *"Achieving things is more important than building relationships"*). Preoccupation with Relationship measures the degree of attachment anxiety in relationships (i.e. *"I worry a lot about my relationships"*).

3.2.3 Experience in Close Relationships - Revised

In order to evaluate anxiety and avoidance level in close relationships, a revised form of Experience in Close Relationships-Revised (ECR-R; Fraley et al. (2000a)) was employed. The 36-item self-report questionnaire that assesses two major dimensions of an individuals attachment status (anxiety and avoidance) in a sentimental relationship was employed. Both the anxiety and avoidance subscales consisted of 18 items each, rated on a 7-point Likert scale ranging from: 1 (Strongly disagree) to 7 (Strongly agree). The anxiety dimension measures insecurity, jealousy and fear of abandonment as opposed to feeling secure about availability and responsiveness of romantic partners. The avoidance dimension measures the feeling of discomfort being close to others and tendency to refrain from attachment. Instead of assigning participants to an attachment style category, this scale yields two separate dimension scores for each participant.

Although these three self-report questionnaires have been widely used in research, there is no study that, to the best of our knowledge, has investigated the relationships among the three different dimensions they explore: childhood reminiscence of parental warmth, features of social behavior and they impact on relationships.

3.3 Hypotheses

We test two hypothesis:

1. We expect to find statistically significant indirect effect of recalled parental bonding (assessed using the PBI scales) over anxiety and avoidance in social relationships (measured with the ECR), when mediated by interpersonal functioning (evaluated using ASQ), to test the theoretical model of attachment;

2. Italian and Singaporean groups will show parallel patterns of associations between recall parental bonding and anxiety/avoidance in social relationships. Specifically, when PBI is significantly associated with ECR in one group via the indirect effect of ASQ, we anticipate finding it will be significantly associated in the other country;

3.4 Methods and Materials

Participants were recruited through social media platforms (students' Facebook groups, for the Italian sample) and web-based software research study participation and management (SONA System, for the Singaporean sample) among non-parents students of University of Trento, Italy, and from Nanyang Technological University, Singapore. After inform consent was given, the online form of the question-

	Means and SDs				Cronbach α		
	Total (N = 1754)	Italy (N = 986)	Singapore (N = 768)	n items	Total	Italy	Singapore
Sex	M = 636 ; F = 1118	M = 359; F = 627	M = 277; F = 491	-	-	-	-
Age	22,14 (2,73)	22,73 (3,17)	21,39 (1,78)	-	-	-	-
PBI-C Mother	26,08 (6,98)	27,20 (7,49)	24,63 (5,96)	7	0,78	0,78	0,72
PBI-O Mother	14,23 (7,11)	15,99 (6,44)	11,96 (7,28)	8	0,72	0,74	0,70
PBI-C Father	20,91 (8,95)	21,74 (9,21)	19,85 (8,50)	18	0,91	0,89	0,93
PBI-O Father	12,56 (6,69)	13,13 (6,63)	11,82 (6,69)	18	0,94	0,93	0,95
ASQ Confidence	30,44 (5,77)	29,85 (6,39)	31,20 (4,76)	12	0,9	0,92	0,91
ASQ Discomfort	37,74 (7,42)	37,56 (7,81)	37,97 (6,89)	13	0,83	0,82	0,87
ASQ Secondary	17,43 (5,47)	15,75 (5,35)	19,57 (4,86)	12	0,85	0,85	0,85
ASQ Approval	23,85 (6,49)	21,86 (6,80)	26,39 (5,04)	13	0,82	0,83	0,85
ASQ Worry	29,56 (6,31)	29,62 (6,71)	29,48 (5,30)	8	0,75	0,78	0,69
ECR Anxiety	3,48 (1,11)	3,34 (1,08)	3,66 (1,13)	10	0,77	0,77	0,82
ECR Avoidance	2,75 (1,09)	2,64 (1,15)	2,89 (1,00)	7	0,77	0,76	0,70

Table 3.1 Descriptive statistics of the sample and internal consistency values

naires were sent through email to the participants (links to Qualtrics for the Singaporean sample, links to Google Modules for the Italian sample)(see Appendix A for English version of the questionnaires, see Appendix B for the Italian versions). Of the total 1784 students who took part in the study, 1754 fully completed the three questionnaires (Italian sample N= 986; M= 359; Mean age = 22,72 [18 35]; Singaporean sample N = 768; M = 277; Mean age = 21,39 [18 34]). Before proceeding with the data analysis, we tested the internal validity of each questionnaire in all the groups (Total, Italy, Singapore); overall, the Cronbach's alpha coefficients ranged from 0,69 to 0,95 suggesting an overall acceptable internal consistency. As reported in Table 3.1, all the Cronbach's alpha values are listed, together with the main descriptive statistics of the sample. Psychometric features of the three instruments are compatible with those reported in a recent review on adult attachment assessment tools Ravitz et al. (2010).

In Table 3.2, we reported the zero-order correlations among the variables considered for this study. PBI and ASQ subscales were all statistically strongly correlated within questionnaires, reflecting the expected direction in both countries, as indicated by the authors of the original versions Parker et al. (1979); Feeney et al. (1994a). As for the ECR, the absence of correlation between anxiety and avoidance, reflects the theoretical and structural concept of their opposite directions Fraley et al. (2000a). We then proceeded with analyses, using mediation and a combined moderated mediation models to test the. To do that, we referred to Andrew F. Hayes regression-based approach Hayes (2017) and used his PROCESS macro for SPSS (version 3.3), which is configured as a logistic regression path analysis tool to estimate the effects of mediators and moderators in theoretical models.

|	PBI-C Mother	PBI-O Mother	PBI-C Father	PBI-O Father	ASQ Confidence	ASQ Discomfort	ASQ Secondary	ASQ Approval	ASQ Worry	ECR Anxiety	ECR Avoidance
PBI-C Mother		-.34***	.38***	-.16***	.21***	-.19***	-.18***	-.12***	-.07*	-.15***	-.15***
PBI-O Mother	-.33***		-.16***	.40***	-.12**	.06	.07	.18***	.13***	.14***	.05
PBI-C Father	.32***	-.16***		-.19***	.28***	-.12***	-.14***	-.13***	-.13***	-.08*	-.1**
PBI-O Father	-.24***	.46***	-.11**		-.05	.07	.09*	.20***	.14***	.15***	.12**
ASQ Confidence	.28***	-.14***	.27***	-.07*		-.54***	-.25***	-.5***	-.37***	-.37***	-.38***
ASQ Discomfort	-.24***	.11***	-.21***	.06	-.42***		.46***	.32***	.31***	.26***	.31***
ASQ Secondary	-.21***	.11***	-.19***	.04	-.19***	.37***		.15***	.09**	.19***	.25***
ASQ Approval	-.18***	.13***	-.15***	.05	-.30***	.40***	.20***		.60***	.48***	.22***
ASQ Worry	-.07*	.13***	-.1**	.06*	-.33***	.30***	.13***	.60***		.51***	.05
ECR Anxiety	-.17***	.20***	-.22***	.09**	-.18***	.28***	.16***	.39***	.45***		.37***
ECR Avoidance	-.23***	.1**	-.31***	-.04	-.26***	.34***	.28***	.15***	.02	.38***	

Table 3.2 Zero-order correlations of variables. Statistics for Italian sample are above the diagonal and below are reported statistics for Singaporean sample. * p <.05 ** p <.01 *** p <.001

3.5 Results

3.5.1 Recalled parental bonding and social-behavioral features: a Mediation Model

In order to test our first hypothesis, we included all the participants (N= 1754) to verify the mediating role of interpersonal behavioral constructs, represented by ASQ subscales, on anxiety and avoidance in relationships (ECR), starting from the perceived parental warmth (PBI). To do that, we adapted Hayes's template number 4 to our theoretical model Hayes (2017)(see Figure 3.1 below).

We decided to analyze each ASQ subscale individually, to explore more in detail the effect. We set the confidence interval at 95% and bootstrapped the regression analysis 5000 times, in order to narrow the point estimates. To interpret the results, bootstrap intervals with different direction crossing 0 reflect a non-significant effect, as reported in literature Preacher and Hayes (2008). Overall, the mediating effect of individual social-behavioral features has a significant effect between inferred parental warmth and anxiety and avoidance in social relationships (see Table 3.3). Specifically, *Confidence* affects the mediation of Maternal (CI: 0,0815-0,1772) and Paternal Overprotection (CI: 0,0078-0,1057) on Avoidance. Following, *Discomfort with Intimacy* (CI: 0,0112-0,1054), *Viewing Relationships as Secondary* (CI: 0,0593-0,0200) and *Need for Approval* (CI:0,0299-0,0937) result to have a major effect in mediating the link between Paternal Overprotection and Avoidance, compared to the direct effects of PBI subscales on ECR, which resulted non-significant. As for the link between parental bonding and ECR Avoidance mediated by Worry about relationships, we found no significant effects for any subscale.
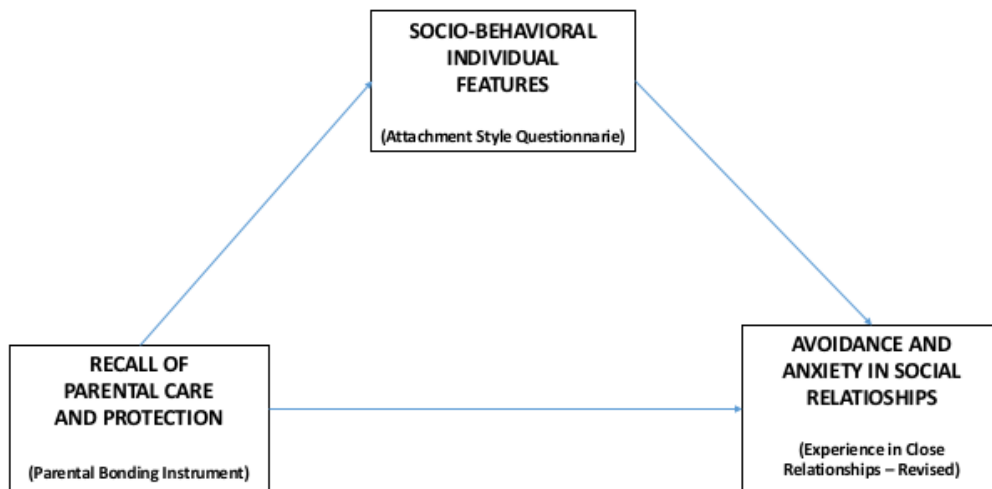
Fig. 3.1 Mediation model adapted to the factors of the study

This might reflect, in a certain extent, the possibility that preoccupation for social connection is more related to anxious traits than avoiding ones, and that it might be affected directly by care and protection experienced in childhood.

3.5.2 Perceived parental warmth, individual socio-behavioral feature and social relationship: a comparison between Italy and Singapore

Our second aim was to deepen the impact that an environmental factor, such as the country people are set in, has in determining the effects of interpersonal functioning over anxiety and avoidance, predicting that the two countries would show parallel patterns. To explore the impact of the country on the proposed study, we adopted the moderated mediation regression analysis, which corresponds to Hayes's model 7 Hayes (2017). Specifically, we set the moderation impact over the effect between PBI and ASQ subscales. Our dependent variables remained ECR anxiety and avoidance (see Figure 3.2. Bootstrapping method was used to calculate point estimates and Confidence Interval, so that if the interval does not includes 0, the result is significant under a p ¡.05.

In Table 3.4, we reported the pairwise contrasts between conditional indirect effects of the moderated mediation path analysis. Looking at the results, it is possible to infer that the effects of the country is very similar in the two groups in almost all the conditions, confirming our second hypothesis. Specifically, the direction of the effects remains the same for both of the samples across all the conditions. The impact of the country results in three specific cases, all involving care-related subscales. Precisely, country of belonging exerts a different impact when Confidence mediates the effect of Maternal Care over Anxiety

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ASQ "Confidence" as a Mediator

DV:	ECR Anxiety				ECR Avoidance			
	direct effect (SE)	CI	indirect effect (SE)	Boot CI	direct effect (SE)	CI	indirect effect (SE)	Boot CI
Predictors								
PBI-C Mother	-0,30 (0,69)	[-0,42 ; -0,15] *	-0,21 (0,03)	[-0,26 ; -0,16] *	-0,38 (0,07)	[-0,51 ; -0,25] *	-0,23 (0,03)	[-0,29 ; -0,18] *
PBI-O Mother	0,40 (0,67)	[0,27 ; 0,53] *	0,11 (0,02)	[0,07 ; 0,15] *	0,11 (0,05)	[-0,02 ; 0,23]	0,13 (0,02)	[0,08; 0,18]*
PBI-C Father	-0,20 (0,05)	[-0,30 ; -0,09] *	-0,17 (0,02)	[-0,21 ; -0,13] *	-0,34 (0,05)	[-0,44 ; -0,24] *	-0,18 (0,02)	[0,23 ; -0,14] *
PBI-O Father	0,32 (0,07)	[0,18 ; 0,45] *	0,05 (0,02)	[0,01 ; 0,09] *	0,03 (0,07)	[-0,11 ; 0,16]	0,06 (0,03)	[0,01 ; 0,11] *

ASQ "Discomfort with Intimacy" as a Mediator

DV:	ECR Anxiety				ECR Avoidance			
	direct effect (SE)	CI	indirect effect (SE)	Boot CI	direct effect (SE)	CI	indirect effect (SE)	Boot CI
Predictors								
PBI-C Mother	-0,34 (0,07)	[-0,47 ; -0,21] *	-0,16 (0,02)	[-0,21 ; -0,12] *	-0,43 (0,07)	[-0,55 ; -0,30] *	-0,19 (0,03)	[-0,24 ; -0,14] *
PBI-O Mother	0,44 (0,07)	[0,31 ; 0,57] *	0,07 (0,02)	[0,03 ; 0,11] *	0,15 (0,07)	[0,02 ; 0,28] *	0,08 (0,02)	[0,04 ; 0,13] *
PBI-C Father	-0,27 (0,05)	[-0,37 ; 0,17] *	-0,10 (0,02)	[-0,13 ; -0,07] *	-0,41 (0,05)	[-0,50 ; -0,31] *	-0,11 (0,02)	[-0,50 ; -0,31] *
PBI-O Father	0,32 (0,07)	[0,19 ; 0,45] *	0,05 (0,02)	[0,01 ; 0,09] *	0,02 (0,07)	[-0,11 ; 0,16]	0,06 (0,02)	[0,01; 0,11] *

ASQ "Viewing Relationhips as Secondary" as a Mediator

| DV:	ECR Anxiety				ECR Avoidance			
	direct effect (SE)	CI	indirect effect (SE)	Boot CI	direct effect (SE)	CI	indirect effect (SE)	Boot CI
Predictors								
PBI-C Mother	-0,41 (0,07)	[-0,54 ; -0,27] *	-0,09 (0,02)	[-0,13 ; -0,06] *	-0,48 (0,07)	[-0,61 ; -0,35] *	-0,13 (0,02)	[-0,18 ; -0,09] *
PBI-O Mother	0,47 (0,07)	[0,34 ; 0,60] *	0,04 (0,01)	[0,02; 0,07] *	0,17 (0,07)	[0,04 ; 0,30] *	0,06 (0,02)	[0,03 ; 0,10] *
PBI-C Father	-0,31 (0,05)	[-0,41 ; -0,21] *	-0,06 (0,01)	[-0,08 ; -0,03] *	-0,44 (0,05)	[-0,53 ; -0,34] *	-0,08 (0,02)	[-0,12 ; -0,06] *
PBI-O Father	0,33 (0,07)	[0,19 ; 0,47] *	0,04 (0,01)	[0,01 ; 0,07] *	0,02 (0,07)	[-0,11 ; 0,16]	0,06 (0,02)	[0,02 ; 0,10] *

ASQ "Need for Approval" as a Mediator

DV:	ECR Anxiety				ECR Avoidance			
	direct effect (SE)	CI	indirect effect (SE)	Boot CI	direct effect (SE)	CI	indirect effect (SE)	Boot CI
Predictors								
PBI-C Mother	-0,28 (0,06)	[-0,40 ; -0,16] *	-0,22 (0,03)	[-0,28 ; -0,15] *	-0,53 (0,07)	[-0,66 ; -0,40] *	-0,08 (0,02)	[-0,12 ; -0,05] *
PBI-O Mother	0,31 (0,06)	[0,19 ; 0,44] *	0,20 (0,03)	[0,14 ; 0,26] *	0,15 (0,07)	[0,02 ; 0,28] *	0,09 (0,02)	[0,05 ; 0,13] *
PBI-C Father	-0,22 (0,05)	[-0,31 ; -0,12] *	-0,15 (0,03)	[-0,19 ; -0,09] *	-0,46 (0,05)	[-0,56 ; -0,36] *	-0,06 (0,01)	[-0,08 ; -0,03] *
PBI-O Father	0,23 (0,06)	[0,11 ; 0,36] *	0,13 (0,03)	[0,07 ; 0,20] *	0,02 (0,07)	[-0,11 ; 0,16]	0,06 (0,02)	[0,03 ; 0,09] *

ASQ "Worry about Relationships" as a Mediator

DV:	ECR Anxiety				ECR Avoidance			
	direct effect (SE)	CI	indirect effect (SE)	Boot CI	direct effect (SE)	CI	indirect effect (SE)	Boot CI
Predictors								
PBI-C Mother	-0,38 (0,06)	[-0,49 ; -0,26] *	-0,12 (0,04)	[-0,19 ; -0,05] *	-0,61 (0,07)	[-0,74 ; -0,48] *	-0,01 (0,01)	[-0,02 ; 0,01]
PBI-O Mother	0,31 (0,06)	[0,19 ; 0,43] *	0,19 (0,04)	[0,13 ; 0,27] *	0,22 (0,07)	[0,09 ; 0,36] *	0,01 (0,01)	[-0,01 ; 0,03]
PBI-C Father	-0,23 (0,05)	[-0,32 ; -0,14] *	-0,14 (0,03)	[-0,19 ; -0,08] *	-0,52 (0,05)	[-0,62 ; -0,42] *	-0,01 (0,01)	[-0,02 ; 0,01]
PBI-O Father	0,13 (0,06)	[0,11 ; 0,36] *	0,13 (0,04)	[0,06 ; 0,20] *	0,07 (0,07)	[-0,07 ; 0,21]	0,01 (0,01)	[-0,01 ; 0,03]

Table 3.3 Results of regression analysis for mediation model. * p <.05

(CI: 0,0017; 0,1397) and Avoidance (CI: 0,0011; 0,1536) in close relationships. With regards to Paternal Care, the two groups present a difference when the effect over Avoidance is mediated by "Discomfort with Intimacy" (CI: 0,0006; 0,1211).
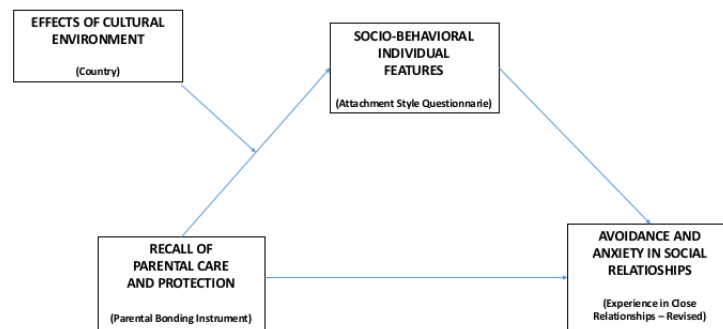
Fig. 3.2 Moderated mediation model adapted to the factors of the study

3.6   Discussion

Mediation model. Taking a look to the results obtained in the analysis for the mediation model, it is possible to observe a general indirect effect of the interpersonal constructs, represented by the ASQ subscales, between recalled parental bonding and experience in close relationships. Care-related subscales of PBI, are negatively correlated with both ECR and ASQ outcomes, while Overprotection presents a positive direction. This is in line with the theoretical constructs of the PBI, as these two dimensions are supposed to be orthogonal. While levels of Anxiety in close relationships resent of either direct effects of parental bonding and mediation of the interactional constructs, Avoidance appears to be more affected by the indirect effect of Overprotection. Specifically, both maternal (CI: 0,08; 0,18) and paternal (CI: 0,01; 0,11) overprotection have a significant impact on Avoidance only when they are mediated by Confidence. As for the other interpersonal features, perceived overprotection from the father influences avoidance when mediated by Discomfort with Intimacy (CI: 0,01; 0,11), Viewing Relationships as Secondary (CI: 0,02; 0,10), and Need for Approval (CI: 0,03; 0,09) more strongly than the direct effect. This suggest that, while the other subscales of the PBI affect both directly and indirectly anxiety and avoidance in closeness, Paternal Overprotection affects avoidance levels only when interactional features mediate the link. With regards to the mediating role of Worry about Relationship, no significant indirect effect was found for any of the PBI component on Avoidance; furthermore, for Paternal Overprotection there was no direct effect either. Taken together, these results underline an impacting role of determined components of perceived paternal behavior on the formation of personal features that act as mediators, hence on avoidance in intimacy in adulthood.

