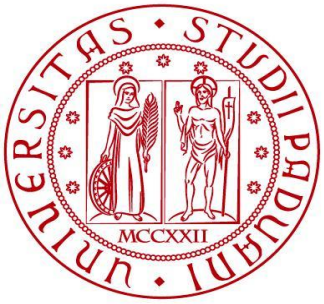

UNIVERSITÀ DEGLI STUDI DI PADOVA

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DIPARTIMENTO DI PSICOLOGIA GENERALE

SCUOLA DI DOTTORATO IN SCIENZE PSICOLOGICHE

XXVII CICLO

INFLUENCE OF EMPATHY AND PSYCHOPATHIC TRAITS ON EMOTIONAL PSYCHOPHYSIOLOGICAL RESPONSES IN WOMEN

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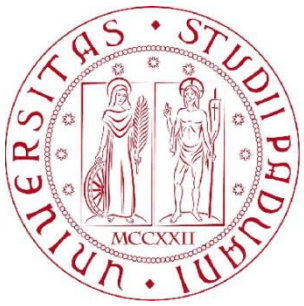

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OVERVIEW

English version:

Psychopathy is traditionally defined as a personality disorder characterized by two main factors: “Emotional Detachment” and “Antisocial Behavior”. With respect to the first factor, classic diagnostic criteria for psychopathy include lack of empathy, emotional callousness, lack of guilt or remorse, and egocentricity. With regard to the second factor, psychopathic individuals show an impulsive behavior without regard for consequences, an absence of long-term goals, perseverative responses, irresponsibility, antisocial and criminal behavior (Hare, 1993).

Cleckley (The Mask of Sanity, 1941) defined two types of psychopaths: “Successful” and “Unsuccessful”. “Unsuccessful” psychopaths present with the typical profile of the disorder, entailing emotional detachment and also antisocial behavior. They manifest violent and criminal behavior and serve several terms of imprisonment. “Successful” psychopaths present with emotional detachment, but a high IQ, and familiar and social favorable environment keeps them away from troubles. Nevertheless, they are egocentric, conspirers, and callous, and their behavior, even if not criminal or illegal, typically violates ethical and moral norms.

In past years, several studies have been conducted in forensic facilities and jails, on “unsuccessful” criminal psychopaths, thus producing interesting results, but poorly applicable to normal population. It’s important to extend these studies to “Successful” psychopaths in the community, and to explore analogies and discontinuities between these two categories. Also, research in detention institutes is often focused on male

psychopaths, due to the predominant presence of this gender into jail, hence the importance to study female psychopathy and to analyze similarities and differences between the two genders in the characterization of the disorder.

The main goal of the present project was to investigate the emotional regulation in women with high empathic or "successful" psychopathic traits and empathic and psychopathic traits selected from the healthy community.

In the first study, we analyzed the influence of empathy on subjective evaluation of emotional pictures and emotional psychophysiological responses (startle reflex, ERPs) in healthy women. Results showed how different levels of empathy had an influence on evaluation of valence and arousal elicited by emotional stimuli. Participants with low empathy levels rated negative pictures as more pleasant, and both positive and negative pictures as less arousing than the group with high empathy levels, indicating a reduced perceived bodily activation. With regards to startle reflex responses and event-related potentials, no differences between the two groups were found.

In the second study, we analyzed individual differences in subjective evaluations and affective psychophysiological responses (startle reflex, ERPs) elicited by emotional pictures, in women with low and high baseline startle responses. The two groups (Low Responders vs. High Responders) did not differ in their subjective evaluation of the pictures, but they differed in their affective modulation of the startle reflex: while the High Responders showed an inhibition of the reflex in response to pleasant stimuli, and a potentiation of the reflex in response to unpleasant stimuli, the Low Responders did not show an affective modulation of the reflex in response to any emotional stimulus.

Low Responders also manifested reduced cortical responses while viewing emotional stimuli, compared to High Responders.

The main goal of the third study was to analyze the capability of Decision-making and cortical responses measured by ERPs in women with high psychopathic traits and a control group through the Iowa Gambling Task. Participants with high psychopathic traits showed perseverative responses during the performance, hyposensitivity to punishment, and hypersensitivity to rewards, compared to the control group.

The forth study aimed at examining the associations between the triarchic conceptualization of psychopathy (measured by the three factors: boldness, meanness, disinhibition), as measured by the Triarchic Psychopathy Measure, and the Narcissistic construct, as measured by the Narcissistic Personality Inventory, in undergraduate students. Several facets of narcissism were found to be related to distinctive configurations of psychopathic traits. The Narcissistic Personality Inventory revealed to capture both the grandiose and vulnerable aspects of narcissism.

In conclusion, the first three studies evidenced how women with low empathy and high psychopathic traits show impairment in emotional regulation and in decision-making capabilities. “Successful” psychopaths can cause relevant physical and moral damages to individuals and society. The fourth study provided a better understanding of the relationship between psychopathy and narcissism.

Italian version:

La psicopatia viene tradizionalmente definita come un disturbo di personalità caratterizzato da due fattori principali: "Distacco Emotivo" e "Comportamento Antisociale". Per quanto riguarda il primo fattore, i classici criteri diagnostici per la psicopatia includono mancanza di empatia, affettività superficiale, mancanza di senso di colpa o rimorso, ed egocentrismo. Per quanto riguarda il secondo fattore, individui con psicopatia presentano comportamento impulsivo senza riguardo per le conseguenze delle proprie azioni ed un'assenza di obiettivi a lungo termine, risposte perseverative, irresponsabilità, e comportamento antisociale e criminale (Hare, 1993).

Cleckley (The Mask of Sanity, 1941) ha definito due categorie di psicopatici: "Successful" ed "Unsuccessful". Gli psicopatici "Unsuccessful" manifestano il profilo tipico del disturbo, con distacco emotivo e devianza sociale. Presentano comportamenti violenti e criminali e scontano ripetute pene nelle carceri. Gli psicopatici "Successful" manifestano distacco emotivo, ma grazie ad un elevato quoziente intellettivo, e all'ambiente familiare e sociale, riescono a mantenere una parvenza di normalità e a tenersi lontani dai guai. Sono egocentrici, cospiratori, superficiali, e il loro comportamento, seppur non criminale o illegale, viola spesso le norme etiche e morali convenzionali.

Negli scorsi anni sono stati condotti diversi studi nelle carceri e in ambienti giudiziari, con psicopatici "Unsuccessful" e criminali, portando ad un bias ambientale e a risultati scarsamente applicabili alla popolazione normale. È importante estendere questi studi a psicopatici "Successful" nelle comunità, in modo tale da poter esplorare analogie e differenze tra queste due categorie di psicopatici. Inoltre, la ricerca nelle carceri si è per lo più focalizzata su psicopatici maschi, a causa della prevalente presenza di persone di sesso maschile nelle carceri, da qui l'importanza di studiare la

psicopatia al femminile e di approfondire l'eventuale presenza di differenze nella manifestazione della sindrome tra i due generi.

Obiettivo principale del presente lavoro di tesi è stato quello di investigare la relazione tra regolazione emozionale e tratti empatici e psicopatici in donne "Successful" nella comunità.

Nel primo studio è stata analizzata l'influenza di diversi livelli di empatia sulla valutazione soggettiva di immagini emozionali e sulle risposte emozionali psicofisiologiche (riflesso di startle, ERPs). I risultati hanno mostrato come differenti livelli di empatia avessero un'influenza sulla valutazione soggettiva di valenza ed arousal elicitati da immagini emozionali. Le partecipanti con bassi livelli di empatia valutavano le immagini negative come più piacevoli, e sia le immagini positive che quelle negative come meno attivanti, rispetto al gruppo con alti livelli di empatia, ad indicare una ridotta percepita attivazione corporea di fronte a stimoli emotigeni. Non sono state trovate differenze tra i due gruppi nelle risposte emozionali psicofisiologiche (startle reflex, ERPs).

Nel secondo studio sono state analizzate differenze individuali nella valutazione soggettiva e nelle risposte affettive psicofisiologiche (startle reflex, ERPs) elicitate da immagini emozionali, in donne con bassi ed alti livelli di reattività di startle di base. I due gruppi (Low Responders vs. High Responders) non differivano nella loro valutazione soggettiva delle immagini, ma differivano nella modulazione affettiva del riflesso di startle: mentre le High Responders manifestavano un'inibizione del riflesso in risposta a stimoli piacevoli, ed un potenziamento della risposta in risposta a stimoli spiacevoli, le Low Responders non mostravano alcuna modulazione affettiva del riflesso in risposta ai vari stimoli emozionali. Inoltre, le Low Responders manifestavano

ridotte risposte corticali durante la visione degli stimoli emozionali, rispetto alle High Responders.