Mediation model moderated by Country. In the second part of the study, we focused on the moderating role of the country Similarly to the Mediation model, hypothesising that both sample would show parallel patterns of association among PBI, ASQ and ECR subscales. Similarly to the mediation model

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ASQ "Confidence" as a Mediator

Dependent variable:	ECR Anxiety					ECR Avoidance				
	effect ITA	*effect SG*	*contrast*	*Boot SE*	*Boot CI*	*effect ITA*	*effect SG*	*contrast*	*Boot SE*	*Boot CI*
Predictor variables										
PBI-C Mother	-0,14	-0,21	0,07	0,03	[0,0017 ; 0,1397] *	-0,16	-0,24	0,08	0,04	[0,0011 ; 0,1536] *
PBI-O Mother	0,07	0,14	-0,07	0,04	[-0,1419 ; 0,0056]	0,08	0,16	-0,08	0,04	[-0,1716 ; 0,0026]
PBI-C Father	-0,14	-0,16	0,02	0,03	[-0,0322 ; -0,0714]	-0,16	-0,18	0,02	0,03	[-0,0331 ; 0,0789]
PBI-O Father	0,03	0,06	-0,03	0,04	[-0,1098 ; 0,0438]	0,03	0,07	-0,04	0,05	[-0,1260 ; 0,0502]

ASQ "Discomfort with Intimacy" as a Mediator

Dependent variable:	ECR Anxiety					ECR Avoidance				
	effect ITA	*effect SG*	*contrast*	*Boot SE*	*Boot CI*	*effect ITA*	*effect SG*	*contrast*	*Boot SE*	*Boot CI*
Predictor variables										
PBI-C Mother	-0,14	-0,17	0,03	0,04	[-0,0402 ; 0,1015]	-0,16	-0,20	0,03	0,04	[-0,0522 ; 0,1151]
PBI-O Mother	0,04	0,10	-0,06	0,04	[-0,1290 ; 0,0124]	0,05	0,12	-0,07	0,04	[-0,1589 ; 0,0177]
PBI-C Father	-0,07	-0,12	0,05	0,03	[-0,0013 ; 0,1056]	-0,08	-0,14	0,06	0,03	[0,0006 ; 0,1211] *
PBI-O Father	0,05	0,05	0,00	0,04	[-0,0785 ; 0,0779]	0,06	0,06	0,00	0,05	[-0,0951 ; 0,0899]

ASQ "Viewing Relationships as Secondary" as a Mediator

Dependent variable:	ECR Anxiety					ECR Avoidance				
	effect ITA	*effect SG*	*contrast*	*Boot SE*	*Boot CI*	*effect ITA*	*effect SG*	*contrast*	*Boot SE*	*Boot CI*
Predictor variables										
PBI-C Mother	-0,09	-0,10	0,01	0,02	[-0,0433 ; 0,0534]	-0,13	-0,13	0,01	0,03	[-0,0569 ; 0,0739]
PBI-O Mother	0,04	0,06	-0,03	0,03	[-0,0855 ; 0,0279]	0,05	0,08	-0,03	0,04	[-0,1125 ; 0,0392]
PBI-C Father	-0,05	-0,07	0,02	0,02	[-0,0116 ; 0,0636]	-0,06	-0,10	0,03	0,03	[-0,0161 ; 0,0850]
PBI-O Father	0,06	0,03	0,03	0,03	[-0,0286 ; 0,0811]	0,08	0,04	0,03	0,04	[-0,0395 ; 0,1104]

ASQ "Need for Approval" as a Mediator

Dependent variable:	ECR Anxiety					ECR Avoidance				
	effect ITA	*effect SG*	*contrast*	*Boot SE*	*Boot CI*	*effect ITA*	*effect SG*	*contrast*	*Boot SE*	*Boot CI*
Predictor variables										
PBI-C Mother	-0,14	-0,24	0,10	0,06	[-0,0229 ; 0,2184]	-0,06	-0,09	0,04	0,02	[-0,0060 ; 0,0890]
PBI-O Mother	0,17	0,23	-0,06	0,06	[-0,1761 ; 0,0570]	0,08	0,11	-0,03	0,03	[-0,0864 ; 0,0309]
PBI-C Father	-0,13	-0,16	0,03	0,05	[-0,0614 ; 0,1229]	-0,05	-0,06	0,01	0,02	[-0,0223 ; 0,0502]
PBI-O Father	0,20	0,08	0,12	0,06	[-0,0045 ; 0,2442]	0,09	0,04	0,06	0,03	[-0,0017 ; 0,1172]

ASQ "Worry about Relationships" as a Mediator

Dependent variable:	ECR Anxiety					ECR Avoidance				
	effect ITA	*effect SG*	*contrast*	*Boot SE*	*Boot CI*	*effect ITA*	*effect SG*	*contrast*	*Boot SE*	*Boot CI*
Predictor variables										
PBI-C Mother	-0,11	-0,13	0,02	0,07	[-0,1159 ; 0,1555]	0,00	0,00	0,00	0,00	[-0,0074 ; 0,0111]
PBI-O Mother	0,14	0,25	-0,11	0,07	[-0,2406 ; 0,0274]	0,01	0,01	-0,01	0,01	[-0,0241 ; 0,0063]
PBI-C Father	-0,15	-0,12	-0,03	0,05	[-0,1257 ; 0,0755]	0,00	0,00	0,00	0,00	[-0,0063 ; 0,0067]
PBI-O Father	0,16	0,11	0,05	0,07	[-0,0766 ; 0,1845]	0,01	0,01	0,00	0,01	[-0,0063 ; 0,0196]

Table 3.4 Indexes of Moderated Mediation by Country (pairwise contrasts between conditional indirect effects)

chart, maternal and paternal care subscales are show a negative direction to anxiety and avoidance in social relationships, while overprotection is positively associated with ECR subscales, and this remains valid for both of the samples. Results highlight that the country moderates the mediation effect in three determined cases, involving solely parental care subscales. As mentioned in the results, Confidence resents of the effect of the Country where each group belongs to in mediating Maternal Care over ECR Anxiety and Avoidance. Moreover, Paternal Care affects diversely Avoidance in the two groups when is mediated by Discomfort with Intimacy. As for ECR Avoidance mediated by Worry about Relationships, it is notable to report the the effects of both samples, and subsequently the contrast, are very close to 0, highlighting a similar result to the previous study, that avoidance in adulthood might not resent of the influence of the mediation role of preoccupation with relationships. Considering the two models together, results show that the influence of perceived parental bonding on anxiety and avoidance in adulthood is

very similar in the two contexts examined in the study, Italy and Singapore, which are contemplated as representative for two different cultural environment. This reflects in a certain extent the universality of attachment, as theorized by Ainsworth and Bolwby (Bowlby, 1969; Ainsworth et al., 2015), which, in spite of everything, it is still a very debated topic, particularly with regards to the ecosocial diversity among cultures (Keller, 2018). One of the strength of this study is to provide a further step in comparing two distinct environments, each consisting of parenting strategies and family composition. Another important element treated is the distinction between maternal and paternal bonding. In fact, although nowadays the competence for child care is becoming more and more equal between the two parents, father role is an area that still is a little explored, especially in reference to the temporal dynamics of attachment in adulthood. However, this study does not lack of limitations, starting from the cross-sectional approach that presents a weaker reliance on retrospective reporting of parental bonding, compared to a longitudinal one. Another point is that, although we utilised original (for Singaporean group) and translated validated (for Italian group) version of the questionnaires, some conceptual-related issues could have led to different interpretation of the items, hence to altered scoring that might have influenced the results. Finally, for both of the countries, the sample was made by undergraduate/post-graduate students, mainly belonging to Social Science or Psychological fields, who happened to be familiar with the theories beneath the study.

3.7   Conclusion and Future Research

Starting from the assumption that early life interactions influence attachment in adulthood, we tested in two different environmental contexts the mediating effect of psychological mechanisms underling social relationships between recalled parental bonding on anxiety and avoidance in adulthood. Results showed statistically significant indirect effects both in Italy and Singapore, suggesting not only the impact of the mediation effect, but also that the pattern is similar in the two groups. This study represents not only a further step in understanding the development of bonding mechanisms in different cultural contexts but also a starting point for further explorations where more modern approaches could be combined, in order to have a more comprehensive vision of the factors that might affect the dynamics of attachment, in both early stages and subsequent phases of life. Future research should extend the assessment by integrating genetic information about variation that could modulate the sensitivity to the familiar environment (e.g., polymorphisms of oxytocin receptor gene and serotonin transporter). A further prospective should include behavioral assessment to compare scoring with observable outcomes; this could be performed collecting data from social media sites, as these platforms cover a relevant part of daily life and represent, in a certain extent, the way people are connected and interact. This would allow practitioners in socio-psychological fields to build more customised interventions, by implementing information about

interaction and relationships derived from the perception of the individual with objective data, in order to provide a more complete view of the person.

CHAPTER 4

Oxytocin Receptor Gene Polymorphisms and Recalled Parental Bonding modulate responses to social stressors in the prefrontal cortex: a Near InfraRed Spectroscopy Study

4.1 Introduction

Major theories in developmental psychology and mental health fields have proved that child's development is widely influenced by initial experiences with caregiver and that parental bonding influences different aspects of an individuals life, such as academic performance, reaction to stress load, and risks of psychopathology (Fraley et al., 2013; Francis and Meaney, 1999; Picardi et al., 2013; Reti et al., 2002; Shin et al., 2012). Additionally, the ability of children in interpreting, regulating, and communicating emotions relies on experiences of emotional socialisation obtained through effective interaction with parents and social others (Spinrad and Gal, 2018). In comparison to negative parenting practices (e.g. parental hostility), positive parenting practices (e.g. maternal sensitivity) are related to better emotional regulation abilities (Morris et al., 2007). Subsequently, this ability will persist in shaping the childs social interactions, as it was posited that proper emotional regulation facilitates the development of empathy rather than anxiety in response to distress of a social other (Spinrad and Gal, 2018). More notably, early childhood experiences with caregiver also formulates individuals inclination towards perceiving the self and social information (Dykas and Cassidy, 2011; Groh and Roisman, 2009; Raby et al., 2015). One illustration of such effect is that avoidant attachment individuals performed better (shorter time taken) than anxious or secure attachment individuals in a classic stroop task involving positive/negative emotional words, implying a tendency to suppress or ignore emotionally arousing stimuli. Caregiving experiences could also inhibit or motivate our interactions in situations without perceived security (Hane et al., 2008). From the above mentioned, it strongly exuberates the theme that parenting influences a childs social-emotional development and affect how individuals take on social situations.

4.1.1 Consequences on Social Information Processing

Indeed, social information processing theory (SIP) (Crick and Dodge, 1994; Dodge and Price, 1994) suggests that we bring on board our previous experiences of interactions into making sense of, and in-

teracting with the social situation. SIP examines the cognitive operations behind peoples behavioral responses in a social situation. In the SIP theory, individuals social encounter begins with attending to the stimuli, encrypting, and processing the information. Subsequently, individuals would attribute the cause of the behavior of a social other through their schema of the world and the interpretations of the social information processed in the earlier stage. Individuals would then formulate social goals and the corresponding actions/response to achieve a certain outcome. The actions would eventually be evaluated for its effectiveness in reaching a particular social outcome behaviors are reinforced if it facilitates the achievement of an intended goal. Based on previously learnt experiences, individuals develop a personally practical/functional relational schema which consists of the beliefs and expectations about how interpersonal relationships work serving as an efficient method for individuals to perceive and interact with the world (Baldwin, 1992). Bowlby (1969/1982) also identified caregivers sensitivity in contributing to the childs internal working model, thereby shaping their social cognition and processes. Individuals with a secure base attachment was illustrated as having a relatively continuous caregiver experience of protection, affection, care, and sensitivity (Bowlby, 1969). Subsequently, Bowlby attempted to describe the two possible implications of prolonged insecure attachment on defensive exclusion inactivity in response/action, and detachment of the mind with regards to interpersonal related stimuli, thereby affecting ones sensitivity and reactivity towards the social encounters (Bretherton and Munholland, 2008; Reisz et al., 2018). On the contrary, securely attached individuals are more receptive towards processing both positive and negative social information (Vandevivere et al., 2014). Furthermore, the efficacy of individuals emotional socialisation could also affect the steps in SIP, as it drives and guides our attention towards different aspects in the environment, alters our interpretation of situational cues, and subsequently determining our behaviors (Goraya and Shamama-tus Sabah, 2013; Lemerise and Arsenio, 2000). Therefore, these may create biases in social information processing, as individuals may reduce the processing of threatening social information to minimise the discomfort that stemmed from their rejected/unaddressed attachment needs in their early years (Dewitte and De Houwer, 2008; Dykas and Cassidy, 2011). The stipulated importance of early caregiving experiences in affecting our social information processing from the theories mentioned above garners the need to explore the relation between parenting practices and its plausible effects on the cognitive biases in social information processing. Specifically, the extent of perceived parental care and overprotection provided would be investigated.

4.2   The influence of parental care in child development

Central to the quality of parenting practices and attachment are the dimensions of care and protection encompassed in the construct of parental bonding (Parker et al., 1979). Parental care refers to the sensitivity of parents towards childs needs (emotional, physical, psychological) and responding positively,

while parental overprotection refers to the excessive restrictions (emotional, physical, psychological) imposed on the child. The quality of parental bonding influences the development of top-down processes of emotional regulation, which could potentially shape social interactions and physiological responses in individuals. The ability to perceive the social situation as risk-free also have implications for the autonomic nervous system (Porges, 2003). For instance, the levels of paternal care and overprotection received by individuals interacted with biology to affect the autonomic response in males towards female distress, revealing effects of paternal care and overprotection on physiological reactivity to signals of suffering (Truzzi et al., 2018). Specifically, higher levels of paternal care were associated with higher heart rate response towards female cries for individuals with a variation of gene that increases sensitivity towards the early caregiving received (Truzzi et al., 2018). Higher heart rate variability scores and lower nose temperature indicative of better autonomic nervous system functioning and inhibition of flight/flight system (calming response) was also found to be elicited in response to the distressing stimulus of cries, for male receivers of adaptive parenting (high care and overprotection) in Italy samples (Dalsant et al., 2015). Moreover, individuals with overprotective fathers have the tendency to approach others cautiously, while caring fathers increases a childs ability to interact with others without inhibition (Zafiropoulou et al., 2014). Other aspects of parental bonding were associated with individuals dysfunctional cognitive representation of the world and self maternal care appears to be critical in regulating the self-esteem, extent of trust, proper socialisation, and emotional health of the child, while maternal overprotection levels coupled with low affection is positively correlated with feelings of being forsaken and experiences of emotional instability (Zafiropoulou et al., 2014). In addition, self-esteem as well as the theory of mind the ability to comprehend others feelings and thoughts, was found to be higher with higher levels of parental care, whereas lower theory of mind scores is correlated with higher parental overprotection (Passanisi et al., 2015). Generally, the literature points towards higher care and lower overprotection as ideal parenting practices, since parental care increases sensitivity to distressing stimuli and allow individuals to be less restrained in social interactions, while parental overprotection reduces effectiveness of emotional regulation and the ability to explore social situations. Consequently, negative parenting practices were also relevant to manifestation of social anxiety traits in individuals: Parental (maternal and paternal) overprotection and paternal overprotection was associated with childrens social anxiety and males general anxiety levels respectively, while there was no effect of parental warmth on social anxiety levels in individuals (Rork and Morris, 2009). Considering the effects that parental bonding has on the social-emotional development of individuals, we examined how continuous and consistent parental bonding (care and overprotection) practices in the first 16 years of childs life (emphasizing on the enduring impact of parenting practices) could mould responses in social situations in the present study. Specifically, the next section discusses the measurement of these social responses through ex-

amining prefrontal cortex activity, which has been found to play a role in the regulation of top-down process of individuals social experience.

4.3 The Role of the Prefrontal Cortex in social behavior

Various brain areas work in concert to provide social experiences for individuals. Brain areas responsible for perception and senses receives the social input (e.g. superior temporal sulcus for social sounds), while activated emotion-related brain areas (e.g. amygdala) could be integrated to affect individuals response of the social situation (Atzil et al., 2011). To illustrate, the nucleus accumbens is required to perceive parenting as fulfilling and positive, while the amygdala was posited to be related to the strain and tension from anxious parenting (Atzil et al., 2011). Additionally, various parts of the prefrontal cortex are also closely involved in the process of social perception and experience in individuals. For instance, the orbitofrontal cortex (OFC) was found to be related to the weighing of the benefits and costs of responding to a social situation determined by previous experiences and biological determination, which is closely interlinked to the amygdala (Murray and Wise, 2010; Nelson and Guyer, 2011). Besides, the ventrolateral prefrontal cortex takes into account social norms, examine whether a certain social action is tolerable in a specific situation, and also partake in response (cognitive, affect, and behavioral) prevention (Berthoz et al., 2002; Dillon and Pizzagalli, 2007; Nelson and Guyer, 2011; Noveck et al., 2004; Rilling et al., 2008). Moreover, the comprehension of mental states and empathetic function is achieved via the anterior cingulate cortex and the dorsomedial prefrontal cortex (Bzdok et al., 2015; Li et al., 2014). In the aspect of parental influence, the suppression of emotionally arousing thoughts of negative valence (e.g. separation or loss of significant other) in anxiously attached individuals revealed lower activation in the OFC as compared to securely attached, suggesting reduction ability to regulate emotions (Gillath et al., 2005). The existence and implications of a top-down regulation process in individuals social experience garners the need to study social information processing processes through examining differential activation of the prefrontal cortex in response to social vocalizations that instinctively elicit responses from individuals, allowing it to be a proxy for social behaviors.

4.3.1 Social vocalizations

Not all environmental sounds are created equal; sounds that implicates a species evolutionary benefits appears as more salient (Soltis, 2004). Infant cries act as a biosocial signal to interact and communicate their basic needs to adults, while humans are generally hard-wired to respond to infant cries subsequently pivoting their attention and motivation towards attending to the needs of the infant (Acebo and Thoman, 1992). For instance, previous studies have found that infant cries elicit physiological alertness and propels response in adults (Messina et al., 2016; Parsons et al., 2014). Moreover, adults displayed

intentions to act upon the distress of an infant through enhanced concerted, planned movements (Parsons et al., 2012). This is also reflected in the neurobiological data, whereby brain areas relating to the motivation to act and communicate with the infant (e.g. supplementary motor area, superior temporal regions) were activated in mothers upon hearing of infant cries, indicative of higher sensitivity towards social cues (Bornstein et al., 2017). The left inferior prefrontal cortex involved in processing and comprehending of sounds was also activated in response to auditory stimuli relating to distressing social signals (Bornstein et al., 2017). Moreover, cries are effective in eliciting negative emotional valence and therefore activates brain structures relating to emotional regulation which drives to reduce distress by eliciting intentions to act (Swain et al., 2014). An increase in physiological arousal (e.g. higher heart rate) was also found when listening to infants crying, indicating the effect of social cries on emotional and biological arousal (Out et al., 2010). Under typical circumstances, it has been established that usual responses towards infant cries includes activations of brain areas relating to motivation to act, increase in processing of the source of distress, and increase in physiological arousal. Accordingly, cries are a form of salient, social communication of emotions whereby the effects are not limited to merely infant cries. Adult cries, infant cries, and infant laughter too, were found to increase peoples physiological alertness and propel them into action (Parsons et al., 2014). This innate response allows for the effective study of individuals interaction with social information through examining the corresponding brain activations in reaction to the social vocalizations.

4.3.2 Moderating effect of oxyocin receptor gene in social behaviors

Neurobiological and physiological responses to social stimuli are a product of a combination of environmental and genetic factors. Serotonin Transporter-Linked gene is widely recognize as a moderator of stress and different aspects of social behavior (Cataldo et al., 2018b; Walum et al., 2012; Heinrichs et al., 2009). Two single nucleotide polymorphisms (SNPs)have found to be linked to the expression of different social behavior: rs53576 and rs2254298, both presenting an A to G variation. With regards to the rs53576, results in literature report that the G allele has been associated with a more successful social development, such as higher levels of dispositional empathy (Rodrigues et al., 2009; Smith et al., 2014), greater prosocial features (Truzzi et al., 2018; Senese et al., 2017; Rodrigues et al., 2009; Tost et al., 2010) and increased neurocardiac reactivity to social stressors (Norman et al., 2012). On the contrary, A carriers showed overall poorer social traits (Thompson et al., 2011; Wu et al., 2012), lower levels of empathic accuracy (Rodrigues et al., 2009) and positive affect (Lucht et al., 2009), all representing a less adaptive social development. Though many results underline the association between specific variations of the genotype with social traits, some inconsitencies still remain (Apicella et al., 2010; Li et al., 2015; Bakermans-Kranenburg and van IJzendoorn, 2008). Considering the rs2254298

polymorphisms (G to A variation) G/G homozygotes were shown to be more susceptible to enviromental factors compared to the A carriers, with higher scores in attachment dimensions and separation anxiety (Costa et al., 2009). Another study that explored the interaction between recalled parental bonding and genetic features, highlights that A-carriers displayed higher heart rates in responses to social stressors (Esposito et al., 2017b). Taking all the information together, it appears that modulation of social behavior is a combination of genetic, environmnetal and neurobiological factors. Evidence in literature reports results about the involvement of oxytocin receptor gene SNPs in modulating the responses to social stressor (Feldman, 2012; Zink and Meyer-Lindenberg, 2012; Domes et al., 2007). A NIRS study by Nishitani and colleagues reported a differential activation of the right inferior anterior prefrontal cortex in G/G homozygotes in responses to infant faces (Nishitani et al., 2017). Although it is possible to find studies about the influence of OXTr SNPs on social behavior, the exact role of the specific variations still needs to be fully elucidated. This study aims to shed light on the possible interaction of these factors with measures of neurophysiological arousal (variations of oxygenated hemoglobin in the prefrontal cortex) in response to distressing stimuli in the form of crying vocalizations. Such neurophysiological responses, markers of overall autonomic nervous system activation reflective of psychological stress, may lie at the critical intersection of genetic and environmental influences on an individual's social development. While genes establish initial patterns of physiological responsiveness, early experiences provide key information which may modify and remodel these initial patterns, allowing the developing individual to best adapt to their evolving and complex environment. In light of recent findings on OXTr rs53576 and rs2254298 variations, we predict that G/G homozygotes, compared to A allele carriers, should display more sensitiveness to distressing social stimuli.

4.4 Research Question and Hypotheses

From the collective literature, it is evident that the developmentally-derived emotional and cognitive processes from early caregiving experiences could result in differential levels of neurophysiological arousal, self-esteem, anxiety, and efficiency of perceiving social information in individuals. Recent studies have begun to explore the effects parental bonding have on the peripheral nervous system response towards social vocalizations, revealing varied levels of sympathetic nervous system arousal across gender, genetic variation, and parental bonding (Truzzi et al., 2017, 2018; Nishitani et al., 2017). Yet, few research studies the neurological consequences/implications in which these early parental effects have on the development of adaptive social behaviors. Therefore, this study wishes to bridge the gap by giving a glimpse into the neurobiological mechanism behind how the interaction between parental bonding perceived in early childhood could potentially influence emotional and social information processes in social situations. This research would help contribute to the literature by attempting to uncover the ra-

tionale underlying the differential neurophysiological reactions and consequences with varying levels of parental bonding using a social information processing model. Moreover, it is interesting to explore effects of parental bonding on individuals emotion processing of social stimuli, and consequently its implications on individuals social information processing. This research is especially crucial in inferring ideal parental bonding practices, in consideration that its effects are intertwined with individuals level of anxiety, adaptiveness towards responding to social vocalizations, and psychopathology as highlighted previously. Two hypotheses were hence derived.

- **Hypothesis 1.** with regards to rs53576, we expect A carriers to show more activation to audio stimuli as a signal of distress since that, according to evidence in literature, people with this variation tend to present less empathic accuracy;

- **Hypothesis 2.** G/G homozygotes will show different levels of sensitiveness to distressing social stimuli, as the levels of parental care and overprotection increase.

4.5 Method and materials

Perceived Parental Bonding. Parental Bonding Instrument (PBI) (Parker et al., 1979) was utilized, intending to measure individuals perceived parent-child attachment in the initial 16 years of their life. Two dimensions namely care and overprotection were explored. Care examines the extent to which affection and sensitive parenting was perceived to be provided by both parents (e.g. seemed emotionally cold to me, spoke to me in a warm and friendly voice) (see Appendix A for the questionnaires). Individuals with low care scores regard parents as rather distant, unsympathetic and unresponsive; while individuals scoring high care has a caring, sympathetic, and affectionate experience of parental bonding. Overprotection examines the extent to which individuals perceived parents to be implementing excessive control and/or impeding their growth towards independence (e.g. invaded my privacy, felt I could not look after myself unless she/he was around). Participants responded to 12 Care and 13 Overprotection items on a scale ranging from very unlike, moderately unlike, moderately like, to very like. To explore the quality of bonding with both parents, PBI comprises of two identical forms (25 items each) for father and mother, constituting a total of 50-items in the questionnaire. PBI was proven to have stability over time in studies with test-retest after a period of 20 years, and was relatively unaffected by mood changes (Lizardi and Klein, 2005; Murphy et al., 2010; Wilhelm et al., 2005). PBI was also found to be closely related to the Egna Minnen Betrsffande Uppfostran (EMBU) questionnaire, which attempted to measure similar constructs of warmth and overprotection (Arrindell et al., 1998). Here, the Cronbachs alpha of the care dimension for mother is $\alpha = 0.94$, and fathers is $\alpha = 0.95$, implying excellent internal consistency. For the overprotection dimension, the Cronbachs alpha value for mother and father are $\alpha = .87$ and $\alpha = .90$

respectively, suggesting acceptable to good internal consistency.

Auditory Stimulus. Prior to Near InfraRed Spectroscopy, three different types of non-linguistic vocalizations were utilized in this study, namely: women cries (WC), infant cries (IC), and cat cries (CC). Infant vocalizations were obtained at the age of 3 months from birth. CC were included to factor in for effect of vocalizations across species. The sounds of IC, and WC (sampling rates 44.1 kHz/32bit) were acquired from the Oxford Vocal Sounds database (Parsons et al., 2014). CC were obtained from selected clips from YouTube (`www.youtube.com`), and 15 seconds snippets of the clips were obtained using the online Audio Trimmer (`http://audiotrimmer.com`). Subsequently, Audacity 2.0.4 (`http://sourceforge.net/projects/audacity/files/audacity/2.0.4/`) was used to minimize the background noise and ensure the compatibility of volume to other sounds. These emotionally salient sounds were chosen with the intention of mimicking social situations found to instinctively elicit response in individuals. The timing ratio of 15 seconds of cry stimulus: 10 seconds of fixationsilence was rated as most distressing among other provided ratios in a previous study that uses auditory social stressors (Dalsant et al., 2015). Therefore, the ratio of 15 seconds of auditory stimuli (infant cry, women cry, cat cry): 10 seconds of inter-stimulus interval was utilized in this study to elicit maximal emotional valence of a social situation in an experimental setting. The sound stimulus consisted of 10 tracks from each type of vocalization, making 30 tracks. NIRStim software was used to construct the approximately 15 minutes sound stimulus (inclusive of inter-stimulus intervals), and to randomize the order of presentation of the auditory stimulus to the participants.

Functional Near-Infrared Spectroscopy (fNIRS). A NIRx fNIRS was employed in this study to acquire data on the relative changes in concentration levels of oxygenated hemoglobin (oxyHb) and deoxygenated hemoglobin (deoxyHb) in the prefrontal cortex. Specifically, fNIRS only measures up to 4 cm of the cerebral brain activity from the surface. In the presence of activation of a cerebral area during the presentation of sound stimulus in the experiment, the higher metabolic demands would require more oxyHb to support its activity, resulting in greater concentration of oxyHb to deoxyHb, which is captured by the equipment. As hemodynamic responses (cerebral blood flow) corresponds closely to neuronal activity, it is possible to infer the level of brain activity via measuring of the concentration levels of the oxyHb and deoxyHb in a cortical area. The instrument scans with a rate of 7,81 Hz and emits light with source wavelengths of 760nm and 850nm, specific to the absorption spectrum required for detection of oxyHb and deoxyHb respectively. An 8x7 source-detector montage was employed, and the prefrontal cortex activity was registered using a 20 channels configuration (see Figure 4.1). Only the oxyHb values were reported in the subsequent analyses as it has a higher correspondence with cerebral hemodynamic responses than deoxyHb values, facilitating a higher accuracy during the inference of brain activity (Strangman et al., 2002).
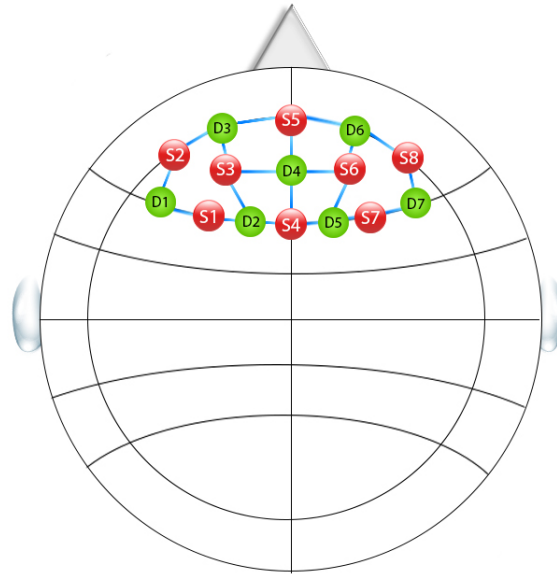
Fig. 4.1 Disposition of sources and detectors on the NIRS cap

Genetic collection and SNP genotyping Genomic DNA was collected asking participants to scrub the inner part of both cheeks for at least 30 seconds each side using a buccal swabs. Samples were placed and left to dry for 48 hours in a 1,5ml tube in a dry place. Genotyping for allelic variants of rs2254298 and rs53576 SNPs was performed using the TaqMan genotyping platform in accordance with the manufacturer's protocol.

4.6   Design and Procedure

One hundred thirty-four participants consisting of 84 females (M_{age} = 21,16, SD = 1.92) and 50 males (M_{age}= 21.16, SD= 1.91) were recruited via the undergraduate research participation pool from the Nanyang Technological University of Singapore (NTU). Having children was set as exclusion criterion in the process of recruitment. Participants were compensated with 3 credits for their time spent (1 credit/0.5 hour), which contributes to a psychology modules course assessment.The study was approved by the ethics committee of the NTUs Institutional Review Board. Participants informed consent were obtained prior to the conducting of study. This study employed a 2 (Care: Mother, Father) x 2 (Overprotection: Mother, Father) x 3 (Sounds: Infant Cry, Cat Cry, Woman Cry) x 2 (Genetics: AA vs GG carriers) factorial, quasi-experimental design. The study comprises of two experimental sessions. The first session was conducted on an online platform of Qualtrics. Upon consenting to partake in the study, participants were tasked to complete the PBI questionnaire online, intending to measure their quality of early experiences of caregiving perceived (parental care and overprotection). Demographic variables relevant for the study (e.g. gender, age, marital status, and ethnicity) were included as starting questions

in the online questionnaire. The second experimental session was scheduled to take place in the Social and Affective Neuroscience Laboratory located in NTU. Upon acquiring informed consent, NIRS cap was mount on the participants. Subsequently, a period of time was factored in to calibrate, inspect, and adjust the signal quality for the NIRS. Prior to the commencement of the experimental session, the experimenter conducted a preview of the NIRS recording to ensure the data is recorded in all the 20 channels. The experimenter also reminded participants to minimize motion. All participants were tasked to listen to a series of randomized sound stimulus (30 tracks) lasting a duration of approximately 15 minutes. Initial 30 seconds of the experiment consists of information of the nature of the sounds that they would be exposed to in the course of experiment. Participants were also instructed to fixate their gaze on the white cross (+) that would be presented on the centre of the black screen throughout the entire stimulus presentation, attempting to control for eye movements. After the instructions, a 15 seconds soundtrack (randomized) would be presented, followed by a 10 seconds inter-stimulus interval of recovery and the next 15 seconds trial, until all 40 soundtracks were presented. The NIRS recording was stopped by the experimenter after the experiment concluded. Before debriefing, a sample of the participant's buccal mucosa was collected using a buccal swab and then sent to laboratory for DNA-related information extraction.

4.7 Results

4.7.1 Pre-processing of NIRs Data

Once results on OXTr SNPs were received, Preceding the analyses of the NIRs data, nirsLAB v.2016 software was utilized to pre-process the data. The quality of the signals was inspected via the labelling of channels with exceptional amount of background noise (gain <8, CV >7.5, NaN) as bad. Data from 134 participants consisting of 84 females ($M_{age}= 21.16$, SD= 1.92) and 50 males ($M_{age}= 21.16$, SD= 1.91) proceeded to the next stage of pre-processing. The onset times of the 30 auditory stimulus were inserted for nirsLAB for identification of the time periods of interest. Spiked artifacts that were produced as a result of sudden movements as well as discontinuities from the data were removed. A bandpass frequency filter consisting of a low filter frequency (0.010 Hz) and high filter frequency (0.20 Hz) was implemented. Finally, hemodynamic states were computed in accordance with the Beer-Lambert Law. A within-subject Statistical Parametric Mapping (SPM1) was subsequently performed on the NIRs data. Parameters were first defined for the SPM1 analysis. This includes the setting of basis function as hemodynamic response function and a temporal filtering of Gaussian FWHM 4 model. A general linear model was then estimated to obtain 4 beta coefficients relating to each channel 1 to 20. These steps were repeated for each data file of the participants. Once results on OXTr SNPs were received from laboratory,

it was possible to build the final dataset, which comprises a total 102 subjects: for the rs53576 the sample consisted of 39 A-carriers (14 Male; 25 Female) and 63 G/G homozygotes (21 Male; 42 Female); as for rs2254298, 36 participants presented the A-variation (14 Male; 22 Female) and 66 the G/G variation (21 Male; 45 Female).

4.7.2   Data Analyses

Preliminary data analysis highlighted that sex of the participants did not have any effect on the neural responses to audio stimuli. For this reason, sex is not taken into account in the analysis nor in the discussion of results. Utilising the R-studio software, twenty within-subject ANOVA were conducted, one for each of the NIRS channels. Before proceeding with analyses, the database was screened and cleaned for missing values or values equal to 0 in all the channels in order to keep only the reliable values. Missing values in NIRS channels might be due to an interruption of the signal while recording. Variables were then checked for skewness and kurtosis, showing an acceptable normal distribution. Six independent variables of genetic variations, maternal overprotection, paternal overprotection, maternal care, paternal care and the types of social vocalizations were considered in the analyses. Subsequently, t-tests for main effect for categorical variables (e.g. allelic variation) and correlation tests for continuous variables (e.g. PBI scores) were conducted for the channels with significance. Moreover, follow up analyses for interaction effects were also examined.

4.7.3   Interaction Effects of ANOVA analyses

rs53576. ANOVA analyses of the concentration of oxyHb revealed significant main effects of the interaction between maternal care, paternal care and paternal overprotection scores and the rs53576 indiscriminately over the entire sound stimuli in five different channels. Specifically, the interaction between the SNP and Maternal Care was found to exert an effect, on channel 18 (F_{Ch18} = 4.854, p = 0.0286). Post hoc analysis revealed a significant correlation for A carriers (r_{Ch18_A} = 0.216617, p = 0.03127) but no for G/G homozygotes (r_{Ch18_G} = -0.08234524, p = 0.3164), though results highlighted an opposite direction of the correlation (see Figure 4.2 below). Channel 18 corresponds to the BA46R, inclufing the middle frontal gyrus (MFG) and the lateral prefrontal cortex.

Interaction between Paternal care and rs53576 variants resulted statistically significant on channels 6 (F_{Ch6}=3.919, p = 0.0488), channel 7 (F_{Ch7} = 4.458, p = 0.0359), and channel 14 (F_{Ch14} = 4.165, p = 0,0424). Post hoc analysis showed, on channel 6, a strong effect for A carriers (r_{Ch6_A} = -0.3027819, p = 0.00169) but not for G/G individuals (r_{Ch6_G} = -0.02588406, p = 0.7302. See Figure 4.3 below. Channel 6 explores the area corresponding to the anterior prefrontal cortex. On channel 7, although the direction of the correlation was different for A-carriers and G/G homozygotes, none of the values reached the sta-

rs53576 - Channel 18
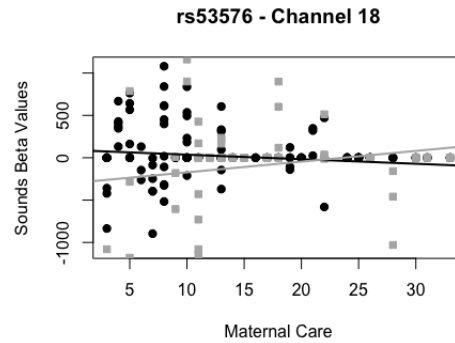
Fig. 4.2 Interaction Effect of rs53576 allelic variations and Maternal Care on OxyHb Concentration in Channel 18

tistical significance (respectively, r_{Ch7_A} = -0.1411721, p = 0.157 and r_{Ch7_G} = 0.07729948, p = 0.3423). The same result occurred with regards to channel 14 (respectively, r_{Ch14_A} = -0.1870246, p = 0.06379 and r_{Ch14_G} = 0.0789843, p = 0.3178).
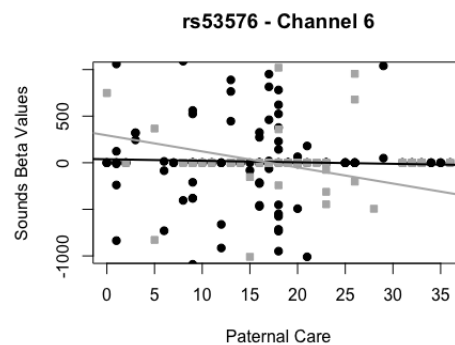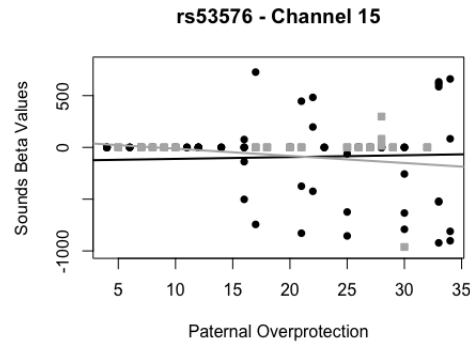

rs53576 - Channel 6

Fig. 4.3 Interaction Effect of rs53576 allelic variations and Paternal Care on OxyHb Concentration in Channel 6

As for Paternal Overprotection, a significant interaction effect was found on channel 9 (F_{Ch9} = 6.839, p = 0.00962) and on channel 15 (F_{Ch15} = 4.047, p = 0.0463). As before, the direction of the effect was opposite between A-carriers and G/G individuals, but post hoc analysis results did not reach significance levels for channel 9 (r_{Ch9_A} = 0.1745565, p = 0.1059 and r_{Ch9_G} = 0.1490231, p = 0.07887). Conversely, on channel 15, the effect of A variation resulted significant, but no the effect of G/G variation (respectively, r_{Ch15_A} = -0.165961, p = 0.03998 and r_{Ch15_G} = 0.02871358, p = 0.7712) (see Figure 4.4 below). Channel 15 includes part of the BA09R, corresponding to the dorsolateral prefrontal cortex (DLPFC).