Obiettivo principale del terzo studio era quello di analizzare le capacità di decision-making e le risposte corticale misurate tramite ERPs in donne con elevati tratti di psicopatia ed un gruppo di controllo, tramite l'utilizzo dello Iowa Gambling Task. Le donne con elevati tratti di psicopatia manifestavano risposte perseverative durante il compito, una ridotta sensibilità alle punizioni, ed un'elevata sensibilità alle ricompense, rispetto al gruppo di controllo.

Il quarto studio mirava ad esaminare l'associazione tra la concettualizzazione triarchica della psicopatia (secondo la quale la sindrome può essere analizzata secondo i tre concetti di boldness, meanness, e disinhibition) , misurata tramite la Triarchic Psychopathy Measure, ed il construtto narcisistico, misurato tramite il Narcissistic Personality Inventory, in studenti universitari. Diversi tratti narcisistici hanno mostrato di essere associati a specifiche configurazioni di tratti psicopatici. Il Narcissistic Personality Inventory ha mostrato di catturare sia gli aspetti "grandiosi" sia quelli "vulnerabili" del disturbo.

In conclusione, i primi tre studi hanno evidenziato come donne con bassi livelli di empatia ed elevati tratti di psicopatia mostrino deficit nella regolazione emozionale e nel decision-making. Tali deficit possono avere rilevanti conseguenze negative, sia fisiche che morali, sugli individui e sulla società nel suo insieme. Il quarto studio ha fornito una migliore comprensione della relazione tra psicopatia e narcisismo.

Keywords: *Psychopathy, Empathy, Emotions, Decision-Making, Startle Reflex, ERPs, Triarchic Psychopathy Measure*

CHAPTER 1

GENERAL INTRODUCTION

1.1 Psychopathy: A definition of the construct

Psychopathy is a personality disorder defined by a constellation of behavioral, interpersonal and affective characteristics, including personality traits such as lack of empathy, egocentricity, impulsivity, manipulativeness, and antisocial and criminal tendencies. It affects approximately 1% of the general population and approximately 15-20% of incarcerated offenders (Hare, 1991).

The current conceptualization of psychopathy was influenced by Cleckley's seminal monograph, The Mask of Sanity (1976), which listed 16 diagnostic criteria that could be used to identify individuals with the disorder. The emphasis was on deficient affective and interpersonal abilities (callousness, inability to love, superficial charm, lack of remorse or guilt), and antisocial behavior (irresponsibility, unreliability, weak impulse control and failure to learn from experience, absence of planning). The Author distinguished between psychopaths and common criminals and his case histories included examples of successful noncriminal psychopaths, such as medical doctors, brokers, and scientists.

Cleckley's notion of psychopathy was operationalized with the advent of the Psychopathy Checklist – Revised (Hare, 1991), which comprises 20 criteria, patterned after Cleckley's. Factor analysis of this instrument has revealed two main dimensions of psychopathy. Factor 1 (Emotional Detachment) comprises emotional and interpersonal

items (absence of empathy, glibness, grandiose sense of worth, pathological lying, superficiality, failure to accept responsibility); factor 2 (Antisocial Behavior) includes markers of an antisocial life-style (early behavior problems, juvenile delinquency, parasitic life, poor behavioral control without regard for consequences, proneness to boredom, poor planning).

Despite a long history of considering psychopathy in terms of affective-interpersonal and antisocial features, Cooke and Michie (2001) refined the construct developing a 3-factor hierarchical model of psychopathy, as measured by the Psychopathy Checklist: Interpersonal Style, Affective Experience, and Impulsive and Irresponsible life-style. Other Authors (Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; Blonigen, Hicks, Krueger, Patrick, & Iacono, 2005; Hare & Neumann, 2005) criticized this model, stating that antisocial behavior is also important in the measurement and diagnosis of psychopathy. Hare (2003) proposed that a 4-factor model (Affective factor, Interpersonal factor, Antisocial factor, Behavioral lifestyle factor) better fitted the construct of psychopathy, including an antisocial tendencies factor as a primary dimension of the construct.

Some of the criteria used to define psychopathy are similar to those used in the diagnosis of several personality disorders (particularly antisocial and narcissistic personality disorders), and some associations have been found (Hart & Hare, 1989). Criteria for antisocial personality disorder focus only on the presence of criminal and delinquent acts, rather than any personality traits, such as glibness, lack of empathy and remorse, and so forth, that are fundamental to the clinical conceptualization of psychopathy. Psychopathy is also positively associated with narcissism (Lee & Ashton, 2005), a construct comprising grandiosity, dominance, superiority, entitlement and high self-esteem.

Recently, Patrick, Fowles, and Krueger (2009) advanced a Triarchic model of psychopathy in an attempt to integrate and reconcile contrasting approaches to measuring psychopathy and to clarify the definition and the boundaries of the concept. The Triarchic model characterizes the disorder in terms of three phenotypic constructs: disinhibition, meanness, and boldness.

Disinhibition consists in a propensity toward externalizing problems, and entails personality traits such as irresponsibility, impulsivity and aggressive acting out, rule-breaking, boredom susceptibility, failure to delay rewards and impatience, and low frustration tolerance (Venables & Patrick, 2012; Hall, Drislane, Patrick, Morano, Lilienfeld, Poythress, 2014). It also entails proneness to alcohol and drugs abuse, and involvement in illegal and norm-violating behaviors.

Meanness is influenced by genetic and environmental factors that contribute to reduced capacity for attachment with others and nurturance. It is related to personality traits such as deficient empathy, deliberate cruelty, disregard for and exploitation of others, coldheartedness, and manipulativeness (Patrick, Drislane, Strickland, 2012). Behavioral manifestations include arrogance, aggressive competitiveness, and verbal derisiveness.

Boldness is the "adaptive" component of psychopathy, comprising traits of interpersonal dominance, emotional stability, and fearlessness behavior. The term bold describes a phenotypic style entailing social poise and efficacy, tolerance for stressors and risks and absence of anxiety, narcissism, high self-confidence, assertiveness and persuasiveness, and bravery (Hall et al., 2014).

The Triarchic conceptualization provides a new basis for reconciling and refining alternative accounts of psychopathy, and for coordinating research on

neuroanatomical and developmental processing contributing the manifestations of the disorder.

1.2 Psychopathy and Empathy

There are several definitions of the concept of empathy. Cohen and Strayer (1996) define it as "the ability to understand and share in another's emotional state or context". This vision acknowledges that empathy comprises the ability to understand the emotional state of others (cognitive empathy) and also the ability to share the emotional states of others (emotional empathy).

Empathy has an interindividual variability (Farrington & Jolliffe, 2001) that can be measured with reliable and valid instruments and is a construct that can have an influence on behavior (Kaukiainen et al., 1999). For example, individuals higher in empathic traits seem to act in a more careful and sensitive way in response to the perceived feelings of others. Empathy encourages prosocial behavior (Batson, Fultz, & Schoenrade, 1987), whereas a lack of empathy seems to facilitate violent and aggressive behavior (Miller & Eisenberg, 1988).

Empathy can be considered as a dichotomous variable (e.g. lack of empathy), or as a continuous variable (e.g. low or high empathy). The dichotomic view is useful in identifying deviant individuals, although the continuous concept is probably more realistic. Several criminologists stated that criminals and offenders have low empathy levels (Burke, 2001; Bush, Mullis, Mullis, 2000; Hogan, 1969). Empathic individuals, who can understand and share negative and distressed emotional reaction of others, resulting from their own violent or aggressive behavior, are inhibited and discouraged from perseverating in their negative actions by seeing and feeling others emotional state

and stop behaving badly in the future (Feshbach, 1975). The capability to feel the distress of another individual can be a protective factor and inhibit harmful behavior (Blackburn, 1993).

A lack of empathy is a core trait in the concept of psychopathy, and it is considered to be the main factor influencing violent and antisocial behaviors observed in the disorder. Blair (2007) states that psychopaths present with an emotional empathy disorder, but not with a cognitive empathy disorder (also called "Theory of Mind"). The Theory of Mind refers to the capability of the individual to represent in its mind the mental states of another person, such as their thoughts, their knowledge, and their desires (Frith, 1989) and it permits to understand and predict others behavior. The deep empathic dysfunction observed in psychopaths does not seem to involve Theory of Mind impairments.