No interaction between Maternal Overprotection and rs53576 was found. Subsequent correlational analysis on the specific nature of the audio stimulus did not lead to statistically significant results.

rs2254298. ANOVA analyses of the concentration of oxyHb revealed significant interaction effects

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rs53576 - Channel 15

Fig. 4.4 Interaction Effect of rs53576 allelic variations and Paternal Overprotection on OxyHb Concentration in Channel 15

between maternal overprotection, paternal care and paternal overprotection scores and the rs2254298 indiscriminately over the entire sound stimuli in ten different channels. Specifically, the interaction between the SNP and Maternal Care was found to exert an effect, on channel 5 (F_{Ch5} = 4.833, p = 0.02975), on channel 10 (F_{Ch10} = 4.615, p = 0.0328), and channel 15 (F_{Ch15} = 4.536, p = 0.0350). With regards to channel 5, post hoc analysis revealed a significant correlation for A carriers (r_{Ch5_A} = -3216566, p = 0.01469) and for G/G homozygotes (r_{Ch5_G} = 02547028, p = 0.009782), highlighting an opposite direction of the correlation. This NIRS channel explores the BA09L, corresponding to the left dorsolateral prefrontal cortex (DLPFC). On channel 10, correlation was significant for G/G homozygotes (r_{Ch10_G} = 0.2023595, p = 0.01004), but not for A-carriers (r_{Ch5_A} = -0.1147093, p = 0.3079). This area refers to the BA08R, which includes the frontal eye field. Again, on channel 15 the correlation was significant for the G/G allelic variation ((r_{Ch15_G} = 0.2653934, p = 0.005505), but not for the A-carrier individuals (r_{Ch15_A} = -0.1310366, p = 0.3313). As aforementioned, this area coincides with the left DLPFC. Graphical significan results are reported in Figure 4.5. Subsequent correlation analysis on the specific nature of the audio stimulus did not lead to statistically significant results.

Rs2254298 – Maternal Care
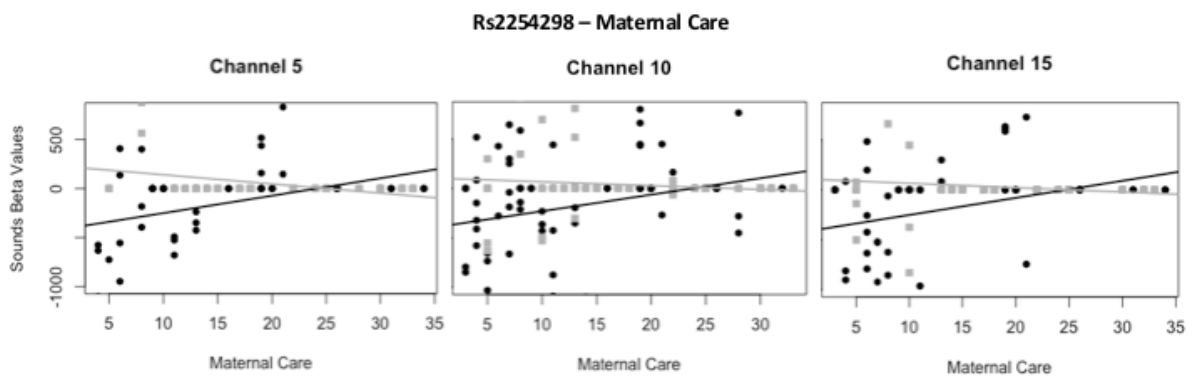
Fig. 4.5 Interaction Effect of rs2254298 allelic variations and Maternal Care on OxyHb Concentration

As for Paternal Care, interaction effects were found on multiple channels. A significant effect was

found on channel 5 (F_{Ch5} = 8.663, p = 0.00387), channel 6 (F_{Ch6} = 8.938, p = 0.00307), channel 7 (F_{Ch7} = 5.251, p = 0.0229), channel 14 (F_{Ch14} = 6.308, p = 0.0127), channel 16 (F_{Ch16} = 5.970 , p = 0.0153), channel 17 (F_{Ch17} = 5.226, p = 0.0232), channel 19 (F_{Ch19} = 5.127, p = 0.0244) and channel 20 (F_{Ch20} = 4.286, p = 0.03976). The interaction effect between Paternal Care and oxygenate hemoglobin on channels 5, 7, 14, 17 and 20 did not result significant post hoc correlational test. For channel 6, a significant effect was found for G/G variant (r_{Ch6_G} = -0.1929193, p = 0.008883) but no for A-carriers (r_{Ch6_A} = -0.03192406. This channel covers the left middle frontal gyrus (lMFG, BA46L). Channel 16, which corresponds to part of the anterior prefrontal cortex (aPFC), revealed a signficant post hoc correlation for G/G homozygotes and levels of oxyHb (r_{Ch16_G} = -0.2012565, p = 0.008899), but no for A variant (r_{Ch16_A} = -0.108015, p = 0.3193). Laslty, Channel 19 presented a significant correlational effect between G/G individuals and levels of brain activation (r_{Ch19_G}= -0.2281971, p = 0.002458) but no for A-carriers (r_{Ch19_A} = -0.03493483); this effect was linked to *pars orbitalis* of the inferior prefrontal gyrus. Results are reported below in Figure 4.6. No significant interaction effect was found between level of oxygenated hemoglobin and Overprotection, both maternal and paternal.
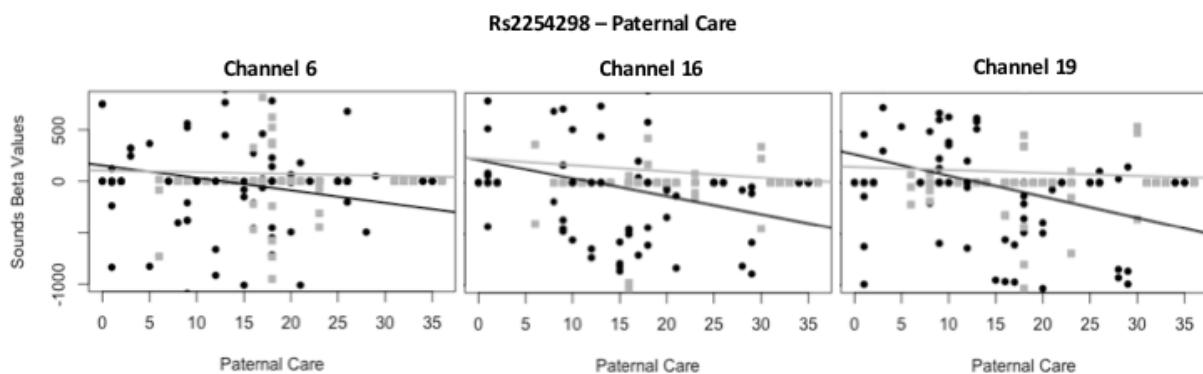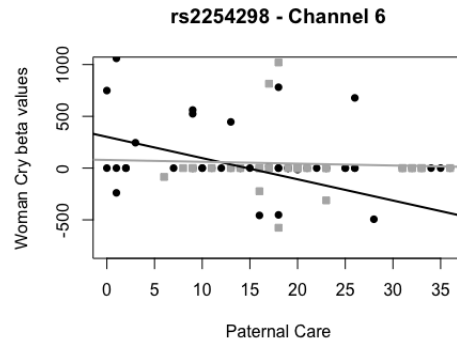

Fig. 4.6 Interaction Effect of rs2254298 allelic variations and Paternal Care on OxyHb Concentration

Further investigations including the nature of the audio stimuli, revealed a significant correlation between paternal care and oxyHb in G/G homozygotes, when listening to woman cry on Channel 6 ($r_{Ch6\_G\_Wcry}$ = -0.3029925, p = 0.01762) but not for A-carriers ($r_{Ch6\_A\_Wcry}$ = -0.03220047, p = 0.8565) (Figure 4.7).

4.8   Discussion

The purpose of this study is to examine the different responses, in terms of brain activation, towards social stimuli and the nature of neurophysiological mechanisms accompanying the different genetic susceptibility and early experiences experienced specifically, the amount of parental care and over-protection perceived. Moreover, we posit that the neurophyslogical responses and activation to social

Fig. 4.7 Interaction Effect of rs2254298 allelic variations and Paternal Care on OxyHb Concentration

stimuli varies depending on the allelic variation in two OXTr gene polymorphisms. To provide a visual understanding of the brain regions involved, it is suggested to refer to the Figure 4.8) below.
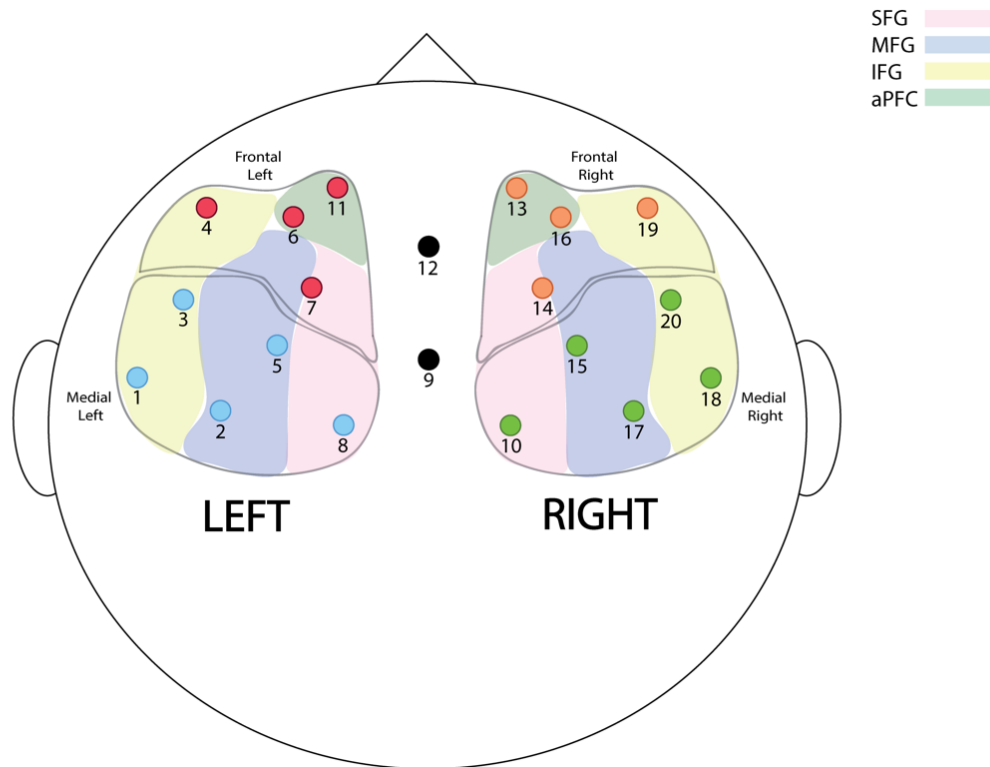
Fig. 4.8 Overview of the brain areas explored by NIRS Channels

Overall, prefrontal cortex activation elicited for specific emotional vocalizations occurred only in a single interaction (Paternal Care and Woman Cry in SNP rs2254298 on channel 6) but a general responsivity/sensitivity in the perception of emotional vocalizations on parental bonding was found instead (as compared to stimulus discrimination). Taking a general look at the significant results, it appears clear that Care-related subscales, maternal and paternal, exert a wider effect on brain activation in both the

oxytocin receptor gene SNPs. With regards to **rs53576**, higher levels of Maternal Care were correlated a greater brain activation in the middle frontal gyrus in A-carriers (BA 46r), an area appointed functions related to language and working memory (Demb et al., 1995), but also to executive-control processes that inhibit memory retrieval (Anderson et al., 2004; Levy and Anderson, 2002). Higher scoring in Paternal Care subscales were correlated to lower activation in the anterior prefrontal cortex (BA 10l), which function is related to working memory and decisional processes, prior to the decision being available to conscious awareness (Soon et al., 2008). Higher levels of paternal Overprotection were related to lower neurophysicological responses in the right dorsolateral prefrontal cortex (BA 09r), which functions are related to inferential reasoning, decision making and present vigilance, specifically related to threat-induced anxiety (Shackman et al., 2009), increasing the activity in this area when a person experiences uncertainty to action, thus in this case A-carriers show less decision-making related activation especially for higher level of Paternal Overprotection, which is considered to be a non-optimal pattern of recalled parental bonding. These correlations represent less adaptive responses to social stressors, confirming the first hypothesis. Moving to the **rs2254298**, only care subscales resulted in significant brain activation and in G/G homozygotes mainly. Starting with Maternal Care, higher scoring were correlated to greater levels of oxyHb in channel 5, 10 and 15. These areas correspond respectively to the left dorsolateral prefrontal cortex (BA 09l), the frontal eye fields (BA 08r) and the right dorsolateral prefrontal cortex (BA 09r). In channel 5 A-carries showed a decrease of activation, while G/G individuals showed the opposite direction; DLPFC in the left hemisphere is attributed to emotion processing and self reactions in decision making, specifically in the involvement of deductive and syllogistic reasoning (Kane and Engle, 2002). This might explain a higher promptness to action in G/G homozygotes compared to A-carriers. With regards to channel 10, the frontal eye field is responsible for saccadic eye movements for the purpose of visual field perception and awareness; this suggests that a higher activation may correspond, again, to a readiness to act, while a decrease in oxtHb levels in this area might reflect less propensity to take action in response to social stressful situations. As already explained, Channel 15 (BA 09r) is deputed to inferential reasoning. Individuals with G/G variation presented lower activation of this area in response to social cues for lower levels of Parental Care, with a higher activity as the the scoring increases. Since this region is related to present vigilance (Shackman et al., 2009) an increased activation for higher Care perceived, might reflect a more efficient response to stressful social stimuli. Differently from Maternal Care, the pattern of response to cries in G/G homozygotes for Paternal care present a negative correlation on channel 6 (BA 10l), 16 (BA 10r) and 19 (BA 47r). The left hemisphere of aPFC is included in BA 10l and, as aforementioned, is related to working memory and decisional processes, before the decision itself is accessible to conscious awareness (Soon et al., 2008). In light of this, higher parental care (which is expression of a more optimal perceived parental warmth) is linked

to a decreased activity in the anterior prefrontal cortex, meaning that the person experiences a reduced working memory-related processing. The right hemisphere of aPFC, which is part of the BA 10r, has shown to be, to a certain extent, involved in retrieval of positive context (Maratos et al., 2001). Taken this assumption together with our results, it shows that, individuals with G/G variation and higher levels of paternal care display a decreased activation of the anterior prefrontal cortex on both sides of the brain, with the possible meaning that, having a more optimal configuration in terms of recalled parental environment and genetic susceptibility, they have a reduced need to retrieve a positive context when facing socially stressful situations. Lastly, channel 19 in positioned on the *pars orbitalis* of inferior frontal gyrus, in the BA 47r. Notably, this area, together with the DLPFC and the orbital frontal cortex (OFC) is deputed to ihibition, but neuroimaging in human lesion-mapping support the evidence that this specific function might be imputed to the right IFG alone Aron et al. (2003, 2004). Bringing this evidence to our result, individuals with G/G variation on rs2254298 have higher levels of activation in terms of response inhibition for low levels of parental care, and, conversely, a decrease of oxyHb for high scoring. In this light, the results for rs2254298 seem to support hypothesis 2 that better parenting practices received could lead to modulation of responsivity towards social situations. This difference could potentially start from the initial stage of social information processing. The larger amount of attention allocated to the listening of the social stimulus characterised by individuals with positive early experiences implicates the extent to which socially related information is being processed and ultimately, responded to. Individuals whom experienced positive caregiving as characterised by higher levels of parental care and lower parental overprotection also seems to be more motivated and increased their intentions to act on or neutralise the social stimuli, and held these intentions in search of a possibility for action, or a less inhibition of the response.

4.8.1 Allelic Differences and Response to Social vocalizations

G/G homozygotes were observed to have a progressive decreasing activation in the left hemisphere of aPFC as the perceived Paternal Care levels increase, while listening to woman cry. Although it is possible to find evidence that link this area to working memory and decisional processes (Soon et al., 2008), aPFC is still one of the less understood regions of the human brain (Ramnani and Owen, 2004). It is possible to infer, from this result is that G/G variation is more sensitive to environmental factors, like Paternal Care, compared to A variation, in response to social cues. This is consistent with other evidence in literature, that highlighted the correlation between genetic susceptibility variations, parental bonding and responses to female cry in other polymorphisms (Truzzi et al., 2017, 2018), though they were exploring heart rate variation. Therefore, a plausible explanation could be that G/G homozygotes tend to perceive cries as having less negative emotional valence that does not require large amount

cognitive resources for emotional regulation as compared to A-carriers. Due to the interlaced nature of the aPFC, it might be necessary to implement different approaches in order to give a better interpretation of this outcome.

4.9   Strenght and limitations

The question of nature and nurture in influencing psychological and social processes has been debated over many years, and it has been established that it is insufficient in merely considering the environmental factors. At the receiving end of the parenting practices, a childs characteristic affected partially by biological make-up (e.g. temperament, level of sensitivity to social vocalizations) could affect their response towards the extent of parental bonding experience provided. A strength of this study is represented by the effort made in order to enrich the literature on individual sensitivity to social cues with a further step, combining genetic features, early life experiences as environmental factor and objective neurophysiological measures. In fact, this study utilizes an objective measure of brain activation through the brain imaging tool (fNIRS) to study the impact of perceived parental warmth on individuals social cognitive processes rather than subjective measures such as self-report. This allows for the control of various biases (e.g. social desirability, the lack of awareness of ones actual cognitive process/thoughts) which results to be helpful in describing a more accurate picture of the underlying social cognitive processes. The study does not lack of limitations: first of all, the sample included a smaller number of A-carriers compared to G/G homozygotes in both polymorphisms, despite the efforts in ensuring a reduced gap between the two variations in both SNPs by recruiting as many participant as possible. Notably, power is a major concern in gene-environment interaction studies, that requires a very large sample size, in order to have enough variability. Albeit the significance of correlations with activation in different areas of the prefrontal cortex relating to social information processing, the correlation coefficient is generally a weak to moderate one. While this could be explained by the fact that various parts of the cerebral cortex work together to form a social experience, it could also relate to the fact that little variance of the activation in areas of the prefrontal cortex is being explained through early experience of parental bonding. Therefore, more studies are required to examine the effects and control for variables (e.g. other early experiences) that could potentially affect ones perception of a social behavior. Physiological measures should also be included in future studies to further complete the picture through better inference and cross reference on the nature of the differential brain activations. Another limitation of the study involves the fNIRs instrument. The fNIRs measures brain activity up to 4 cm of the cerebral cortex, which could pose as a limitation for examining social behaviors. Although areas contained in the prefrontal cortex have been proved to be linked to subcortical structures, social behaviors typically involves emotions, which are processed in areas such as the nucleus accumbens and the amygdala, that are

crucial in gaining a better understanding of the nature of interaction and processes involved in perception of social situations.

4.10 Conclusion

In conclusion, the general idea that parental bonding practices influences the social information processing when interacting with environmental susceptibility-related variation of two main SNPs of oxytocin receptor gene was supported. Better parenting practices received could lead to an increase in prefrontal cortex areas relating to responsivity towards social situations, a decrease in response inhibition areas and facilitate the better processing and understanding of the communication of social needs. Moreover, it also increases brain activation in areas relating to ones motivation to act and responding to the needs of social others. In addition, differences between sexes were not explored in this study, due to the gap between males (N= 35) and females (N=67) in the final sample. These differences, together with genetic susceptibility, might exert an effect in the prefrontal cortex activation towards social vocalizations. Generally, the influence of early parental care and overprotection on the prefrontal activation are more pronounced in G/G homozygotes than in A-carriers, for rs2254298. That is, changes in the levels of parental overprotection and care values could lead to significant changes in the individual with G/G variant brain responses to social vocalizations, while there is a relatively constant brain responses in A-carriers. With regards to rs53576 the effects were observed in A-carriers, showing that the direction of the correlation tends to be more related to the social cue than to the parental care or overprotection. This study highlights the importance of fathers contribution towards parenting of the child. While mothers caregiving behaviors are often emphasized and put in the spotlight, this study illustrates the potential effect paternal caregiving behaviors have on their child, especially with regard to the care. Therefore, parenting as an initial learning of how to communicate effectively with others seems to require the involvement of both parents. This study also sheds light into how early parental care and overprotection can go about affecting the process of perceiving social information, supplementing an account to understand the neurological mechanisms behind the negative impact that poor parenting practices have on the outcomes of the child.

CHAPTER 5

Instagram usage and Relational Needs: An Exploratory Study Investigating the Influence of Internal Working Models on Instagram Behaviors

5.1   Introduction

All humans contain biologically driven capacities and desire to participate in social interactions and social bonding (Bowlby, 1969; Trevarthen and Aitken, 2001). Part of an infants instinctive behavior is to constantly seek for proximity, attention, and care from the caregiver. Effects of a good caregiver-infant attachment are paramount. It can moderate the impact of biological and psychological risks on a childs development (Laucht et al., 2001), influence physiological and psychological processes by modulating brain sensitivity to stress and shapes cognitive and socioemotional development which are known to remain relatively stable over an individuals lifetime (Esposito et al., 2017a; Winston and Chicot, 2016). While all areas of development are inextricably connected, socioemotional development is a fundamental aspect to the mastery of all other areas (Foley and Hochman, 2006). The initial ability to understand, communicate, express and regulate emotions is heavily dependent on the experiences of emotional socialization that is obtained through effective interaction with parents and others (Spinrad and Gal, 2018). Notably, the caregiver-child relationship sets the foundation of a childs attachment style and simultaneously form an internal working model (IWM) consisting of generalised beliefs and expectations from others as well as the worthiness of self (Bowlby, 1969). The IWM will then facilitate an individuals expectations in future social relationships and guide social behaviors (Akhtar, 2012). Securely attached individuals construct working models based on warm and sensitive attachment figures. As a result, they tend to maintain a sense of security, positive self-regard and confidence (Mikulincer and Shaver, 2012) and seek to build greater intimacy by utilising proximity-seeking coping strategies in times of distress (Simpson and Rholes, 2012) in future social interactions. Conversely, avoidant individuals with IWM based on a distant and rejecting attachment figure will tend to suppress their negative emotions, inhibit proximity seeking and cope with stress independently.

5.1.1 Main Concepts in Bowlby's Attachment Theory

The primary assumption of attachment theory is that there is a biological predisposition in human species to form close emotional, affectional bonds between an individual and his or her significant other (Green and Scholes, 2003) in the interest of safety and survival (Bowlby, 1969, 1973). According to Bowlby, the innate propensity to engage in attachment behaviors are manifested through seeking behaviors such as physical or psychological proximity to ensure an individuals internal attachment behavioral system is kept under homeostasis. When the child feels the presence of a threat or scenarios that could cause serious distress to him/herself, the so-called "attachment behavioral system" is activated, arousing the infant to actively and instinctively seek for protection provided by an attachment figure. This behavioral system can result in mainly two outcomes: **Secure Attachment.** Attachment behaviors during infancy consist of a set of innate, default strategies (crying, smiling, looking, locomoting) that function together to achieve a specific goal (Shaver and Hazan, 1993) of the caregivers proximity, sense of closeness and support. This is also considered as the primary, secure attachment strategy (Valsiner and Connolly, 2002; Ainsworth, 1978). Theoretically, these secure behaviors denote an evolutionary function of enhancing the chances of survival and hence, activated from a biologically pre-programmed system. From a psychological standpoint, the aim is to reduce levels of fear, anxiety and distress. However, when this set-goal is undermined, the infant starts to show signs of distress and engage in alternative attachment strategies as an attempt to re-establish a close connection with the caregiver. **Insecure Attachment.** The accumulation of adverse experiences in the caregiver- infant attachment relationship will lead to the negative expectations of the caregivers responsiveness and availability. As a result, the infant would have to take refuge in insecure strategies to cope with their attachment need. Research discovered two types of insecure strategies that infants would normally resort to (Ainsworth, 1978). Firstly, anxious/ambivalent attachment styles, where infants are excessively distressed and preoccupied by the attachment need, increasing his or her effort to restore contact with the caregiver. Secondly, avoidant attachment styles, where infants are similarly distressed but choose to avoid, or ignore the attachment figure and display independency to protect themselves from the anticipated painful ramifications (Bowlby, 1973; Dozier and Kobak, 1992). The three types of attachment styles consisting of different set of strategies and expectations are ultimately responsible for the differences we observe amongst individuals. The early experiences with parents are predictive of an individuals long-term developmental outcomes (Sroufe and Jacobvitz, 1989), by shaping the development of personalities, adaptive capacities, vulnerabilities and resistances against potential psychological disorders (Schore, 2015). Furthermore, secure attachment has been found to be highly correlated with emotional regulation, flexible thinking, social adaptation and overall mental health (Sroufe et al., 2005), in which warmth and acceptance of caretakers are the key ingredients for the development of secure attachments (Thompson, 2008). Clearly, the parent-child rela-

tionship plays an important role in serving as a prototype for future relationships of the child, where the child uses his or her experiences as a template to apply to future relationship experiences (Malekpour, 2007). This conceptualization provides the foundation of an internal working model (i.e., underlying beliefs and expectations about an attachment figure) that is formed during infancy and throughout childhood. Collectively, attachment is a powerful predictor of a childs future social and emotional outcome (Benoit, 2004) and the quality of early relationships are predictive of future relationship dynamics in social and intimate settings (Feeney and Noller, 1990; Collins and Read, 1990; Hazan and Shaver, 1987; Kobak and Sceery, 1988; Main et al., 1985). Understanding the mechanisms behind early experiences of a caregiver-infant attachment relationship in a childs social developmental trajectory can help us understand the role of different attachment styles and internal working models play in modulating the childs future social interpretations, expectations and behaviors.

5.1.2 Internal Working Models: a lifespan draft of behavior

As aforementioned, a central topic to the tenet of Bowlbys attachment theory is the concept of internal working models (Bowlby, 1969, 1973): patterns of early interactions with caregiver collectively develop an internal working model (IWM) of attachment, in the form of mental representations consisting of expectations and beliefs about the caregivers availability and responsiveness as well as beliefs about whether the self is deserving of care and attention (Ainsworth, 1978). Working models are also believed to guide how information is processed, the type of information attended to and what information is remembered (Bowlby, 1973). These internal representations of the self and others as a result of early attachment expectations have a profound impact in influencing the way an individual interprets and respond to situations, even when it is not consciously activated (Sroufe, 1997). Individuals who are securely attached builds an IWM based on secure attachment interactions with their caregivers who actively meet their physical and psychological needs. They are more inclined to seek and expect supportive, satisfying encounters with others and they engage in proximity-seeking coping strategies in times of distress (Simpson and Rholes, 2012) in order to achieve the goal of building greater intimacy. In the contrary, individuals who are anxiously attached adopts an insecure working model based on the intermittent, unpredictable care and responsiveness from their caregivers. They tend to exhibit greater negativity and lower level of confidence in themselves (Mikulincer and Shaver, 2012), engage in hyperactivating strategies as means of reducing anxiety. Individuals with an avoidant attachment style similarly build an insecure working model, but based on neglectful, unresponsive and rejecting attachment figures. They tend to believe that they are unworthy of care, suppresses negative emotions, rely on deactivating strategies such as detaching themselves from others and solely rely on themselves to alleviate insecurities or worries. IWMs are developing representations that undergo maturity from vari-

ous experiences in attachment relationships and have formative influence throughout ones life. It affects future relationship functioning as well as ones psychological and physical health(Bowlby, 1973), help to determine future motivations and expectations of future social relationships (Waters et al., 1991), guide emotional regulation and behaviour towards the goal of closeness and security when the attachment system is activated (Bowlby, 1969). The persistence of IWM of self and others contribute to the continuity of attachment, maturing through experiences in romantic and social relationships and become more elaborate with beliefs and expectations extended to include information about the self, such as ones worthiness of love, and information about significant others, such as their availability of love and support (Feeney and Collins, 2015).

5.1.3 Adult Attachment

Several research has demonstrated that there are relative stability and continuity of attachment beginning from childhood and enduring lifelong, progressing across relationships (Waters and Cummings, 2000) and across development (Shaver and Hazan, 1993; Ainsworth, 1989; Waters and Cummings, 2000). The dynamics of adult attachment was first found parallel to caregiver-infant attachment in a study of adult romantic relationships (Shaver and Hazan, 1988). Adopting the three category attachment styles framework (secure, anxious-ambivalent and avoidant) (Ainsworth, 1978), researchers discovered that the differences in early social experiences produce identical enduring variations observed in romantic relationships. They identified similar patterns between the dynamics of these relationships and majority of adults maintained their attachment orientation even during adulthood (Kirkpatrick and Davis, 1994). This further supports that the dynamics of caregiver-infant relationships are fairly stable and governs the way adults function in close relationships. Subsequently, adult romantic relationships were assessed across two broad dimensions, attachment avoidance and attachment anxiety (Brennan et al., 1998; Fraley et al., 2000a; Griffin and Bartholomew, 1994). These measures were then later adapted to assess individual differences in adult attachment (Collins and Read, 1990).

5.1.4 Attachment Avoidance

Firstly, attachment avoidance, suggests the degree to which individuals are comfortable with emotional intimacy and closeness in relationships. In intimate relationships, individuals with higher levels of avoidance often have a negative view towards self and their romantic partner (Bartholomew, 1990). With the belief that others are often rejecting and neglectful, they construct defense mechanisms such as disconnecting socially and become immensely self-protective to minimise any potential negative responses or rejection from others. Avoidant individuals resort to self-reliant ways such as exercising autonomy, independence, and control (Mikulincer, 1998). Ultimately, they regard relationships as secondary and

avoid being involved in intimate relationships.

5.1.5 Attachment Anxiety

Secondly, attachment anxiety, reflects the degree to which individuals are often worried about being abandoned and unappreciated. Individuals with higher levels of anxiety have negative views of others and fragile, conflicting views of self. These negative mental representations may translate into possessive behaviors such as the preoccupation with the responsiveness and availability (Shaver et al., 2005) in fear of abandonment by others, or heightened vigilance of their partners behaviour (Cassidy and Berlin, 1994) and increased dependency (Mikulincer and Shaver, 2007). They adopt hyperactivating coping strategies as a means to increase the sense of felt security (Mikulincer, 1998) and to gain approval from others. Individuals with low levels of both anxiety and avoidance are reflective of attachment security (Fraley et al., 2000a). Individuals who hold a positive, secure view of their parents are also more likely to hold secure views of close friendships and romantic relationships (Furman et al., 2002). As a result of their trust in relationships and high self-confidence, they are able to seek and provide support during stressful and challenging social situations (Collins and Feeney, 2000). Predictably, the same kind of dynamics during infancy play out in adulthood as an individual transfers existing knowledge and mental representations of their significant others to make sense of new social interactions.

5.1.6 Dimensions of Attachment Styles

Attachment styles can be measured and categorised in a handful of manner the three-group (secure, anxious-ambivalent, avoidant), four-group model (secure, preoccupied, dismissing, fearful), or the two-dimension model (attachment anxiety, attachment avoidance) (Bartholomew, 1990; Bartholomew and Horowitz, 1991; Hazan and Shaver, 1987). Central to the conceptualisations of adult attachment lies in the internal working models (IWMs) of self and others, acquired in early childhood and believed to guide subsequent social behaviors (Feeney et al., 1994a). In other words, there are key underlying psychological mechanisms that are embodied in the IWM of each attachment styles (Feeney et al., 1994a; Bartholomew and Horowitz, 1991) in guiding our social behaviors. To elucidate, Figure 5.1 highlights the various underlying dimensions of attachment styles that has been identified as important features across infant attachment research and category models of adult attachment.

5.2 Social Network Sites and Attachment Style

As humans are indeed social animals, people constantly act in ways that will elicit contact and connection from people around them (Flynn et al., 2018), in varying behaviors based on the attachment experiences they individually encountered. In the actual global world, social connections surpass the physical
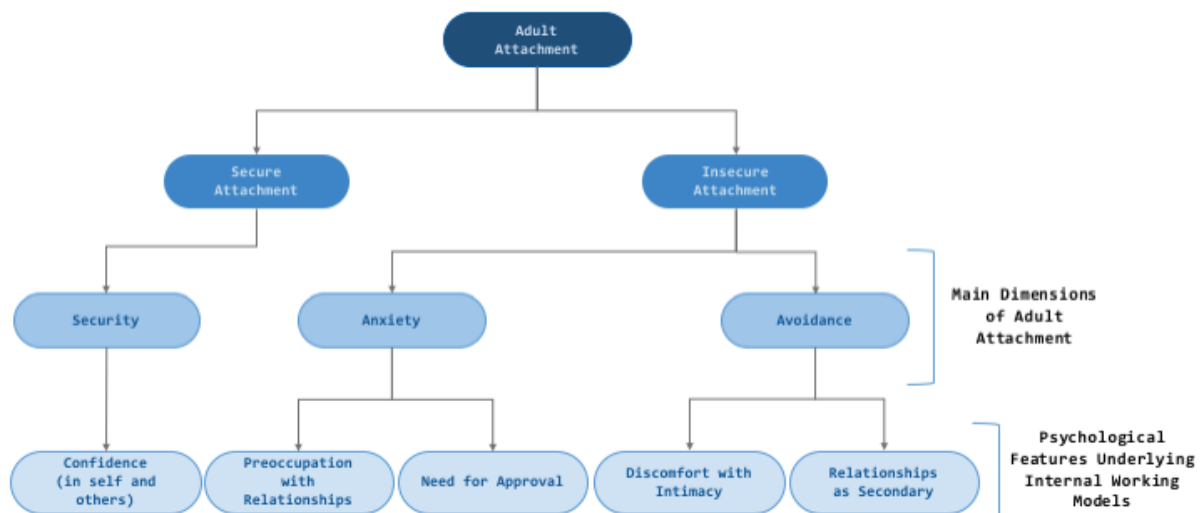
Fig. 5.1 Main dimensions of adult attachment style and related psychological mechanisms

world that were constantly engaged in, towards the digital world where social networking sites are being embraced by a large and diverse network of people. Different forms of media are playing an increasingly prominent role amongst an increasing number of adults across the lifespan (Duggan et al., 2015). Social network sites such as, Facebook, Instagram, Twitter, LinkedIn, and YouTube are a dynamic online sociocultural platform that provides users with plentiful and unprecedented opportunities for self-identity and to forge relationships with people all over the world (Nadkarni and Hofmann, 2012). One can easily expand or maintain his or her social network with the functions (posts, individualised captions, pokes, etc.) provided by online interaction mediums. There are also positive psychological outcomes such as an increasing sense of belonging amongst adults (Sheldon et al., 2011; Ellison et al., 2007), enhanced self-esteem (Gonzales and Hancock, 2011), self-expression (Livingstone, 2008), increased social capital (Ellison et al., 2007) and cognitive benefits that are related to ones executive functioning (Myhre et al., 2017) from engaging in social media. However, social media mediums could also lead to negative psychological issues such as increased loneliness (Ryan and Xenos, 2011), anxiety issues (Acar, 2008; Pierce, 2009) and a decreased self-esteem (Forest and Wood, 2012) when misused. There is a considerable amount of research that demonstrated the relationship between social networking sites and attachment styles(Chen et al., 2019; Oldmeadow et al., 2013). Notably, attachment styles were discovered to be associated with Facebook engagement (Hart et al., 2015), addiction (Eroglu, 2015; Monacis et al., 2017), negative emotions encountered (Oldmeadow et al., 2013) and the propensity of jealousy felt (Marshall et al., 2013). Overall, findings supported the role of attachment styles in modulating online social media usage (Buote et al., 2009), although most of the research focused on Facebook, it is certain that several characteristics of social mediums could appeal to individuals with different attachment styles. For instance, offline interactions provide the competency of maintaining relationships in a virtual world where individuals with anxiety attachment orientation might often struggle with. Additionally, a

virtual interaction environment would also appeal to individuals with attachment avoidant who prefers to maintain relationships in a safe physical proximity and facilitate interactions by allowing users to control the pace and time to engage in online social interactions at their convenience and preferences. A further important but understudied element is the relationship between attachment styles and other increasingly popular social media platforms that may provide technology attributes that appeal to different users. As aforementioned, the majority of research focused on the association between attachment styles and Facebook. Although this is an undoubtedly popular SNS supported by billions of active users, it may not be a solid representative of ones online social behavior in different cultures and age groups. This limits the possibility to generalize previous findings. Another prominent phenomenon in the social media market is the growth of Instagram, an increasingly popular mobile phone-based photo and video sharing application. Instagram allows user to express themselves, actively interact and connect with others by sharing information of their daily lives, record daily events and keep involved with what others are doing (Phua et al., 2017; Lee et al., 2015). Currently, there are more than 1 billion active users per month, with about 60% of Instagram users around the world logging in and uploading 95million pictures and videos on an average day (Parker, 2016). Most of the users are between 18 and 34 years old (updated to July 2019, source Statista.com see Figure 5.2 below)
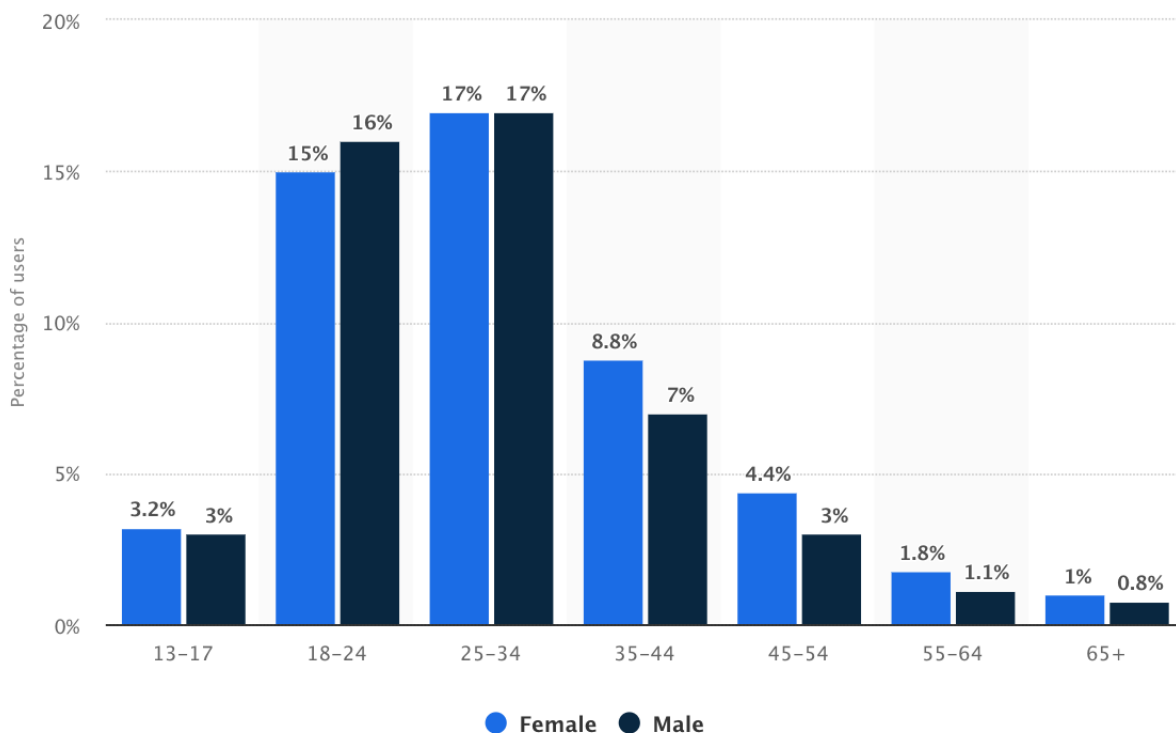
Fig. 5.2 Distribution of Instagram users worldwide as of July 2019, by age and gender

Notably, in two studies that investigated the motivations and the gratifications behind Instagram usage, findings showed that Instagram was used mainly to show affection and demonstrate sociability

(Phua et al., 2017), while some of the primary motivations for most users were (1) seeking out social relationships with people who share similar interests (social interaction, attachment needs), (2) self-expression and, (3) escapism (Lee et al., 2015). Clearly, Instagram is a platform that could potentially provide greater insights into the relationship between social media and attachment styles, as well as predicting patterns of social media engagement. The current study aims to bridge the gap in the literature demonstrating the patterns of Instagram usage by utilizing the framework of attachment styles, to explain potential drivers of the variations we observe on online social engagement and identify key underlying psychological mechanisms of attachment styles that drives certain social behavioral tendency.

5.3 Research Question and Hypotheses

Given that empirical literature supports the hypothesis that attachment styles formed in childhood governs the way an individual perceives social relationships and determine future social behavioral tendencies on Facebook, it would be relevant to examine whether the same pattern would be extendable to another popular online platform. Another concern is the contribution of specific SNSs features in social media engagement. Moreover, it would be far-reaching to identify the psychological mechanisms of adult attachment that could explain patterns of social media usage. The current study considers other popular social media channels, specifically Instagram, amongst young adults in Singapore and investigates the potential interplay between the development of an individuals attachment style, along with interpersonal experiences in modulating online social performances. Based on the view that social media networks are capable of providing a sense of closeness or belonging that could satisfy the need for attachment the following hypothesis was formulated:

- **Hypothesis 1:** Attachment styles influence the variance in the intensity of Instagram usage. There will be a positive correlation between individuals with greater attachment anxiety and the intensity usage of Instagram. There will be a negative correlation between individuals with attachment avoidance and the intensity of Instagram usage.