Regarding emotional empathy, there may be two neural circuits involved in the generation of this response: a subcortical pathway, and a cortical pathway (Adolphs, 2002). The subcortical way (retinocollicular, pulvinar, amygdalar) permits a rough stimulus elaboration, whereas the cortical way (retinogeniculostriate, extrastriate, fusiform) allows a more detailed and refined stimulus processing. It permits the "semantic processing" of the expression, hence the individual can name the emotional expression and initiate a goal-directed behavior in response to the expression.

The empathic response is basically elicited in response to visual (e.g. sad or frightened faces) or vocal expression of emotion (e.g. crying voices). For example, frightened faces are negative unconditioned stimuli that inform the individual about the aversiveness of a stimulus or situation, which should then be avoided (Mineka & Cook, 1993). Sad facial expressions discourage behaviors that may have cause sadness in another individual and foster a reparatory and helping behavior. Angry facial

expressions are important signal to inform the observer to stop a behavior in act and to trigger a response reversal, inhibiting the idea of initiate that action again in the future (Blair, 2007). Several neuroimaging studies found that sad and fearful expressions are modulated by amygdala activity (Blair, 2003), and amygdala damages generally lead to deficit in recognizing fearful expressions (Adolphs, 2002; Blair, 2003). Orbitofrontal and ventrolateral prefrontal cortex are activated by angry faces and also are implicated in response reversal (Cools, Clark, Owen, & Robbins, 2002; Blair, 2003). Psychopathic individuals show structural and functional deficits in these mentioned areas and an impairment in recognizing facial and vocal expressions. A study examined skin conductance response (SCR) to sad faces in psychopathic adults (Blair, 1999): they showed a reduced SCR in response to sad faces compared with normal adults. Similar results were also found in children with psychopathic tendencies (Blair, Jones, Clark, & Smith, 1997). Blair and colleagues (2002) examined processing of vocal affect in psychopathic individuals. Neutral words were spoken with different intonations: happy, disgusted, angry, sad, and fearful tones, and participants were asked to recognize the emotion of the speakers based on the intonation used. Psychopaths were impaired in the recognition of fearful and sad vocal affect. Verona, Patrick, Curtin, Bradley, and Lang (2004) investigated psychophysiological responses to emotional sounds in incarcerated psychopaths. They showed reduced skin conductance responses to positive and negative emotional sounds and a delate in the heart rate differentiation between emotionally relevant and neutral sounds. A study investigating facial expression processing in women with psychopathy (Eisenbarth et al., 2013) found an early lower reactivity to angry and fearful facial expressions.

1.3 Psychopathy, Emotions, and Decision-making

1.3.1 Emotions

Emotions may be defined as brief episodes of synchronized responses involving cognitive, physiological, motivational, motor, and subjective components (Borod, 1993; Ekman, 1992; Ekman, 1992; Lang, 1984). Emotions accompany individuals through their whole life, guiding, enriching, and providing a meaning to existence. They are essential for promoting adaptive behavior, and for individual, social, and intellectual development as human beings. In psychological research, emotions are investigated in experimental settings through the study of emotional processing capabilities. Emotional processing can be defined as the perception and evaluation of emotional stimuli. It may involve, for example, the viewing of emotional clips, pictures, or images, the recognition of emotional facial expressions, or memorization and recollection of emotionally loaded events (Kemp, Silberstein, Armstrong, & Nathan, 2004).

Despite their mask of mental health, psychopaths lack the capability to understand and feel emotional experiences and to appreciate what emotional events mean to others. An affective deficit has been supported by several studies investigating emotional processing in psychopaths. Hare, Williamson, and Harpur (1988) demonstrated that psychopaths failed in extracting meaning from emotional words. The study required to group a list of words based on their meaning: while non psychopaths grouped words based on their connotative meaning, psychopaths grouped words on the basis of denotative meaning, hence ignoring their emotional significance. In lexical decision tasks, affective words are generally found to be recognized faster and with greater accuracy than neutral words. In studies requiring participants to decide whether a string of letters made up a word, psychopaths failed to show a differentiation between emotional and neutral words, whereas normal controls made faster lexical decisions in

response to affective words compared to neutral words (Williamson, Harpur, & Hare, 1991; Kiehl, Hare, McDonald, & Brink, 1999; Lorenz and Newman, 2002). In another study, individuals with psychopathy showed an absence of affective priming for negative and positive target words compared to a control group (Blair et al., 2006). Day and Wong (1996) found an absence of right hemisphere lateralization in a task requiring the processing of negative words, presented in the left or right visual field, in criminal psychopaths compared with criminal non-psychopaths. Reidy, Zeichner, and Foster (2009) assessed the processing of affective words in collegiate psychopathic females. Participants saw violent images or images of prosocial behavior before completing the lexical task. Exposure to violent images had not an influence on the processing of sad words in psychopathic women, suggesting a deficient activation of sadness in response to eliciting aversive events.

1.3.2 Decision-making

Emotions can also have a significant influence on apparently rational judgments and decision-making. Risk evaluation, for example, change when individual feel angry or frightened (Lerner & Keltner, 2000). Emotional anticipation is fundamental in regulating social behavior, enabling prediction of positive or aversive outcomes. It helps in the choice between alternative options and helps us to survive (Poli, Sarlo, Bortoletto, Buodo, & Palomba, 2007). Decision-making requires the selection of one option from different choices. "Cold" cognitive reasoning and "hot" emotional processing can both have an influence on decisions. "Cold" reasoning is associated with a rational evaluation of risks and benefits associated with choices, and require the ability to retrieve knowledge about risk/benefit ratio from memory, and to hold this knowledge in working memory when comparing the options. "Hot" emotional processing involves

affective responses to the several options (Seguin, Arseneault, & Tremblay, 2007). This last process is consistent with Damasio's Somatic Marker Hypothesis (Damasio, Everitt, & Bishop, 1996), which states that emotional experience guides rational decision-making unconsciously, biasing the available responses. Somatic markers can be viewed as "gut feelings", or "hunches", as bodily signals associated with particular emotional states that involuntarily and automatically are integrated by the ventromedial prefrontal cortex into more conscious decision-making processes.

A task often used to measure decision-making is the Iowa Gambling Task (IGT), designed to simulate uncertain, rewarding, and punishing aspects of real-life decisions (Bechara, Damasio, Damasio, & Anderson, 1994). Compared with other decision tasks, it emphasizes more the emotional aspects of economic decision. The task has been applied to various clinical populations, such as substance abuse patients, schizophrenics, pathological gamblers, and patients with prefrontal cortex damages, with the aim of evaluating decision-making deficits in the context of a wider assessment (Bechara, 2007). In the IGT, individuals have to choose between decks of cards that yield high immediate gains, but also higher future losses (disadvantageous decks), and decks of cards that yield lower immediate gain, but smaller future losses (advantageous decks), leading to long-term gains (Bechara, Damasio, Damasio, & Lee, 1999). In the computerized version of the IGT, the individual sees four decks of card on the screen. Using the mouse, he or she can click on a card on any of these four decks. After the decision is made, the face of the chosen card is displayed on the screen and a message appears, indicating the amount of money that has been lost or won.