- **Hypothesis :** The variance in online engagement and self-disclosure is explained by specific underlying mechanisms of attachment styles.

Specifically, attachment anxiety individuals with an elevated fear of abandonment and jealousy would explain the greater online engagement and online self-disclosure as they seek greater validation and concern for evaluation. This can be similarly reflected in greater emotional expressivity and sensitivity, signified by a greater number of posts on Instagram. Conversely, attachment avoidance individuals with a greater tendency to avoid intimacy and are highly self-reliant would explain the lesser

online engagement and online self-disclosure as they seek lesser validation, exhibiting increased autonomy and anonymity. This would be reflected in decreased social disclosure and sensitivity with lesser number of posts on Instagram.

5.4 Experimental Design, Materials and Methods

5.4.1 Participants

One hundred ninety-three participants (N = 193) consisting of 126 females (M_{age_F}= 21.52, SD_{age_F} =1.69) and 67 males (M_{age_M}= 21.54, SD_{age_M} =1.59) were recruited via the undergraduate research participation pool from the Nanyang Technological University of Singapore (NTU). To ensure privacy of participants, all data were collected using an alphanumeric code to render the identity anonymous. Participants informed consent was obtained prior to the commencement of the study and all responses were kept strictly confidential. The method and procedure for this study have been approved by the ethics committee of NTU Institutional Review Board.

5.4.2 Materials

The instruments used in this study included two measures: (1) First is to assess individual differences in the psychometric properties that constitutes to an internal working model, specifically on ones view of others and self, and (2) the second is to measure the avoidance and anxiety levels of romantic relationships. Instagram behaviors that were identified in this study was detected through the three public interaction indexes – posts, followers and following users – from the participants profile. A complete copy of the questionnaires, including the measures described below, is included in Appendix A.

Individual Attachment Style. To assess individual differences in adult attachment, the Attachment Style Questionnaire (ASQ; (Feeney et al., 1994b), a 40-item self-report questionnaire was utilized. ASQ was developed to capture the conceptual domain of attachment by Bowlby and Ainsworth (Bowlby, 1969; Ainsworth, 1978) while taking into consideration general relationships, instead of romantic or close relationships in which other adult-attachment questionnaires tended to focus on. The scale measures five dimensions that have been identified to be important features in infant attachment research and category models of adult attachment (see Figure 5.1). Confidence (8 items), Fear of Intimacy (10 items), Need for Approval (7 items), Relationships as Secondary (7 items) and Preoccupation with Relationships (8 items). Each item was being rated on a 6-point scale ranging from: 1 (Totally disagree) to 6 (Totally agree). ASQ displayed good internal consistency in numerous studies (Meredith et al., 2007, 2006; Mikulincer and Shaver, 2007; Alexander et al., 2001) and proven test-retest stability over a 10-week interval (Feeney et al., 1994b). In this study, the Cronbach α coefficients for the five subscales

ranged from .75 to .81, suggesting an acceptable internal consistency.

Experience in Close Relationships. In order to evaluate anxiety and avoidance level in romantic relationships, a revised form of Experience in Close Relationships-Revised (ECR-R; (Fraley et al., 2000b)) was employed. The 36-item self-report questionnaire assesses two major dimensions of an individuals attachment status (anxiety and avoidance) in a sentimental relationship. Both the anxiety and avoidance subscale consisted of 18 items each, rated on a 7-point Likert scale ranging from: 1 (Strongly disagree) to 7 (Strongly agree). The anxiety dimension measures attachment-related anxiety that can be portrayed as insecurity, jealousy and fear of abandonment (i.e. *I often worry that my partner doesnt really love me*) as opposed to feeling secure about availability and responsiveness of romantic partners. The avoidance dimension measures attachment-related avoidance that can be presented as feeling uncomfortable being close to others and tendency to refrain from attachment. The validity of ECR-R has been demonstrated in several studies that included experimental manipulations and behavioral observations, reflecting high internal consistency and high test-retest reliability (Sibley and Liu, 2004; Sibley et al., 2005; Fraley et al., 2000b). Instead of assigning participants to an attachment style category, this scale captures two separate dimension scores for each participant. Hence, it is an appropriate measure for assessing relationships that are directly proportional, specifically between attachment dimensions and social media behaviors (Oldmeadow et al., 2013). In the current study, Cronbachs α for the anxiety and avoidance subscales were .93 and .94 respectively, and the correlation between the two was 0.44 (p <.001). For an overview of the correlation between subscales, please refer to Table 5.1.

Online Social Behaviors. The difference amongst individuals online social performances was conceptualized as the various user engagement behaviors on Instagram. Participants provided the Uniform Resource Locator (URL) of their Instagram profiles in the questionnaire on Qualtrics. The study takes on an exploratory approach and focuses on three public interaction indexes, namely the number of posts they uploaded, number of followers, and number of following as Instagram usage and engagement variables. Information obtained was all public and extracted with an algorithm created in a Python environment. Nevertheless, these social interaction indexes were found to be similar from prior literature on the Internet and empirical research (Lee et al., 2015; Oldmeadow et al., 2013) that often relied on self-report measures for engagement information and will provide useful insights on the engagement level and self-disclosure of Instagram users. For instance, the greater number of followers, following and posts could imply greater involvement on Instagram to avoid loneliness, or to be noticed by others.

5.4.3   Procedure

The current study focused on the environmental factors (specifically, individual attachment and other social relationships experiences and perceptions) that modulates social performances. Upon sign up, an

	Age	Instagram posts	Instagram followers	Instagram following	Confidence	Discomfort with Intimacy	Relationships as Secondary	Need for Approval	Worry about Relationships	Anxiety	Avoidance
Age	1.0000										
Instagram posts	0.0298	1.0000									
Instagram followers	0.0609	0.1494*	1.0000								
Instagram following	0.0632	0.2281**	0.4384***	1.0000							
Confidence	0.2296**	0.1357	0.0632	0.2445***	1.0000						
Discomfort with Intimacy	0.0149	-0.1127	-0.0168	-0.0979	-0.4135***	1.0000					
Relationships as Secondary	0.1459*	-0.1302	0.0325	-0.1192	-0.2015**	0.5377	1.0000				
Need for Approval	-0.1812*	-0.0091	0.0754	-0.0173	-0.3198***	0.4406***	0.2532***	1.0000			
Worry about Relationships	-0.1252	0.0670	0.0676	-0.0054	-0.3491***	0.3323***	0.1727*	0.6498***	1.0000		
Anxiety	-0.0435	0.0138	0.0120	-0.0466	-0.2841***	0.2420***	0.1413	0.4032***	0.5240***	1.0000	
Avoidance	0.0544	-0.1693	-0.1881**	-0.1589*	-0.2768***	0.3348***	0.3191***	0.1691*	0.0174	0.3714***	1.0000

Table 5.1 Correlation coefficients among the Instagram metrics and psychological dimensions of attachment.
Levels of significance * $<.05$; ** $<.01$; *** $<.001$

instruction email was sent to each participant with the accompanying links to the various surveys hosted by an online survey platform called Qualtrics. The first session required all participants to complete an informed consent approved by the authors university's Internal Review Board (IRB) before completing the questionnaires for the study. The questionnaires provided in the email were listed in the following order: 1) ASQ; to assess essential dimensions of adult attachment and its differences among patterns, 2) ECR-R; to evaluate anxiety and avoidance levels in romantic relationships, and 3) Social Media URLs; to retrieve information on participants social behaviors in the digital world. The first two questionnaires were supplemented with demographic information that were relevant for the study (e.g. gender, age, education status, and ethnicity) as the starting questions of the online questionnaire. To prevent any missing data, all participants were required to answer each question on the survey.

5.4.4 Data Analytic Plan

Exploratory analyses using the statistical software R-studio (ver. 1.1.383) on the predictive value of the specific constructs of attachment styles on individuals Instagram behaviors followed two main paths: (1) General Linear Models (GLM) to tests explanatory variables of the attachment style and (2) Tree-Based Models to identify which particular constructs of attachment style and socio-demographic characteristic(s) of the participants (Sex and Age) were operative. Key dimensions of ASQ were categorized to the three attachment styles (secure, anxiety and avoidance) to facilitate interpretation.

5.4.5 Preliminary Analysis

Prior to data analysis, all the subscales of the questionnaires were controlled for normality by checking skewness values [-0.3303 ; 0.7907] and correlations among the subscales were calculated using the Pearson Product- Moment Correlation Coefficient, together with Instragram interaction metrics (SEE

TABLE 2). No significant correlation was found except for a small correlation between the attachment dimension confidence with Instagram followers (r = .22, p = .03), and following (r = .13, p = .20), with higher levels of confidence being associated with higher numbers of Instagram followers and following. Notably, attachment avoidance was correlated negatively with Instagram followers, following and posts, ranging from r = - .06 to -.19, with higher attachment avoidance being associated with lower numbers of Instagram followers, following and posts.

5.4.6 Generalized Linear Models to Investigate Determining Factors of Instagram Behaviors

Three General Linear Models (GLM) was performed with the Instagram behaviors index score as the dependent variable. Index score for Instagram behaviors was calculated as the mean z-score of all possible social media interaction metrics (Instagram followers, following and number of posts). To test independent explanatory variables, three different models that assumed certain conditions of the attachment style constructs and sociodemographic characteristics (Gender and Age) was derived. The following shows a breakdown of the model conditions:

- Model 1: Instagram Behaviors ∼ Attachment Style Questionnaire Subscales (Confidence, Discomfort with Intimacy, Viewing Relationships as Secondary, Need for Approval, Worry about Relationships) + Age + Sex

- Model 2: Instagram Behaviors ∼ Experiences in Close Relationships Subscales (Anxiety, Avoidance) + Age + Sex

- Model 3: Instagram Behaviors ∼ Attachment Style Questionnaire Subscales + Experiences in Close Relationships Subscales + Age + Sex

While no significant effect of sex nor of age was found in the models, Confidence was found to be significantly correlated to the number of the profiles followed by the participants (*Following*) in Model 1 (estimate = 19.257, p = 0.00156) and in Model 3 (estimate = 17.8606, p = 0.00414). As for ECR constructs, Avoidance had a significant negative effect for all the Instagram metrics in Model 2 (estimate = -49.8070, p = 0.00576) and for number of followers in in Model 3 (estimate = -140.890, p = 0.00445).

5.4.7 Tree Based Models to Identify Predictors of Instagram Behaviors

To determine which among the attachment style dimensions and sociodemographic characteristics (Sex and Age) were indicative in predicting Instagram engagement behaviors, recursive partitioning schemes (RPS), specifically regression tree models (Costello et al., 2003; Esposito et al., 2015) was employed. Regression trees are methods of multivariate data exploration that are conceptually simple to understand and provide visually pleasing representations of complex dataset. They are associated with recursive

partitioning schemes that explores the entire structure of a dataset while developing easy-to-visualize decision rules of splitting the data and producing a graphical output (regression tree) ranking variables by statistical importance. The main characteristics of regression trees are the feature space (space that all predictor variables occupy) that is subsequently recursively partitioned into another set of area such that observations with similar response values are grouped together. The regression tree model involves two progressive steps: (1) *growing*, to explore relations among variables and building the tree, and (2) *pruning*, to optimize decision tree performance and avoid overfitting the data by eliminating branches that do not add to the prediction accuracy in cross-validation. Tree based models provide information on the important independent variables in explaining the distribution of the data points of the response variable in a hierarchical manner. The model begins by exploring all the potential relations among the variables and identifying the most influential independent variable relative to the response variable, defining it as the Root Node. Subsequently, it evaluates which values of the independent variables stratify the dependent variable in sample pairs that differ statistically (Esposito et al., 2015). Essentially, in each node, the variable that is most strongly associated with the response variable is selected for the splitting process of dividing the node further into two or more sub-nodes, producing a Decision Node and nodes that do not split are called Leaf/ Terminal Node. Using the *r-part* and *r-partplot* packages for the statistical software R-studio (ver. 1.1.383) (Milborrow, 2016), the set of parameters used for the splits was: (a) A node must have at least 30 data-point pairs to be considered for a split, and (b) the minimum number of data point pairs for each terminal node was set at 15. To allow the tree to grow to it full size, complexity parameter was set equal to zero and the tree was pruned to remove branches containing nodes with t-values greater than 1.64 (α = .05)(Esposito et al., 2015).

5.5   Results

Tree models provide a top-down hierarchy of the importance of independent variables in explaining dependent variables. Below are the three optimal trees that predict the distribution from the lower values (left) to the higher (right) of different Instagram metrics (considered as engagement behaviors), that represent the dependent variable . The explanatory variables included all attachment style dimensions under the Attachment Style Questionnaire, Experiences in Close Relationships Questionnaire as well as the sex and age of the participants. In each figure (see Figures 5.3, 5.4 and 5.5), the bottom rectangle shows the distribution of a dependent variable (e.g., Instagram posts) from least (left) to most (right). The values within the root and decision nodes (ovals) of the tree refers to the condition of the independent variable that statistically divides the distribution of the dependent variable. The lines directing the path beginning from the root node indicating 'yes' or 'no' refer to whether or not the condition is met. Each leaf is then divided into sub-leaves (decision nodes). The terminal leaves represent the final state of the

subgroups that cannot be further subdivided. In each of the quadrangles, the reported value represents the size of the group, and the percentage compared to the initial sample size.

5.6 Discussion

The purpose of this study is to explore the contribution of different attachment styles in the different patterns of online social behaviors. Different attachment styles govern the way an individual perceives future social relationships while determining social behavioral tendencies in both offline and online interactions. It has been suggested that attachment styles are associated with online social media engagement (Hart et al., 2015), addiction (Eroglu, 2015; Monacis et al., 2017) as well as an individuals overall well- being (Casale et al., 2015). Majority of studies that focused on Facebook consistently reported that anxiety attachment styles were associated with greater social media usage, while avoidant attachment styles would determine lesser social media usage. In line with the literature of attachment styles and social media behavior relationship, we had two main aims for this study: (a) to analyze whether previous findings of attachment styles and social media usage were comparable to Instagram usage, and (b) to explore specific underlying dimensions of attachment styles that were responsible in predicting different Instagram behaviors (online engagement and self-disclosure).

5.6.1 Attachment Styles and Intensity of Instagram Usage

In general, present findings from the tree-based models supported the first hypothesis. Findings revealed that greater Instagram usage (defined as greater number posts, followers and following) was predicted by lower levels of attachment avoidance and anxiety related dimensions, especially *Worry about Relationships*. Consistent with previous literature (Buote et al., 2009; Chen et al., 2019; Oldmeadow et al., 2013), the fear of abandonment, rejection (Brennan et al., 1998) and preoccupation with relationships prolong even in adulthood among individuals who are anxiously attached. As means of alleviating their anxieties and worries of being left alone, they tend to spend more time on social media sites, such as posting more amount of photos (Oldmeadow et al., 2013), finding more friends by increasing their number of followers and following in order to establish social relationships and thereby satisfying their social and attention needs (Hart et al., 2015). Lesser Instagram usage was predicted by greater attachment avoidance and characteristics of insecure attachment styles (lack of confidence in self and lack of trust in others). Theoretically consistent with the attachment theory, avoidant individuals are known to exhibit hesitance to become intimate or close with others (Brennan et al., 1998). As a result, they were expected to be disengaged from using Instagram (Hart et al., 2015), maintain a safe distance from relationships in both online and offline settings as well as interactions that would involve discussing emotions, thereby explaining lesser amount of Instagram posts, followers and following. Taken together, both attachment

anxiety and avoidance predicted the variance in the intensity of Instagram usage we observed in this study, which was consistent with previous literature. We also found *Confidence* to be an impactful predictor across the three metrics, with lower levels linked to less engagement. Clearly, this suggests that there is a connection between attachment styles and the way people behave in online social interactions.

5.6.2 Underlying Dimensions of Attachment Styles and Instagram Behaviors

For the second hypothesis, a handful of underlying dimensions of attachment styles were identified to be strong influential features of explaining the quantity of Instagram posts, followers and following(s).

Instagram Posts. As expected, the underlying dimensions that were strongly predictive of greater number of Instagram posts were the greater preoccupation with relationships and need for approval, both of which are under the dimensions of anxiety attachment. Regression tree is reported in Figure 5.3. As predicted, both lower levels of *Avoidance* and greater scoring for *Anxiety* suggested greater number of Instagram posts, together with lower *Discomfort with Intimacy*. Intuitively, this pattern describes that less avoidant individuals would be driven to actively engage in online social interactions and exhibit greater tendency for self-disclosure through posting more photos to get the attention they might be yearning for. As we did not find any effect for *Need for Approval*, a possible explanation could be the conflicting drives in times of distress, triggering heightened concern of criticism or opinions by others (Park et al., 2004; Srivastava and Beer, 2005; Hart et al., 2015) and an increased social sensitivity as well as negative feelings (Oldmeadow et al., 2013) that could potentially occur from the negative feedback in the form of likes and comments from posting photos on Instagram. Anxiously attached individuals are known to express greater sensitivity to social feedback and expected to engage actively on Instagram in desire of positive feedback (Shaver et al., 2005). However, the lack of likes or undesirable comments might reflect their unpopularity and incompetence, causing them to shun away from engagement and self-disclosure behaviors, despite the desire for acceptance being rooted amongst anxiously attached individuals. Ultimately, either *Sex* either *Age* seem to operating in picture posting behavior, with females older than 22 showing a tendency to share more contents (in terms of photos) compared to male with less than 22. This might reflect psychological mechanisms, like self-confidence, related to age. As for *Sex*, results might not be fully reliable as the number of male and females in the sample was not equal. Additionally, we also found that in more conventional methodological approach, like Generalized Linear Model, in predicting Instagram number of post, the variables *Sex* and *Age* were found not to be a significant predictor. However, in a stratified distribution approach, both of the variables appeared to be predictive of Instagram posts. This could reflect that differences in methodology, like using a stratified and recursive sampling methodology, may have better captured the key features (Ye et al., 2013) of the population being studied and provide supplementary findings that yield greater informative traits.
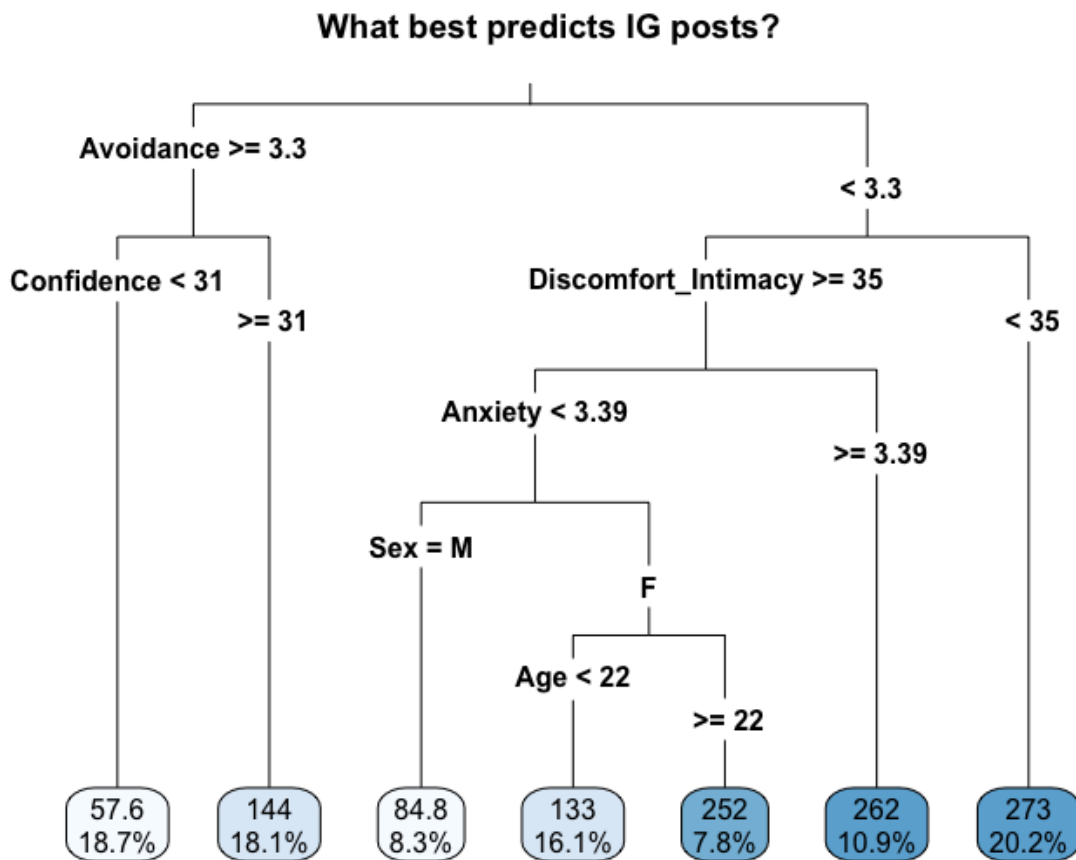
Fig. 5.3 Regression tree for psychological mechanisms describing number of posts on Instagram

Instagram Followers. Similarly to the number of posts, the underlying dimensions that were discovered to be predictive of greater number of Instagram followers included low levels of *Avoidance*, together with greater *Confidence* a greater *Need for Approval*. As show in regression tree plot (Figure 5.4), two of this dimensions can be identified as part of the anxiety attachment, while *Confidence* is related to a more secure pattern. We expected individuals with avoidance associated features to have a lesser amount of Instagram followers as they perceive relationships as superficial or of little value and generally often uncomfortable with closeness (Peterson, 2001) and, would exhibit resistance towards the idea of establishing relationships or engaging in situations that involves self-disclosure. Results showed that besides the need to get other people's approval, *Worry about Relationships* predicts a greater amount of Instagram followers. This implies that allowing people to see personal contents, such as pictures and videos, can pursue as a sort of expedient to be connected to people. This would allow Instagram "friends" to get access to shared materials and to leave feedback, such as "like" or comments, satisfying, in return, that demand for consent.
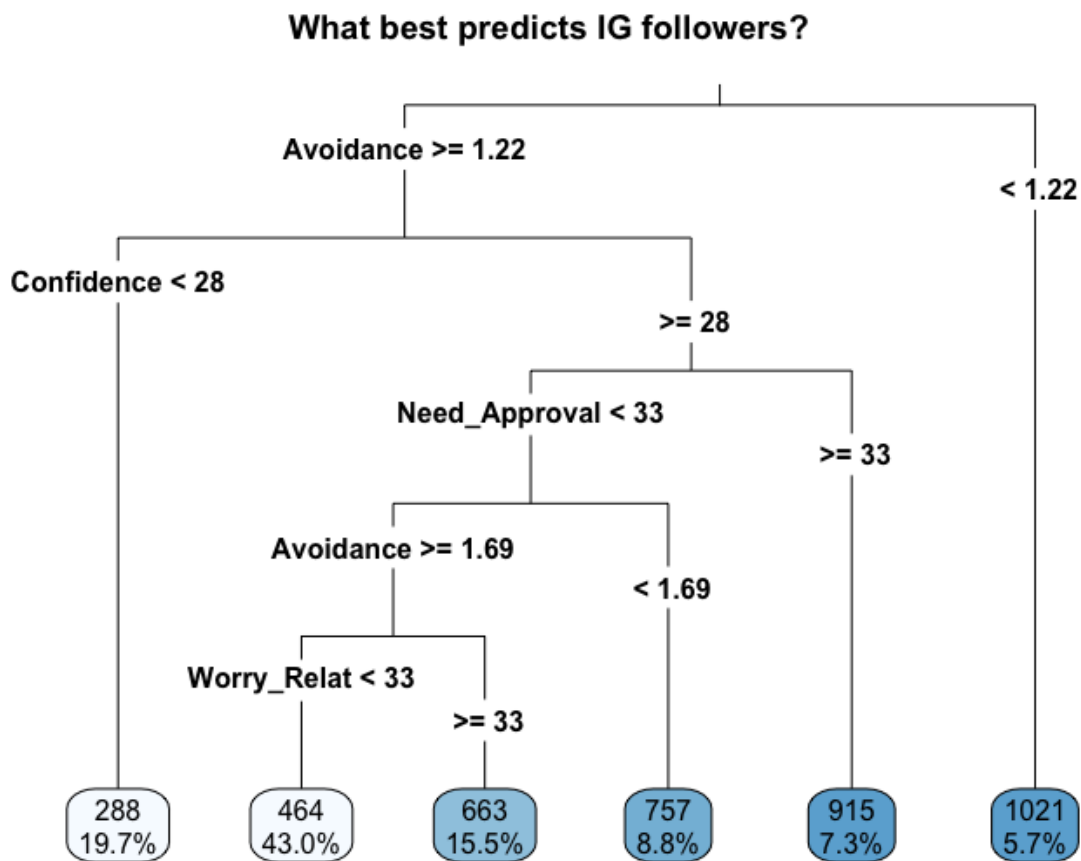
Fig. 5.4 Regression tree for psychological mechanisms describing number of followers on Instagram

Instagram Following. With regards to the number of profiles followed by Instagram users in our sample, higher levels of *Confidence*, high scoring for *Worry about Relationships*, and lower attachment *Anxiety* appear to play a major role in describing the influence of psychological mechanisms over this specific behavior. Regression tree with results is presented in Figure 5.5. Arguably, research highlighted that many individuals tend to engage in para-social relationships with celebrities with the most followed users being pop stars (Lee et al., 2015). This implies that the number of followed account might not necessarily be associated to the individual's perception of relationships (Stapleton et al., 2017). Rather, the profiles that a user chooses to follow might more be pertinent to the sharing of similar interests, or simply be account of people they are fond of (Lee et al., 2015). Individuals with higher levels of attachment avoidance, who might struggle with social interactions in the physical social world and look for avenues to compensate potential feelings of loneliness or social exclusion, might benefit from this type of social engagement.

What best predicts IG following?
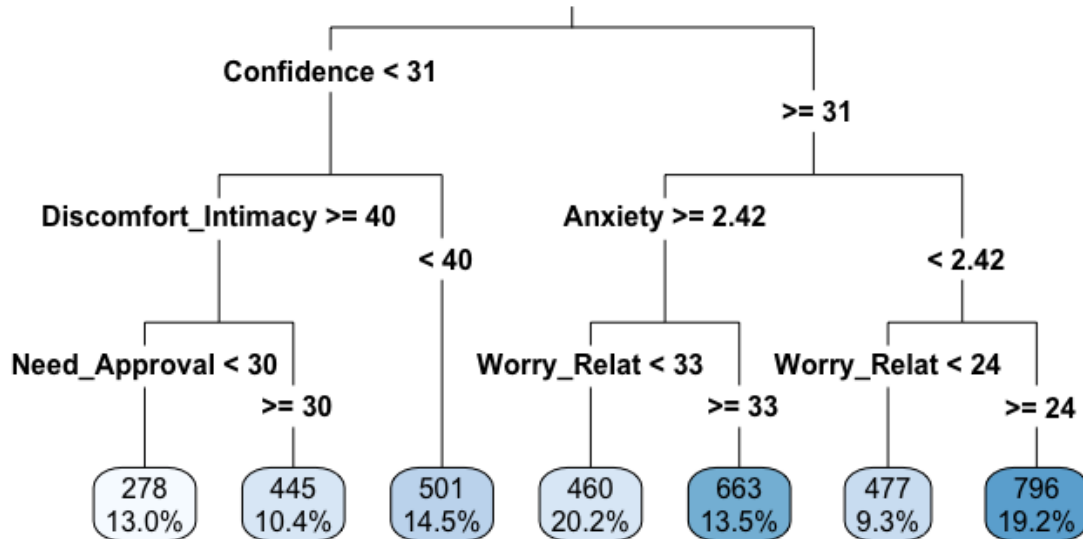
Fig. 5.5 Regression tree for psychological mechanisms describing number of followers on Instagram

5.7 Conclusion

Overall, this exploratory study provided several insights and contributes to the literature in the field of attachment styles and social media usage particularly in the identification of specific underlying psychological mechanisms of attachment styles that are responsible in modulating online social performances. Instead of using broad terms that denote attachment anxiety or attachment avoidance, which majority of previous studies highlighted, we found that there are specific relational dimensions or features of attachment styles that online users are subconsciously seeking to satisfy when engaging in social media, thereby predicting and explaining the differences we observe in online behaviors. The degree of an individuals need for approval by others appeared to be consistently predictive of all three interaction metrics. In the social world, being recognized by the others, by gaining their social acceptance and approval, can be a powerful force in propelling an individual to behave in manners that is part of the social norm (Matsuba, 2006), especially in a culture that values relationships with members of other groups and stresses on conformity. Therefore, it is important to note that cultural differences can facilitate an individuals expectations and values, resulting in different social behavioural tendencies. Future

research could determine whether the current social network analysis remains the same with the proposed attachment framework and persists across different cultures such as individualistic cultures, in which social behaviors tend to be dictated by individuals personal attitudes and preferences. Inevitably, our findings should be considered in light of several limitations. In terms of methodology, participants Instagram logs (posts, followers, following) were taken into account since the creation of their Instagram account, excluding a longitudinal follow up about how the trends, in term of number of posts and visibility, change in time. While there is a degree of stability and continuity of attachment across the developmental trajectory, we should consider external situational forces that could influence individuals to engage in spontaneous social behavioral performances that might not necessarily be a true indication of ones attachment styles. To elucidate, amongst the entire population of participants, more than half were in their first year of education. Regardless of their attachment styles, it could have been possible that the transition to a new phase of life enforces the need to engage in online social interactions to boost their involvement with others. Furthermore, the sample in this study were mostly young students and may not the most accurate representation of Singapore national population and findings could limit the possibility to generalize results to other countries. Future research could consider limiting the analysis of interaction metrics ranging from a year to 6 months and include other quantitative and qualitative interaction metrics (e.g., average number of likes or comments per post and type of posts). Most notably, the questionnaires used in this study to measure individuals attachment styles were predominantly formulated based on real-world social settings and not calibrated for online social interactions, suggesting that the outcome measures may not accurately be a good representation of ones attitude towards online relationships and ultimately, online social behaviors. Further research could consider adapting an attachment style questionnaire that strictly measures the attitude towards online social relationships and social media platforms. Further studies should include more variables to the investigation of SNSs usage, like information about genetic susceptibility and early life experiences, which interaction have been shown to modulate the propensity to develop psychological distress up to psychiatric disorder (for a review, see (Cataldo et al., 2018b). A deeper understanding of the concomitant mechanisms that lie behind an inappropriate employment of social media platforms could represent a relevant support in clinical work, especially with regards to self-esteem related issues. A study by Steinfield and colleagues reports that a proper usage of Facebook could help people with low levels of self-esteem to bridge social capital (Steinfield et al., 2008), improving in return the general well-being.

Conclusions

In the last decades lots of research has been done in the field of social behavior, within the gene-by-environment interaction frame. Together with the development of better technologies, it has been feasible to investigate human behavior; thanks to new approaches in genetics and neuroimaging, evidence reports the activation of targeted brain regions in response to social cues, and the involvement of detailed genes or polymorphisms in the modulation of physiological feedback during stressful social tasks. However, the concept of social behavior itself has gone through deep changes as social media platform provided parallel opportunity for social interactions. Some endeavours have been done in aiming to detect personality traits, risk for psychopathology and the usage of internet based social networks, but differences and similarities between online and offline social behavior are still poorly explored. The main objective of my experimental activities was to deepen the two sides - "online" and "offline" - of social behavior and relationships, by integrating methodologies from genetics, psychology, neuroimaging and social media sites. The present work has several strengths: in first experimental study supported the assumption that the perception of early interactions with primary caregivers affect the development of psychological mechanisms underling social relationships in adulthood, hence, as indirect effect, the levels of anxiety and avoidance experienced in closeness. The first study also endorses the hypothesis that the formation of attachment bonding is comparable in different countries. The possibility to compare diverse countries, including both caregivers, is very helpful to better comprehend how and which environmental components contribute to the adjustment of interactional dynamics that affect social behavior. The second study implements two further approaches, genetic and neurophysiology, to explore to which extent the interaction between two specific variations of oxytocin receptor gene and recalled parental bonding affects the neural responses to stressful social cues. Findings suggest that a higher genetic sensitivity to external context and positive perceived parental bonding result in a more optimal neural activation in response to different kind of cry. Conversely, form a lower sensitivity does not follow a significant variation in neural responses, regardless of the parental bonding. Although genetic methodology requires large sample sizes, the present work provided a valuable starting point toward a deeper understanding of the effects of perceived parental care and modulation by genetics. The third study utilized the main indexes of Instagram profiles to describe which of the social media features better describes psychological mechanisms underneath virtual relations and adult attachment, in terms of

anxiety and avoidance. The models in output highlights a trend of greater information sharing and accessibility for higher levels of anxiety and a tendency to self-closure for higher levels of avoidance and avoidant-related interactional features. Considering all the results together, it appears necessary to keep integrating different methodologies, such as different physiological assessment, verging on the analysis of human social behavior, which should include more online interaction. Moreover, further research about human behavior should focus on the potential role of social media sites not only to better understand interaction modalities, but also to deepen their a potential function in interventions. By drawing a more complete picture of the status of a person's social interaction strategies, responses and of the single elements that contributed to the development of the actual online and offline relationships, it would be possible for practitioners to improve protocol in clinical work, by providing more customized services.

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1. Bonassi, Andrea; **Cataldo, Ilaria**; Gabrieli, Giulio; Foo, Jia Nee; Lepri, Bruno; and Esposito, Gianluca, "Oxytocin Receptor Gene Polymorphism and Early Parental Bonding Interact in Shaping Instagram Social Behaviour" in Plos ONE *(submitted)*.

2. **Cataldo, Ilaria**; Lepri, Bruno; Neoh, Michelle; and Esposito, Gianluca, "Social Media Usage and Development of Psychiatric Disorders in Childhood and Adolescence" in FRONTIERS IN PSYCHOLOGY *(submitted)*.

3. **Cataldo, Ilaria**; Neoh, Michelle; Chew, Wei Fang; Foo, Jia Nee; Lepri, Bruno; and Esposito, Gianluca, "Oxytocin receptor gene polymorphisms and recalled parental bonding modulate responses to social stressors in the prefrontal cortex: a Near InfraRed Spectroscopy Study" in NATURE SCIENTIFIC REPORT *(submitted)*.

4. Senese, Vincenzo Paolo; Azhari, Atiqah; **Cataldo, Ilaria**, "A Multisystem Psycho-Biological Approach to the Understanding of Parental Dispositions" in PARENTING, SCIENCE AND PRACTICE, v. 19, n. 1-2 (2019), p. 164-167.
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6. **Cataldo, Ilaria**; Azhari, Atiqah; Esposito, Gianluca, "A review of Oxytocin and arginine-vasopressine receptors and their modulation of autism spectrum disorder." in FRONTIERS IN MOLECULAR NEUROSCIENCE, n.s., v. 2018, (2018).

7. Bonassi, Andrea; Ghilardi, Tommaso; Truzzi, Anna; **Cataldo, Ilaria**; Azhari, Atiqah; Setoh, Peipei; Shinohara, Kazuyuki; Esposito, Gianluca, "Dataset on genetic and physiological adults responses to social distress" in DATA IN BRIEF, v. 13, (2017), p. 742-748.
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8. **Cataldo, Ilaria**; Azhari, Atiqah; Lepri, Bruno; Esposito, Gianluca, "Oxytocin receptors (OXTR) and early parental care: An interaction that modulates psychiatric disorders" in RESEARCH IN DEVELOPMENTAL DISABILITIES, v. 2017, (2017).

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Appendices

Appendix A

Questionnaires English Version

MOTHER FORM

This questionnaire lists various attitudes and behaviours of parents. As you remember your MOTHER in your first 16 years would you place a tick in the most appropriate box next to each question.

	Very like	Moderately like	Moderately unlike	Very unlike
1. Spoke to me in a warm and friendly voice	☐	☐	☐	☐
2. Did not help me as much as I needed	☐	☐	☐	☐
3. Let me do those things I liked doing	☐	☐	☐	☐
4. Seemed emotionally cold to me	☐	☐	☐	☐
5. Appeared to understand my problems and worries	☐	☐	☐	☐
6. Was affectionate to me	☐	☐	☐	☐
7. Liked me to make my own decisions	☐	☐	☐	☐
8. Did not want me to grow up	☐	☐	☐	☐
9. Tried to control everything I did	☐	☐	☐	☐
10. Invaded my privacy	☐	☐	☐	☐
11. Enjoyed talking things over with me	☐	☐	☐	☐
12. Frequently smiled at me	☐	☐	☐	☐
13. Tended to baby me	☐	☐	☐	☐
14. Did not seem to understand what I needed or wanted	☐	☐	☐	☐
15. Let me decide things for myself	☐	☐	☐	☐
16. Made me feel I wasn't wanted	☐	☐	☐	☐
17. Could make me feel better when I was upset	☐	☐	☐	☐
18. Did not talk with me very much	☐	☐	☐	☐
19. Tried to make me feel dependent on her/him	☐	☐	☐	☐
20. Felt I could not look after myself unless she/he was around	☐	☐	☐	☐
21. Gave me as much freedom as I wanted	☐	☐	☐	☐
22. Let me go out as often as I wanted	☐	☐	☐	☐
23. Was overprotective of me	☐	☐	☐	☐
24. Did not praise me	☐	☐	☐	☐
25. Let me dress in any way I pleased	☐	☐	☐	☐

Fig. A.1 Parental Boding Instrument - Mother Form (English version)

FATHER FORM

This questionnaire lists various attitudes and behaviours of parents. As you remember your FATHER in your first 16 years would you place a tick in the most appropriate box next to each question.

	Very like	Moderately like	Moderately unlike	Very unlike
1. Spoke to me in a warm and friendly voice	☐	☐	☐	☐
2. Did not help me as much as I needed	☐	☐	☐	☐
3. Let me do those things I liked doing	☐	☐	☐	☐
4. Seemed emotionally cold to me	☐	☐	☐	☐
5. Appeared to understand my problems and worries	☐	☐	☐	☐
6. Was affectionate to me	☐	☐	☐	☐
7. Liked me to make my own decisions	☐	☐	☐	☐
8. Did not want me to grow up	☐	☐	☐	☐
9. Tried to control everything I did	☐	☐	☐	☐
10. Invaded my privacy	☐	☐	☐	☐
11. Enjoyed talking things over with me	☐	☐	☐	☐
12. Frequently smiled at me	☐	☐	☐	☐
13. Tended to baby me	☐	☐	☐	☐
14. Did not seem to understand what I needed or wanted	☐	☐	☐	☐
15. Let me decide things for myself	☐	☐	☐	☐
16. Made me feel I wasn't wanted	☐	☐	☐	☐
17. Could make me feel better when I was upset	☐	☐	☐	☐
18. Did not talk with me very much	☐	☐	☐	☐
19. Tried to make me feel dependent of her/him	☐	☐	☐	☐
20. Felt I could not look after myself unless she/he was around	☐	☐	☐	☐
21. Gave me as much freedom as I wanted	☐	☐	☐	☐
22. Let me go out as often as I wanted	☐	☐	☐	☐
23. Was overprotective of me	☐	☐	☐	☐
24. Did not praise me	☐	☐	☐	☐
25. Let me dress in any way I pleased	☐	☐	☐	☐

Fig. A.2 Parental Boding Instrument - Father Form (English version)

Instructions: Show how much you agree with each of the following items by rating them on the scale of Totally Disagree to Totally Agree.