Individuals with psychopathy often commit impulsive crimes without thinking about the consequences of their own actions on others or even themselves, they fail to avoid behaviors which have already been punished in the past, being unable to learn

about and appropriately respond to stimuli associated with a bad outcome (Hare, 1991), and they also show an "inability to inhibit previously rewarded behavior when presented with changing contingencies" (Whiteside & Lynam, 2001). The Iowa Gambling Task, investigating reward and punishment sensitivity, and maladaptive perseveration, can be a valid tool for assessing those aspects in psychopaths. Van Honk Hermans, Putman, Montagne, and Schutter (2002) investigated performance at the Iowa Gambling Task in individuals with low and high psychopathic behavioral characteristics. Low psychopaths showed an intact performance at the game and intact punishment learning. High psychopaths did not show such punishment learning and performed maladaptively during the task, mimicking the gambling behavior of prefrontal patients. Blair, Morton, Leonard, and Blair (2006), in a study on decision-making, examined responses to rewarding and punishing stimuli in psychopaths and control individuals. They used a task in which participants had to choose between two objects associated with different levels of reward or punishment. Psychopaths were impaired when choosing between different levels of reward or punishment. Economic decision-making was also studied by Koenigs, Kruepke, and Newman (2010). The Authors administered the Ultimatum Game and the Dictator Game to incarcerated primary and secondary psychopaths, and also to non-psychopaths, to determine whether different subtypes of the psychopathic construct were associated with different responses to decision-making tasks. In the Ultimatum Game, two players interact to decide how to split a sum of money. A player makes a proposal about how to divide the sum between the two players, and the other player can either accept or reject the offer. If the offer is rejected neither player will receive anything, whereas if the offer is accepted the money will be divided according to the proposal. In the Dictator Game, a player decides the split of a sum of money, and another player has a completely passive role and simply receives the remainder of the sum decided by the proposer. Primary

psychopathy was associated with lower acceptance rates of unfair offers in the Ultimatum Game, as well as with lower offer amounts in the Dictator Game. Newman Patterson, and Kosson (1987) used a card-playing task involving monetary rewards and punishments. In the task, the probability of being punished increased linearly by 10% with every successive block of 10 cards, increasing progressively from 10% to 100%, and the participant could decide when to stop making another response. Incarcerated psychopaths played significantly more cards, and lost more money, than did non-psychopaths, showing maladaptive perseverations and an incapability to alter their dominant response in the task.

1.4 The Neuroanatomical basis of Psychopathy

In recent years, an increasing number of neuroimaging studies tried to localize brain abnormalities associated with psychopathy and antisocial personality, and a burgeoning body of evidence shows that there are links between brain deficits and antisocial and psychopathic behavior. Brain imaging studies can be divided into "structural" studies (assessing brain morphology) and "functional" studies (assessing brain activity). In psychopathy research, functional studies have used tasks involving emotional processing, fear conditioning, decision-making, social cooperation, punishment and reward administration. To date, the key brain areas that have been shown to be impaired in antisocial and psychopathic individuals are the prefrontal cortex (orbitofrontal and ventromedial prefrontal cortex), the anterior cingulate cortex (ACC), the amygdala and hippocampus. These identified structures have important roles in emotional regulation, social and moral cognition, learning, and memory.

1.4.1 Prefrontal Cortex

The prefrontal cortex has been the most commonly recognized structure to be compromised in antisocial and psychopathic individuals, especially its ventromedial (VMPFC) and orbitofrontal (OFC) subdivisions. It is known that damages to certain areas of the prefrontal cortex produce deficit in decision-making and social behavior, although preserving normal cognitive abilities (Damasio, Tranel, & Damasio, 1991; Shallice & Burgess, 1991). Anderson, Bechara, Damasio, Tranel, and Damasio (1999) investigated the consequences of early prefrontal cortical lesions in two adult patients. They showed an impaired social behavior, insensitivity to punishment and consequences of their decisions, and impaired moral reasoning, symptoms resembling psychopathy.

The OFC receives projections from and sends projections to the amygdala. It is involved in instrumental learning and response reversal, both of which are impaired in psychopathic individuals (LaPierre, Braun, & Hodgins 1995). It is involved in social and emotional cognition and damages to the OFC manifests with deficits in affective responses, in particular in defensive responses and negative emotions (Angrilli, Palomba, Cantagallo, Maietti, & Stegagno, 1999; Angrilli, Bianchin, Radaelli, Bertagnoni, & Pertile, 2008). Damages of the OFC cause “acquired sociopathy”, a condition characterized by aggressivity, lack of empathy, deficit in planning and organizing behavior, impulsivity, irresponsibility, impaired insight, and disinhibition (Malloy, Bihrle, Duffy, & Cimino, 1993; Stuss et al., 1983).

The VMPFC is a key structure in response reversal capabilities and decision-making and patients with lesions of the VMPFC show impairments in these tasks (Izquierdo, Suda, & Murray, 2004; Bechara et al., 1999). It has also been frequently identified in neuroimaging studies of moral cognition (Moll et al., 2002; Greene &

Haidt, 2002; Luo et al., 2006). The somatic marker hypothesis states that decision-making capabilities depend on emotions and several studies have shown that damage of the VMPFC cause incapability to use somatic and emotional signals for guiding right decisions. Lesions to the VMPFC cause an impairment in decision-making tasks, such as the Iowa Gambling Task (Izquierdo et al., 2004; Bechara et al., 1999), a task simulating reward and punishment contingencies. When a normal individual has to make a decision about which card select from advantageous or disadvantageous decks, the neural activity related to this information is signaled to the VMPFC, which in turn activates the amygdala. The amygdala would then activate a somatic state that integrates conflicting information about reward and punishment related to a specific deck. The resulting somatic state will finally influence the decision to pick or not a card from that specific deck. A damage to the VMPFC disrupts this process.

There are only a few studies that bear on the question of whether prefrontal structural abnormalities characterize psychopathy and antisocial personality. Raine, Lencz, Bihrle, LaCasse, and Colletti (2000) found specific deficit in the prefrontal gray matter (as opposed to white matter) in a group of 21 antisocial psychopathic individuals compared with both normal controls and substance abuse group. Laakso and colleagues (2002) also found reduced left prefrontal gray volume in alcohol abusers with antisocial disorders compared to controls. Individual differences in psychopathy scores (PCL-R) were found to correlate with prefrontal grey matter volume, with high scorers showing a reduced prefrontal gray volume (Yang, Raine, Lencz, Bihrle, LaCasse, Coletti, 2005).

As regards functional imaging, several studies using emotional tasks found an increased frontal activation in psychopaths. For example, Intrator and colleagues (1997) found increased Cerebral Blood Flow (CBF) in frontotemporal regions in drug abusing psychopaths compared to drug abusing non-psychopaths during a task requiring the

processing of affectively negative words. Similarly, Kiehl and colleagues (2001) found a hyperactivation of frontotemporal region in an affective memory task in psychopaths with antisocial personality disorder. Furthermore, an increased activation to emotionally negative pictures in the right medial prefrontal cortex has been found in psychopaths (Muller et al., 2003). Psychopaths may show an augmented activation because of their emotional deficits; hence, to perform affective tasks as well as controls, they may need greater neural activation.

There are several ways by which prefrontal deficits may predispose to psychopathic tendencies. Individuals with prefrontal damage fail in tasks requiring risky decisions and make wrong choices even when they know which are the most advantageous responses (Bechara, Damasio, Tranel, & Damasio, 1997). This impairment is likely to contribute to the weak behavioral control, impulsivity, irresponsibility, and rule breaking behavior that characterizes the psychopath (Hare, 1991). Prefrontal impairment may also result in deficit in the fear response, which has been found in psychopathic and antisocial individuals. The prefrontal cortex is part of a neural circuit that plays a role in fear conditioning and stress reactions (Frysztak & Neafsey, 1991). Individuals who are less responsive to negative stimuli during childhood would be less sensitive to socializing punishment and show a predisposition to psychopathy. A prefrontal dysfunction may also result in impairment in arousal activation and a sensation-seeking behavior in an attempt to compensate for such low physiological arousal, a behavior found in both antisocial and psychopathic individuals (Gatzke, Raine, Loeber, Steinhauer, & Stouthamer-Loeber, 2002).

Prefrontal structural deficits may render psychopaths impulsive and disinhibited, insensitive to danger and threat, interpersonally inappropriate, and poor decision makers.

1.4.2 Amygdala and Hippocampus

The amygdala dysfunction is one of the key neural systems implicated in psychopathy (Patrick, 1994; Blair, Morris, Frith, Perrett, & Dolan, 1999) and its dysfunction has a functional impact on empathy, socialization, and aggressivity (Bechara et al., 1999). It is involved in response to fearful and sad expressions (Blair et al., 1999), in stimulus-reinforcement learning, enabling for example the association between actions that harm others and the aversive reinforcement of a victim distress (Blair, 2007), and in enhancing the perception of stimuli that have emotional significance (Anderson & Phelps, 2001). It is also a critical structure in somatic state activation and for implementing advantageous decisions. Patients with amygdala lesions showed poor judgment and poor decision-making capabilities in real-life behavior (Tranel & Hyman, 1990; Adolphs, Tranel, Damasio, & Damasio, 1995). Furthermore, patients with amygdala damages showed impairment in evoking somatic states after winning or losing in real-life settings (Bechara et al., 1999).

As regards structural imaging, Tiihonen and colleagues (2000), using MRI, found a relationship between reduced amygdala volume and higher psychopathy scores in violent offenders as measured with the PCL-R. Functional deficits in the amygdala and hippocampus have been found in aggressive and violent offenders. For example, Raine, Buchsbaum, and LaCasse (1997) observed, in a PET study with murderers, abnormal functional asymmetries: a lower left and a higher right functioning in both structures. In a similar way, Soderstrom, Tullber, Wikkelsö, Ekholm, and Forsman (2000) found a bilateral reduced functioning of the hippocampus in a SPECT study with violent offenders. Laakso and colleagues (2001) observed a volume reduction of the hippocampus in violent and antisocial offenders compared to controls. Schneider and colleagues (2000) observed an increased activation in the amygdala in psychopaths with

antisocial personality disorder during an aversive conditioning paradigm. Kiehl and colleagues (2001), during a memory task requiring the processing of emotional stimuli (neutral and negative words), found a reduced activation in the amygdala and hippocampus in psychopaths using fMRI. Regarding structure, Laakso and colleagues (2001) found, through MRI, an association between reduced hippocampal volume and higher psychopathy scores in antisocial alcohol abusers. Birbaumer and colleagues (2005) and Veit and colleagues (2002) found that adults with the disorder presented with reduced amygdala activation during aversive conditioning tasks.

1.4.3 Anterior Cingulate Cortex

Psychopathy is also associated with ACC dysfunctions. The anterior cingulate cortex plays a key role in several cognitive functions, such as decision-making, empathy, impulse control, emotional regulation, error detection and conflict monitoring, and reward anticipation (Decety & Jackson, 2004; Jackson, Brunet, Meltzoff, Decety, 2006; Bush, Luu, Posner, 2000). Activation in the anterior and posterior cingulate cortex has also been associated with attentional processes (Heinze et al., 1994; Posner and DiGirolamo, 1998) and affective processes (Mayberg et al., 1999). Lesions to the right ACC have been found to cause deficits in inhibitory control and emotional processing (Danckert et al., 2000; Hornak et al., 2003). In humans, ACC lesions cause perseverative behavior (Mesulam, 2000), deficit in recognizing facial and vocal emotional expressions (Hornak et al., 2003), impaired error monitoring (Swick and Jovanovic, 2002), and dysregulated response inhibition (Kiehl, Liddle, & Hopfinger, 2000).

1.5 Psychophysiology of Psychopathy

1.5.1 Event-Related Potentials (ERPs)

1.5.1.1 Emotions

Emotions can be viewed as being organized around two motivational systems, appetitive and defensive, that evolved to guide individuals in their environmental and social interactions (Bradley, Codispoti, Cuthbert, & Lang, 2001). The appetitive system is activated in positive contexts promoting survival, such as procreation, nourishment, and nurturance, and it foster a behavioral repertoire of ingestions, copulation, and care giving. Conversely, the defensive system is activated in threatening and fearful situations, with a behavioral repertoire of withdrawal, and fight or flight responses. Direction and intensity of motivational activation can be indicated by two predominant factors: valence and arousal. Subjective evaluations of pleasure or displeasure (valence) indicate which of the two motivational systems is activated, whereas judgments of arousal indicate the intensity level of this activation. Subjective reports are not direct indicators of neural activity on motivational circuits, and they are influenced by personal, social, and cultural factors. Nevertheless, they broadly support the consistency of this two factors view and the hypothesis of a biological determination (Bradley et al., 2001). Several studies aimed at investigating appetitive and aversive states used pictures to induce affect and motivational circuits activation. Pictures with specific emotional contents are particularly relevant for individuals because of their association with reinforcers essential to survival and sustenance of individuals and species. Pictures eliciting an aversive state typically include attack, loss, illness, contamination, and mutilation contents, whereas pictures eliciting an appetitive state include generally erotic sex nudes, nature, families, and food contents. To evaluate reactivity direction, paradigms typically also include neutral pictures, representing contents neither pleasant

nor unpleasant, such as household objects or unexpressive faces. A widely used database of pictures used to elicit emotions is the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). It allows for a selection of images that are associated with standardized rating of valence and arousal, separately for men and women. Through the IAPS it is possible to replicate and compare published findings and to easily interpret and draw conclusions from multiple studies. A valid instrument often used to assess subjective evaluation of pleasure and arousal associated with emotional pictures is the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). It is a non-verbal, graphic, assessment technique that measures reports of affective response in many emotional contexts. For valence evaluation, SAM depicts various figures ranging from a smiling and happy one, to an unhappy and frowning one (see Fig. 1.1, top panel). For arousal dimension, SAM depicts a range of graphic stimuli from an excited and highly activated figure, to a sleepy and closed eyes figure (see Fig. 1.1, middle panel). SAM also considers a third dimension: the feeling of control in front of emotional situations (dominance). This third dimension is represented as a change in the size of figures, from a large figure indicating complete control of the situation, to a small figure indicating a lack of control of an overwhelming situation (see Fig. 1.1, bottom panel). In the paper-and-pencil version of the SAM, or in its computerized version, the individual is asked to place and "x" or to click with the mouse over any of the five figures in each dimension, or between figures, resulting in a 9-point rating scale.

Emotions cannot be considered apart from bodily changes and during presentation and subjective evaluation of emotional stimuli, also several psychophysiological measures can be collected, as they can be valid and useful indexes to investigate motivational activation. For example, during defensive states, several

studies observed cardiac deceleration (e.g., Fanselow, 1994), increases of blood pressure (e.g., LeDoux, Cicchetti, Xagoraris, & Romanski, 1990), potentiation of the startle reflex (e.g., Davis, 2006), and greater electrodermal activity (Hamm et al., 1997). During appetitive states, an inhibition of the startle reflex (e.g., Bradley, Cuthbert, & Lang, 1999), and higher skin conductance (e.g., Bradley et al., 2001) were observed.

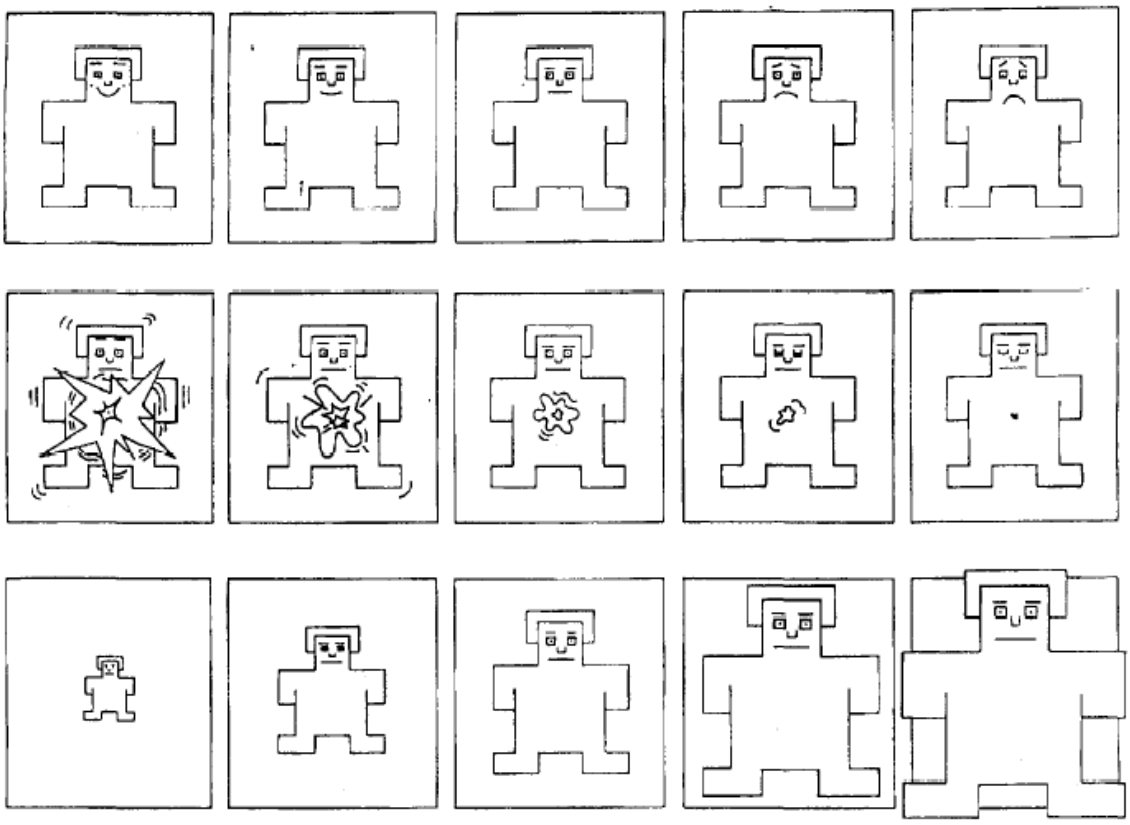

Figure 1.1 *The Self-Assessment Manikin (SAM) used to rate affective dimensions of valence (top panel), arousal (middle panel), and dominance (bottom panel). From Bradley & Lang (1994).*