	Totally Disagree	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree	Totally Agree
1. Overall, I am a worthwhile person	☐	☐	☐	☐	☐	☐
2. I am easier to get to know than most people	☐	☐	☐	☐	☐	☐
3. I feel confident that other people will be there for me when I need them	☐	☐	☐	☐	☐	☐
4. I prefer to depend on myself rather than other people	☐	☐	☐	☐	☐	☐
5. I prefer to keep to myself	☐	☐	☐	☐	☐	☐
6. To ask for help is to admit that you're a failure	☐	☐	☐	☐	☐	☐
7. People's worth should be judged by what they achieve	☐	☐	☐	☐	☐	☐
8. Achieving things is more important than building relationships	☐	☐	☐	☐	☐	☐
9. Doing your best is more important than getting on with others	☐	☐	☐	☐	☐	☐
10. If you've got a job to do, you should do it no matter who gets hurt	☐	☐	☐	☐	☐	☐
11. It's important to me that others like me	☐	☐	☐	☐	☐	☐
12. It's important to me to avoid doing things that others won't like	☐	☐	☐	☐	☐	☐
13. I find it hard to make a decision unless I know what other people think	☐	☐	☐	☐	☐	☐
14. My relationships with others are generally superficial	☐	☐	☐	☐	☐	☐
15. Sometimes I think that I am no good at all	☐	☐	☐	☐	☐	☐
16. I find it hard to trust other people	☐	☐	☐	☐	☐	☐
17. I find it difficult to depend on others	☐	☐	☐	☐	☐	☐
18. I find that others are reluctant to get as close as I would like	☐	☐	☐	☐	☐	☐

19. I find it relatively easy to get close to other people	☐	☐	☐	☐	☐	☐
20. I find it easy to trust others	☐	☐	☐	☐	☐	☐
21. I feel comfortable depending on other people	☐	☐	☐	☐	☐	☐
22. I worry that others won't care about me as much as I care about them	☐	☐	☐	☐	☐	☐
23. I worry about people getting too close	☐	☐	☐	☐	☐	☐
24. I worry that I won't measure up to people	☐	☐	☐	☐	☐	☐
25. I have mixed feelings about being close to others	☐	☐	☐	☐	☐	☐
26. While i want to get close to others, I feel uneasy about it	☐	☐	☐	☐	☐	☐
27. I wonder why people would want to be involved with me	☐	☐	☐	☐	☐	☐
28. It's very important to me to have a close relationship	☐	☐	☐	☐	☐	☐
29. I worry a lot about my relationships	☐	☐	☐	☐	☐	☐
30. I wonder how I would cope without someone to love me	☐	☐	☐	☐	☐	☐
31. I feel confident about relating to others	☐	☐	☐	☐	☐	☐
32. I often feel left out or alone	☐	☐	☐	☐	☐	☐
33. I often worry that I do not really fit in with other people	☐	☐	☐	☐	☐	☐
34. Other people have their own problems, so I don't bother them with mine	☐	☐	☐	☐	☐	☐
35. When I talk over my problems with others, I generally feel ashamed or foolish	☐	☐	☐	☐	☐	☐
36. I am too busy with other activities to put much time into relationships	☐	☐	☐	☐	☐	☐
37. If something is bothering, others are generally aware and concerned	☐	☐	☐	☐	☐	☐
38. I am confident that other people will like and respect me	☐	☐	☐	☐	☐	☐
39. I get frustrated when others are not available when I need them	☐	☐	☐	☐	☐	☐
40. Other people often disappoint me	☐	☐	☐	☐	☐	☐

Fig. A.3 Attachment Style Questionnaire (English version)

The statements below concern how you feel in emotionally intimate relationships. We are interested in how you generally experience relationships, not just in what is happening in a current relationship. Please read each of the following statements and rate the extent to which you believe each statement best describes your feelings about close relationships.

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
1. I'm afraid that I will lose my partner's love.	☐	☐	☐	☐	☐	☐	☐
2. I often worry that my partner will not want to stay with me.	☐	☐	☐	☐	☐	☐	☐
3. I often worry that my partner doesn't really love me.	☐	☐	☐	☐	☐	☐	☐
4. I worry that romantic partners won't care about me as much as I care about them.	☐	☐	☐	☐	☐	☐	☐
5. I often wish that my partner's feelings for me were as strong as my feelings for him or her.	☐	☐	☐	☐	☐	☐	☐
6. I worry a lot about my relationships.	☐	☐	☐	☐	☐	☐	☐
7. When my partner is out of sight, I worry that he or she might become interested in someone else.	☐	☐	☐	☐	☐	☐	☐
8. When I show my feelings for romantic partners, I'm afraid they will not feel the same about me.	☐	☐	☐	☐	☐	☐	☐
9. I rarely worry about my partner leaving me.	☐	☐	☐	☐	☐	☐	☐
10. My romantic partner makes me doubt myself.	☐	☐	☐	☐	☐	☐	☐
11. I do not often worry about being abandoned.	☐	☐	☐	☐	☐	☐	☐

12. I find that my partner(s) don't want to get as close as I would like.	☐	☐	☐	☐	☐	☐	☐
13. Sometimes romantic partners change their feelings about me for no apparent reason.	☐	☐	☐	☐	☐	☐	☐
14. My desire to be very close sometimes scares people away.	☐	☐	☐	☐	☐	☐	☐
15. I'm afraid that once a romantic partner gets to know me, he or she won't like who I really am.	☐	☐	☐	☐	☐	☐	☐
16. It makes me mad that I don't get the affection and support I need from my partner.	☐	☐	☐	☐	☐	☐	☐
17. I worry that I won't measure up to other people.	☐	☐	☐	☐	☐	☐	☐
18. My partner only seems to notice me when I'm angry.	☐	☐	☐	☐	☐	☐	☐
19. I prefer not to show a partner how I feel deep down.	☐	☐	☐	☐	☐	☐	☐
20. I feel comfortable sharing my private thoughts and feelings with my partner.	☐	☐	☐	☐	☐	☐	☐
21. I find it difficult to allow myself to depend on romantic partners.	☐	☐	☐	☐	☐	☐	☐
22. I am very comfortable being close to romantic partners.	☐	☐	☐	☐	☐	☐	☐
23. I don't feel comfortable opening up to romantic partners.	☐	☐	☐	☐	☐	☐	☐
24. I prefer not to be too close to romantic partners.	☐	☐	☐	☐	☐	☐	☐
25. I get uncomfortable when a romantic partner wants to be very close.	☐	☐	☐	☐	☐	☐	☐

26. I find it relatively easy to get close to my partner.	☐	☐	☐	☐	☐	☐	☐
27. It's not difficult for me to get close to my partner.	☐	☐	☐	☐	☐	☐	☐
28. I usually discuss my problems and concerns with my partner.	☐	☐	☐	☐	☐	☐	☐
29. It helps to turn to my romantic partner in times of need.	☐	☐	☐	☐	☐	☐	☐
30. I tell my partner just about everything.	☐	☐	☐	☐	☐	☐	☐
31. I talk things over with my partner.	☐	☐	☐	☐	☐	☐	☐
32. I am nervous when partners get too close to me.	☐	☐	☐	☐	☐	☐	☐
33. I feel comfortable depending on romantic partners.	☐	☐	☐	☐	☐	☐	☐
34. I find it easy to depend on romantic partners.	☐	☐	☐	☐	☐	☐	☐
35. It's easy for me to be affectionate with my partner.	☐	☐	☐	☐	☐	☐	☐
36. My partner really understands me and my needs.	☐	☐	☐	☐	☐	☐	☐

Fig. A.4 Experience in Close Relationships - Revised (English version)

Appendix B

Questionnaires Italian Version

Questo questionario elenca vari comportamenti e atteggiamenti dei genitori. A fianco di ciascuna affermazione troverà dei quadratini che corrispondono a differenti valutazioni (molto probabile, probabile, poco improbabile, improbabile). In base a come ricorda sua MADRE nel corso dei suoi primi 16 anni ponga una crocetta sulla valutazione che ritiene più appropriata per quella affermazione.

	Molto probabile	Probabile	Poco probabile	Improbabile
1. Mi parlava con voce calda e amichevole	⬆	⬆	⬆	⬆
2. Non mi dava l'aiuto di cui avevo bisogno	⬆	⬆	⬆	⬆
3. Mi lasciava fare ciò che mi piaceva	⬆	⬆	⬆	⬆
4. Era emozionalmente fredda nei miei confronti	⬆	⬆	⬆	⬆
5. Sembrava comprendere i miei problemi e le mie preoccupazioni	⬆	⬆	⬆	⬆
6. Era affettuosa nei miei confronti	⬆	⬆	⬆	⬆
7. Preferiva che fossi io a prendere le decisioni	⬆	⬆	⬆	⬆
8. Non voleva che diventassi adulto/a	⬆	⬆	⬆	⬆
9. Cercava di controllare tutto ciò che facevo	⬆	⬆	⬆	⬆
10. Invadeva la mia vita privata	⬆	⬆	⬆	⬆
11. Le piaceva discutere le cose con me	⬆	⬆	⬆	⬆
12. Mi sorrideva spesso	⬆	⬆	⬆	⬆
13. Mi trattava come un bambino/a	⬆	⬆	⬆	⬆
14. Non sembrava capire ciò che volevo o di cui avevo bisogno	⬆	⬆	⬆	⬆
15. Mi lasciava decidere le cose da solo/a	⬆	⬆	⬆	⬆
16. Mi faceva sentire non desiderato/a	⬆	⬆	⬆	⬆
17. Riusciva a farmi sentire meglio quando ero turbato/a	⬆	⬆	⬆	⬆
18. Non parlava molto con me	⬆	⬆	⬆	⬆
19. Cercava di rendermi dipendente da lei	⬆	⬆	⬆	⬆
20. Sentiva che non potevo badare a me stesso senza che lei fosse presente.	⬆	⬆	⬆	⬆
21. Mi dava tutta la libertà che volevo	⬆	⬆	⬆	⬆
22. Mi lasciava uscire tutte le volte che volevo	⬆	⬆	⬆	⬆
23. Era iperprottettiva nei miei confronti	⬆	⬆	⬆	⬆
24. Non mi ha mai lodato	⬆	⬆	⬆	⬆
25. Mi lasciava vestire come preferivo	⬆	⬆	⬆	⬆

Fig. B.1 Parental Boding Instrument - Mother Form (Italian version)

Questo questionario elenca vari comportamenti e atteggiamenti dei genitori. A fianco di ciascuna affermazione troverà dei quadratini che corrispondono a differenti valutazioni (molto probabile, probabile, poco probabile, improbabile). In base a come ricorda suo PADRE nel corso dei suoi primi 16 anni ponga una crocetta sulla valutazione che ritiene più appropriata per quella affermazione.

	Molto probabile	Probabile	Poco probabile	Improbabile
1. Mi parlava con voce calda e amichevole	↑	↑	↑	↑
2. Non mi dava l'aiuto di cui avevo bisogno	↑	↑	↑	↑
3. Mi lasciava fare ciò che mi piaceva	↑	↑	↑	↑
4. Era emozionalmente freddo nei miei confronti	↑	↑	↑	↑
5. Sembrava comprendere i miei problemi e le mie preoccupazioni	↑	↑	↑	↑
6. Era affettuoso nei miei confronti	↑	↑	↑	↑
7. Preferiva che fossi io a prendere le decisioni	↑	↑	↑	↑
8. Non voleva che diventassi adulto/a	↑	↑	↑	↑
9. Cercava di controllare tutto ciò che facevo	↑	↑	↑	↑
10. Invadeva la mia vita privata	↑	↑	↑	↑
11. Gli piaceva discutere le cose con me	↑	↑	↑	↑
12. Mi sorrideva spesso	↑	↑	↑	↑
13. Mi trattava come un bambino/a	↑	↑	↑	↑
14. Non sembrava capire ciò che volevo o di cui avevo bisogno	↑	↑	↑	↑
15. Mi lasciava decidere le cose da solo/a	↑	↑	↑	↑
16. Mi faceva sentire non desiderato/a	↑	↑	↑	↑
17. Riusciva a farmi sentire meglio quando ero turbato/a	↑	↑	↑	↑
18. Non parlava molto con me	↑	↑	↑	↑
19. Cercava di rendermi dipendente da lui	↑	↑	↑	↑
20. Sentiva che non potevo badare a me stesso senza che lui fosse presente.	↑	↑	↑	↑
21. Mi dava tutta la libertà che volevo	↑	↑	↑	↑
22. Mi lasciava uscire tutte le volte che volevo	↑	↑	↑	↑
23. Era iperprottettivo nei miei confronti	↑	↑	↑	↑
24. Non mi ha mai lodato	↑	↑	↑	↑
25. Mi lasciava vestire come preferivo	↑	↑	↑	↑

Fig. B.2 Parental Boding Instrument - Father Form (Italian version)

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Istruzioni: *Indichi quanto concorda con ciascuna delle seguenti affermazioni, valutandole in base alla scala riportata accanto ad esse.*

	Totalmente in disaccordo	Fortemente in disaccordo	Lievemente in disaccordo	Lievemente d'accordo	Fortemente d'accordo	Totalmente d'accordo
	1	**2**	**3**	**4**	**5**	**6**
1. Nel complesso sono una persona valida	1	2	3	4	5	6
2. È più facile arrivare a conoscere me che la maggior parte delle altre persone	1	2	3	4	5	6
3. Sono fiducioso che gli altri ci saranno quando avrò bisogno di loro	1	2	3	4	5	6
4. Preferisco dipendere da me stesso piuttosto che dagli altri	1	2	3	4	5	6
5. Preferisco stare sulle mie	1	2	3	4	5	6
6. Chiedere aiuto equivale ad ammettere di aver fallito	1	2	3	4	5	6
7. Il valore di una persona andrebbe valutato in base ai suoi successi	1	2	3	4	5	6
8. Raggiungere degli obiettivi è più importante che costruire delle relazioni	1	2	3	4	5	6
9. Dare il massimo è più importante che andare d'accordo con gli altri	1	2	3	4	5	6
10. Se hai un lavoro da fare, non dovrebbe importarti di chi ne avrà un danno	1	2	3	4	5	6
11. Per me è importante piacere agli altri	1	2	3	4	5	6
12. Per me è importante evitare di fare delle cose che agli altri non piacciono	1	2	3	4	5	6
13. Trovo difficile prendere una decisione, a meno che non sappia ciò che pensano gli altri	1	2	3	4	5	6
14. Le mie relazioni con gli altri sono solitamente superficiali	1	2	3	4	5	6
15. A volte penso di non valere nulla	1	2	3	4	5	6
16. Ho difficoltà a fidarmi degli altri	1	2	3	4	5	6
17. Ho difficoltà a dipendere dagli altri	1	2	3	4	5	6
18. Trovo che gli altri siano riluttanti ad entrare in confidenza quanto io vorrei	1	2	3	4	5	6
19. Trovo relativamente facile entrare in confidenza con gli altri	1	2	3	4	5	6

20. Mi fido facilmente degli altri	1	2	3	4	5	6
21. Mi trovo a mio agio nel dipendere dagli altri	1	2	3	4	5	6
22. Mi preoccupo che agli altri non importi di me quanto a me importa di loro	1	2	3	4	5	6
23. Mi preoccupo quando la gente entra troppo in confidenza	1	2	3	4	5	6
24. Mi preoccupo di non essere all'altezza degli altri	1	2	3	4	5	6
25. Ho sentimenti contrastanti circa l'essere in confidenza con gli altri	1	2	3	4	5	6
26. Se da una lato voglio entrare in confidenza con gli altri, dall'altro mi sento a disagio	1	2	3	4	5	6
27. Mi chiedo perché la gente voglia avere a che fare con me	1	2	3	4	5	6
28. Per me è veramente importante avere una relazione stretta	1	2	3	4	5	6
29. Mi preoccupo molto delle mie relazioni	1	2	3	4	5	6
31. Mi sento fiducioso nelle relazioni con gli altri	1	2	3	4	5	6
32. Spesso mi sento lasciato in disparte o solo	1	2	3	4	5	6
33. Spesso mi preoccupo di non riuscire ad entrare in sintonia con gli altri	1	2	3	4	5	6
34. Gli altri hanno i loro problemi, per cui non li infastidisco coi miei	1	2	3	4	5	6
35. Quando discuto dei miei problemi con gli altri, di solito mi vergogno o mi sento stupido	1	2	3	4	5	6
36. Sono troppo impegnato in altre attività per dedicare molto tempo alle relazioni	1	2	3	4	5	6
37. Se qualcosa mi disturba, gli altri solitamente ne sono consapevoli e preoccupati	1	2	3	4	5	6
38. Sono fiducioso di essere gradito e rispettato dagli altri	1	2	3	4	5	6
39. Mi sento frustrato quando gli altri non sono disponibili nel momento in cui ne ho bisogno	1	2	3	4	5	6
40. Gli altri spesso mancano alle mie aspettative	1	2	3	4	5	6

Fig. B.3 Attachment Style Questionnaire (Italian version)

Istruzioni: *Le seguenti affermazioni riguardano ciò che lei prova nelle relazioni sentimentali. Siamo interessati a come vive le relazioni in genere, non solo a ciò che sta accadendo in una relazione attualmente in corso. Legga ogni affermazione ed indichi, per ognuna, il suo grado di accordo o disaccordo, barrando la casella corrispondente.*
Nel rispondere, tenga presente che per "partner" si intende esclusivamente un partner sentimentale (ad es. la propria ragazza o il proprio ragazzo, la fidanzata o il fidanzato, il proprio coniuge), e quindi non parenti, amici o colleghi.
Inoltre, tenga presente che le parole "vicino" ed "intimo" si riferiscono alla vicinanza psicologica e/o emotiva (ad es. aprirsi, confidarsi, condividere emozioni ed esperienze), oltre che a quella fisica o sessuale.

	Fortemente in disaccordo			Né in disaccordo né in accordo			Fortemente in accordo
	1	**2**	**3**	**4**	**5**	**6**	**7**
1. Mi preoccupa non essere all'altezza degli altri	1	2	3	4	5	6	7
2. Non mi sento a mio agio nell'aprirmi al partner	1	2	3	4	5	6	7
3. Dico più o meno tutto al mio partner	1	2	3	4	5	6	7
4. Non sono a mio agio quando il partner vuole avere molta intimità	1	2	3	4	5	6	7
5. Di solito discuto dei miei problemi e delle mie preoccupazioni con il mio partner	1	2	3	4	5	6	7
6. Mi dà molto fastidio non avere dal mio partner l'affetto ed il sostegno di cui ho bisogno	1	2	3	4	5	6	7
7. Spesso ho paura che il mio partner non mi ami veramente	1	2	3	4	5	6	7
8. Mi sento molto a mio agio quando sto in intimità con il mio partner	1	2	3	4	5	6	7
9. Trovo che il mio partner non voglia essere così intimo con me quanto io vorrei	1	2	3	4	5	6	7
10. Preferisco non mostrare al partner come mi sento veramente dentro	1	2	3	4	5	6	7
11. Mi preoccupo molto delle mie relazioni	1	2	3	4	5	6	7
12. Preferisco non essere troppo intimo/a con i miei partner	1	2	3	4	5	6	7
13. Temo che perderò l'amore del mio partner	1	2	3	4	5	6	7
14. Talvolta i miei partner cambiano i loro sentimenti nei miei confronti senza una ragione apparente	1	2	3	4	5	6	7
15. Il mio partner capisce veramente me e le mie necessità	1	2	3	4	5	6	7
16. Trovo facile dipendere dai partner	1	2	3	4	5	6	7

17. Mi innervosisco quando i partner diventano troppo intimi	1	2	3	4	5	6	7
18. Sembra che il mio partner mi noti solo quando sono arrabbiato	1	2	3	4	5	6	7
19. Mi preoccupo raramente che il mio partner possa lasciarmi	1	2	3	4	5	6	7
20. Trovo difficile concedermi di dipendere dai partners	1	2	3	4	5	6	7
21. Trovo facile essere affettuoso con il partner	1	2	3	4	5	6	7
22. Temo che il mio partner non tenga a me quanto io tengo a lui/lei	1	2	3	4	5	6	7
23. Trovo relativamente facile raggiungere l'intimità con il mio partner	1	2	3	4	5	6	7
24. Non mi preoccupo spesso di essere lasciato	1	2	3	4	5	6	7
25. Mi sento a mio agio nel dipendere dai partner	1	2	3	4	5	6	7
26. Spesso mi auguro che i sentimenti del/la mio/a partner nei miei confronti siano forti quanto i miei per lei/lui	1	2	3	4	5	6	7
27. Il mio partner mi fa dubitare di me stesso	1	2	3	4	5	6	7
28. Il mio desiderio di essere molto intimo qualche volta spaventa e allontana le persone	1	2	3	4	5	6	7
29. Temo che, conoscendomi, il partner scopra che non gli piace come sono realmente	1	2	3	4	5	6	7
30. Quando il mio partner non è con me, mi preoccupa che possa interessarsi a qualcun altro/a	1	2	3	4	5	6	7
31. Spesso mi preoccupo del fatto che il mio partner non vorrà più stare con me	1	2	3	4	5	6	7
32. Nei momenti di bisogno, mi aiuta rivolgermi al mio partner	1	2	3	4	5	6	7
33. Parlo a lungo delle cose con il mio partner	1	2	3	4	5	6	7
34. Mi sento a mio agio nel condividere con il mio partner i miei pensieri e sentimenti intimi	1	2	3	4	5	6	7
35. Quando mostro i miei sentimenti ai partner, ho paura che loro non provino le stesse cose nei miei confronti	1	2	3	4	5	6	7
36. Non è difficile per me raggiungere l'intimità con il mio partner	1	2	3	4	5	6	7

Fig. B.4 Experience in Close Relationships - Revised (Italian version)