Viewing affective pictures also elicits brain responses, which have been studied using a variety of measures, including the event-related potentials (ERPs). ERP waveforms are positive and negative voltage fluctuation, related to a set of underlying components, changing in size (amplitude) and time (latency), and associated with physical or psychological events. They can be recorded from the scalp and extracted from electroencephalographic activity through signal filtering and averaging. Some

components are referred to by acronyms (for example: ERN – Error-Related Negativity, FRN – Feedback-Related Negativity, CNV – Contingent Negative Variation, SPW – Slow Positive Wave), but most of them are referred to by a letter indicating polarity of the component ("N" for negative components, "P" for positive components) and a number indicating either the latency of the component (in milliseconds), or the ordinal position of the component into the waveform. A major advantage of using this technique is that its temporal resolution is very high, on the order of milliseconds, so that it can measure with great accuracy when brain activities take place (Picton et al., 2000).

The International Affective Picture System (IAPS; Lang et al., 2008), providing a standardized stimulus set for emotion and attention research, has been widely employed in affective ERPs studies. Its images vary systematically in their arousal and valence scores, so that ERPs component effects can be compared with IAPS rating and be easily interpreted. ERPs studies with IAPS pictures suggest that emotionally laden images capture greater attention than neutral images, with amplitude variations observed both for early and late components (Conroy & Polich, 2007; Schupp et al., 2000). The effects of arousal and valence seem to differ during temporal course: valence seems to have a greater influence on earlier ERPs components, whereas arousal seems to influence later components (Codispoti, Ferrari, & Bradley, 2007; Olofsson & Polich, 2007). Stimulus valence prompts an initial selective attention for salient contents, and several studies found greater effects produced by unpleasant and threatening stimuli rather than pleasant stimuli (Crawford & Cacioppo, 2002; Öhman & Mineka, 2001). This negativity bias could reflect a facilitating effect of amygdala for a rapid processing of aversive information (LeDoux, 1995; Morris, Öhman, & Dolan, 1998). Stimulus arousal determines attentional allocation for emotional processing with high intrinsic

motivational properties. This engagement facilitates memory encoding and storage of affective events (Bradley, Greenwald, Petry, & Lang, 1992; Lang, Greenwald, Bradley, & Hamm, 1993).

Short Latency Components (100-200 ms)

Some early ERPs (in the 100-200 ms range) have been found to be emotionally modulated by picture stimuli. P1 and N1 are sensory components sensitive to physical and perceptual characteristics of stimuli, and their processing is reflected by extrastriate visual cortex activity (Olofsson, Nordin, Sequeira, & Polich, 2008). These potentials also respond to manipulations of selective attention (Luck, Woodman, & Vogel, 2000; Vogel & Luck, 2000). Smith, Cacioppo, Larsen, and Chartrand (2003) administered affective target pictures (pleasant and unpleasant) matched on their arousal level, and they found, in occipital sites, a greater P1 potential in response to negative pictures rather than positive pictures. These results suggested a major engagement of selective attention for unpleasant stimuli. Similarly, Carretie, Hinojosa, Martin-Loeches, Mercado, and Tapia (2004) observed this negativity effect presenting single targets of unpleasant and pleasant images within a sequence of neutral images. Delplanque and Lavoie, Hot, Silvert, and Sequeira (2004) replicated these results for a late P1 at parietal-occipital sites using an oddball task. A study by Carretie and colleagues Hinojosa, Albert, and Mercado (2006) found greater P1 positivity for negative stimuli at frontal sites. A late N1 component was found resistant to habituation for high arousing unpleasant pictures compared to other emotional stimuli (Carretie, Hinojosa, & Mercado, 2003).

Middle Latency Components (200-300 ms)

Affect-related ERPs modulation has also been observed for middle latency components (in the 200-300 ms range). Processing in this range reflects stimulus discrimination and response selection (Di Russo, Taddei, Apnile, & Spinelli, 2006). The Early Posterior Negativity (EPN) is a component occurring at 200-300 ms and it shows greater amplitude in response to arousing stimuli, both pleasant and unpleasant, compared to neutral stimuli. It manifests with a negative polarity over fronto-central sites, and with a positive polarity over temporo-occipital sites (Schupp, Junghöfer, Weike, Hamm, 2003; Schupp, Markus, Weike, Hamm, 2003; Schupp et al., 2004, Schupp, Junghöfer, Weike, Hamm, 2004). It is theorized that the EPN reflects attention processes, selecting affectively arousing stimuli for deeper elaboration (Dolcos & Cabeza, 2002; Schupp et al., 2004). The N2 component affective modulation reflects selective attention for intrinsically relevant stimuli and it shows greater negativity in response to unpleasant compared to neutral and pleasant stimuli, and this effect was localized to the anterior cingulate cortex (Carretie et al., 2004).

Long Latency Components (>300 ms)

The last segment of the waveform related to emotional processing is characterized by the P300, and the subsequent Slow Positive Wave (SPW). The first component is often elicited with oddball paradigms, in which target stimuli are presented in a series of non-target stimuli. It indexes attentional processes and memory encoding and storage (Polich, 2007), motivational significance, task relevance, arousal level, and mental resource allocation (Duncan-Johnson & Donchin, 1977; Polich & Kok, 1995; Squires, Donchin, Herning, & McCarthy, 1977). Arousal effects have been

observed in passive viewing paradigm, for active paradigm asking to discriminate affects, for oddball task employing emotional stimuli as targets or distractors (Delplanque, Silvert, Hot, Sequeira, 2005; Keil et al., 2002; Mini, Palomba, Angrilli, & Bravi, 1996; Schupp et al., 2000). Arousal modulated ERPs are generally of maximum amplitude over the parietal cortex, indicating how emotional arousal enhances activity in cerebral structures that are typically involved in target processing (Sabatinelli, Lang, Keil, & Bradley, 2007). Delplanque and colleagues (2005) observed greater amplitude over fronto-central sites using emotional stimuli as task-irrelevant distractors. The Slow Positive Wave (SPW) is involved in working memory processes and memory formation (Azizian & Polich, 2007). For example, Palomba, Angrilli, and Mini (1997) found greater SPW positivity for arousing stimuli in the 300-900 ms range, and reported how high arousing stimuli were recalled more often than neutral stimuli. Dolcos and Cabeza (2002) also found similar effects, observing higher positivity over centro-parietal sites for arousing stimuli that were later recalled. Keil and colleagues (2002) found an enhancement of neural activity for emotional compared to neutral images, both in the P3 and the Slow Positive Wave interval. Neural sources of the SPW modulation were located in the occipital and parietal cortex. Amrhein, Mühlberger, Pauli, and Wiedemann (2004) also found greater positivity for unpleasant and pleasant than for neutral images for the P300 and the SPW amplitude.

Affective individual variability in the Event-Related Potentials has so far received small consideration. Examining associations between psychological traits, such as empathy, callousness, and impulsivity, and ERP emotional variability, seems to be an important step towards a better comprehension of emotional reactivity and clinical affective dysfunctions.

Findings using Event-Related Potentials in psychopathy revealed an alteration in affective-related ERPs components in response to emotional stimuli. Hall and colleagues (2011) examined ERPs responses to emotional stimuli in a group of adult male offenders assessed with the Psychopathy Checklist-Revised (PCL-R). This instrument comprises a first factor measuring affective and interpersonal aspects of psychopathy, and a second factor measuring antisocial deviance, impulsivity, and aggressivity. The first factor was found to be associated with a reduced positivity of the Slow Positive Wave in response to aversive stimuli compared with neutral stimuli. The second factor was associated with an overall reduction in P3 amplitude in response to pictures, regardless of their valence. Hence, the first factor seems to be associated with a specific deficit in processing aversive and negative stimuli, whereas the second factor is related to a generalized deficit in inhibiting behavior.

1.5.1.2 Decision-making

Decision-making and risk taking are related processes that assume a fundamental role in daily life (Krain, Wilson, Arbuckle, Castellanos, & Milham, 2006). Individuals deal with problem-solving and unpredictable events every day. In order to live successfully, they have to compare different choices, and evaluate possible costs and achievements following an action or decision. Emotion and affects can have a strong influence on behavior regulation and organization. Several studies investigated ERPs modulations in decision-making and risky contexts. Bianchin and Angrilli (2011) investigated a slow negative component, belonging to the family of the Readiness Potential (called Decision Preceding Negativity – DPN), preceding a risky decision during the Iowa Gambling Task, and a fronto-central negative component (called Feedback-Related Negativity – FRN) elicited by a feedback revealing economic

outcome following the card choice. DPN was greater in right prefrontal sites 500 ms prior to the picking from economically disadvantageous compared to economically advantageous decks. FRN (occurring at 260 ms) showed a greater negativity to economic losses compared to economic gains in fronto-central sites (Fz-FCz). Gehring and Willoughby (2002) also analyzed neural processing occurring in response to feedback about monetary loss and gain in a monetary gambling task. The Authors found a higher sensitivity to losses in participants: a negative component occurring at 256 ms showed greater amplitude when participants were faced with a bad outcome (negative feedback) compared to a positive outcome. This component had a distribution in medial-frontal sites (Fz) and dipole localization modeling found the Anterior Cingulate Cortex (ACC) to be the neural generator of the component. Several Authors also found a greater negativity in response to negative feedback compared to positive feedback (Yeung & Sanfey, 2004; Nieuwenhuis, Holroyd, Mol, & Coles, 2004).

Psychopathy involves impairment at responding to stimuli associated with punishment, poorly planned behavior, impulsivity, and insensitivity to possible risky outcomes. Potts and colleagues (Potts, George, Martin, & Barratt, 2006) examined rewarding and punishing responses in a monetary task in undergraduate students with low vs. high impulsivity traits. The high impulsivity group showed a reduced medial frontal negative component in response to the punishment trials compared to the low impulsivity group. This reduced sensitivity to punishment in impulsive individuals could be associated with a greater attractiveness of immediate rewards despite potential long-term negative outcomes. Yamaguchi, Onoda, and Abe (2011) investigated the relationship between Feedback-Related Negativity (FRN) and impulsivity in healthy individuals performing a gambling task. They found an FRN after negative feedback informing about a monetary loss, and also a correlation between FRN amplitude and

impulsivity scores. Bernat, Nelson, Steele, Gehring, and Patrick (2011) examined the influence of externalizing pathology on responses to gain and loss feedback in a gambling task. Externalizing is a psychological construct reflecting a propensity toward impulsivity, antisocial behavior, sensation seeking, and substance abuse (Krueger, 2002). The Authors measured Feedback-Related Negativity (FRN) and P300 following the presentation of a feedback stimulus. P300 is generally studied in oddball paradigms, but it can also be found in response to feedbacks, and it is functionally distinct from the FRN (Frank, Woroch, & Curran, 2005). FRN in this study was not related to externalizing scores, whereas P300 positivity was reduced in high externalizing individuals, in response to both gain and loss feedback, reflecting a generalized hyporesponsivity in P300 amplitude rather than a specific effect of a feedback or the other.

1.5.2 Startle Reflex

The startle reflex is an automatic and reflexive response, not influenced by voluntary control, to an abrupt and intense stimulation (Grillon & Baas, 2003). It consists of a rapid sequential muscles contraction, which manifests with a forward thrusting of the head and a descending flexor wave reaction, extending through the trunk and the knees. In humans, the startle reflex response is generally measured by recording the eyeblink reflex, the most persistent and consistent component of the startle pattern (Landis & Hunt, 1939). It manifests with a rapid contraction of the orbicularis oculi muscle (see Figure 1.2), which is innervated by the facial nerve. Measurement of the orbicularis oculi during eyeblink is prevalently obtained through electromyography, using two electrodes placed below one eye. The EMG waveform is rectified and integrated, and scored for latency and peak amplitude. This method can

register signals proximal to the neural path of innervation (Lang, Bradley, and Cuthbert, 1990). The eyeblink reflex can be elicited by visual, tactile, or auditory brief and intense stimuli, and with a fast rise time. The great majority of studies employing startle reflex rely on acoustic startle, evoked by short noises (50 ms) with a high intensity (90-110 dB range). The noises are not noxious for the auditory system, because of its very short duration (Grillon & Baas, 2003). The acoustic startle blink has an onset latency ranging from 20 to 50 ms. Startle reflex amplitude shows a high variability reflecting variation in the internal state of the individual and it can be a valid tool yielding information about attentional and affective state of the organism (Filion, Dawson, & Schell, 1998). With regard to startle reflex investigation, two main research areas have emerged: General startle reactivity (in the absence of experimental manipulations), and affective startle reactivity, aimed at investigating emotional and motivational state of the individual. Startle reflex reflects the valence direction of an affective state, and this is a great advantage in the study of emotions. In fact, other psychophysiological correlates, such as cardiovascular, electrodermal, and facial electromyographic measures, do not index the emotional valence. The startle reflex can well integrate subjective and verbal reports, which can be biased by intentional distortions (Grillon & Baas, 2003).

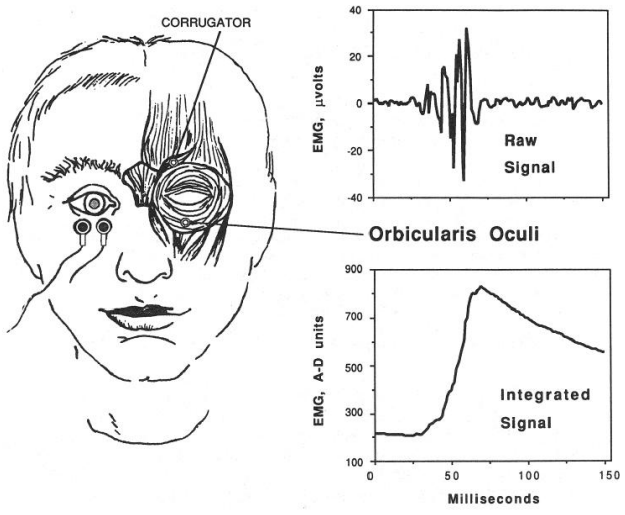

Figure 1.2. *Left panel: Orbicularis oculi and corrugator muscles, and placement of the recording electrodes. Top right panel: A muscle action potential registered during an eyeblink reflex. Bottom right panel: Integrated signal. The obtained waveform is scored for latency and peak amplitude analysis in most studies. From Lang, Bradley, & Cuthbert, 1990.*

1.5.2.1 Neural Mechanism of Startle Reflex

The primary acoustic startle reflex pathway has a very short latency and is mediated by a simple neural circuit, involving three central synapses (Davis, 2006): the auditory nerve fibers to cochlear root neurons; the cochlear root axons to neurons in the nucleus reticularis pontis caudalis; and the nucleus reticularis pontis caudalis axons to motor neurons in the facial motor nucleus (eyeblink reflex) or spinal cord (whole body startle). Fear can facilitate transmission in this short-latency pathway, and the amplitude of the startle reflex can be augmented in the presence of fearful or threatening stimuli (fear-potentiated startle). The neural station where fear alters the neural transmission of the startle reflex is the nucleus reticularis pontis caudalis (Davis, 2006). A key structure projecting to pontis caudalis and modulating startle during fear states is the amygdala, which sends projections from its lateral and basolateral nuclei through three parallel routes: a direct pathway from central nuclei of the amygdala to the pontis caudalis; an indirect pathway from central nuclei of the amygdala to deep layers of superior colliculus and mesencephalic reticular formation to pontis caudalis; and an indirect route from the medial nuclei of the amygdala, to the ventromedial hypothalamus, to the periaqueductal gray, to the pontis caudalis (Davis, 2006). The basolateral nuclei of the amygdala also projects to the bed nucleus of the stria terminalis, which projects to the startle pathway. The bed nucleus is part of the extended amygdala and it is similar to amygdala in terms of morphology, transmitter, and efferents (Alheid, De Olmos, Beltramino, 1995). It is a structure involved in responses to less defined and more durable threats (Gewirtz et al., 1998). Not only fear cues, but also situations of general anxiety can lead to a potentiation of the startle reflex. For example, general startle reactivity shows a gradual enhancement over the course of aversive conditioning, reflecting a response to chronic stress (Gewirtz, McNish, & Davis, 1998). Ameli, Ip,

and Grillon (2001) found an augmentation of the reflex amplitude when individuals were placed back in an environment where they had previously received electric shocks. There seems to be two separate response systems, each influencing the amplitude of the acoustic startle response. A first way, involving the central and medial nuclei of the amygdala, which has a role in mediating rapid responses to specific and contingent threat, and a second way, including the bed nucleus of the stria terminalis, which mediate a more sustained response and influence behavior for a long time after the eliciting stimulus disappeared. Central nuclei mediated behaviors can be referred to as "fear": a phasic response associated with a clearly identifiable source, whereas behaviors mediated by the bed nucleus can be referred to as "anxiety": a generalized feeling of worrying not related to a specific cue.

Lesions to the amygdala seem to confirm its key role in startle reflex modulation and in fear responses. Angrilli and colleagues (1996) studied affective modulation of the startle response in a male patient with a right amygdala lesion. He showed an overall inhibited startle reflex response controlateral to the lesion and did not show the typical potentiation of the reflex in response to aversive and negative stimuli.

Another key structure that seems to have an influence on startle reflex modulation is the orbitofrontal cortex. It is involved in organizing complex emotional responses and in social behavior (Adolphs, 1999). Lesions to this brain area cause behavioral and emotional problems similar to the ones observed in some psychiatric disorders, such as depression and psychopathy (Anderson et al., 1999; Angrilli et al., 1999; Damasio, Tranel, & Damasio, 1990; Stuss & Benson, 1984). Angrilli and collaborators (2008) investigated startle reflex responses in six male patients with localized lesion on the orbitofrontal cortex, compared to 20 healthy controls. Patients manifested a significant reduction of the startle reflex amplitude, and they also reported

a reduced perceived unpleasantness of the acoustic startle probe. Lesions to the orbitofrontal cortex seem to disrupt the cortical modulation on subcortical arousal, which is necessary for biological responses to emotionally relevant stimuli.

1.5.2.2 Startle Reflex Paradigms

Baseline Paradigms

Baseline startle reflex is defined as a resting response elicited by a sudden and intense stimulation in absence of any experimental manipulation. Its amplitude is coherent and constant intra-individually, but manifests with wide inter-individual differences (Filion et al., 1998). This generally leads researchers to normalize startle results to remove this great variability among individuals. Several studies though showed how this general startle reactivity might be associated with anxiety disorders. For example, Ludewig and colleagues (2005) found an enhanced general startle reactivity in patients with panic disorder. Kumari, Kaviani, Raven, Gray, and Checkley (2001) found a greater startle reflex reactivity and shorter latencies in obsessive-compulsive patients. Different Authors also found augmented baseline startle reactivity in war veterans with post-traumatic stress disorder (Morgan, Grillon, Southwick, Davis, & Charney, 1996; Orr, Lasko, Metzger, & Pitman, 1997; Grillon & Morgan, 1999). Psychopharmacological studies showed how anxiolytic and anxiogenic drugs can alter general startle reactivity. Diazepam and flurazepam, for example, reduce startle reflex amplitude (Davis, 1979), whereas stimulant drugs, such as caffeine and yohimbine, enhance general startle reactivity (Andrews, Blumenthal, & Flaten, 1998; Morgan et al., 1993).

Affective Modulation Paradigms

In the first study examining the effect of affective foreground on startle reflex modulation, Vrana, Spence, and Lang (1988) presented acoustic startle probes in the context of emotional pictures viewing, with positive, negative, and neutral contents. The selected positive and negative pictures varied in their valence, but were equally arousing. They found a linear trend in startle reflex amplitude: the smallest startle responses occurred during positive images viewing, whereas the greater startle response was observed during unpleasant pictures (see Fig. 1.3).

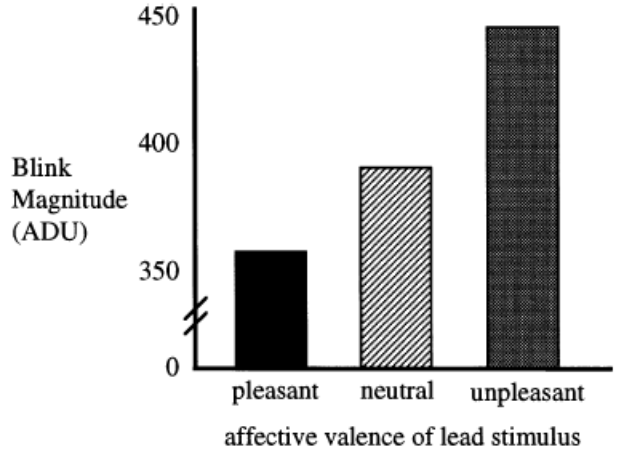

Figure 1.3. *Affective modulation of the startle reflex. Startle reflex magnitude was measured while participants view emotional picture stimuli. From Vrana, Spence, & Lang, 1988.*

These findings can be interpreted on the basis of the motivational priming theory proposed by Lang and collaborators (1990). They affirmed that physiological reflexes are determined by two factors: the classification of the reflex as being appetitive or aversive, and the actual affective state of the individual (positive or negative valence). Reflexes associated with and appetitive contingency (such as a salivary response to food) would be enhanced if activated when the individual is already experiencing a positive state. Conversely, defensive responses (such as the startle reflex) would be augmented when occurring during a negative emotional state. Hence, reflexes matching

an ongoing emotional process will be amplified. Also, when a reflex mismatches the actual affective state, it will be inhibited or attenuated (see Fig. 1.4).

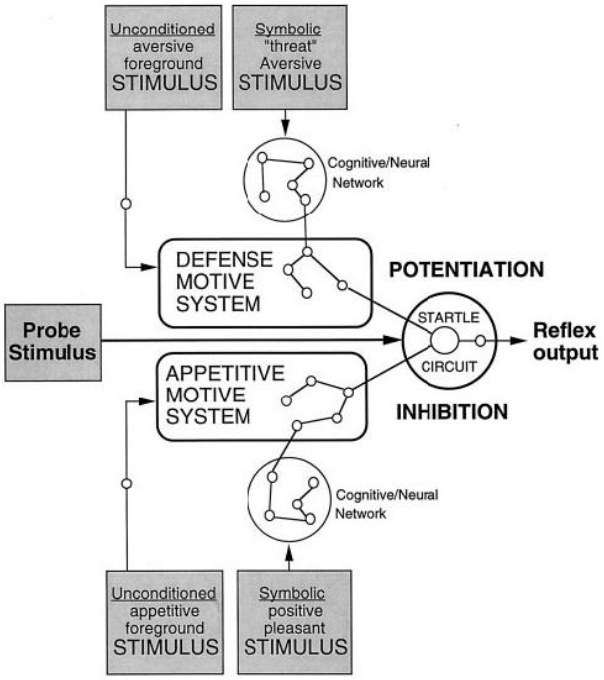

Figure 1.4. *Motivational priming theory. Probe stimuli prompt startle reflex. When a negative stimulus activates the defensive system, the startle reflex is potentiated. When the appetitive system is activated, the startle reflex results inhibited. From Lang, Bradley, and Cuthbert (1998).*

Several studies with normal individuals employing emotional pictures replicated this phenomenon (e.g., Bradley, Cuthbert, & Lang, 1991; Cuthbert, Bradley, & Lang, 1990; Bradley, Cuthbert, & Lang, 1990). Affective modulation of the startle reflex can provide useful information that is not available from behavioral and verbal measures and it may be a powerful and valid tool for assessing and better understanding affective differences in healthy and pathological individuals. For example, Hamm and colleagues (1997) reported greater startle potentiation in phobic individuals when they saw images depicting their phobic objects than when viewing other aversive images, and larger startle reflex amplitude when viewing phobic stimuli compared to normal controls viewing the same images.

A psychophysiological phenomenon commonly observed in psychopathic individuals is a lack of potentiation of the startle reflex in response to unpleasant and aversive stimuli. Patrick, Bradley, and Lang (1993) tested affective modulation of the startle reflex in incarcerated males divided into psychopathics, non-psychopathics, and a mixed group (classified though the PCL-R). They found that psychopaths did not show the typical pattern of potentiation of the startle reflex in response to negative emotional pictures compared to the other two groups (see Fig. 1.5). Furthermore, this lack of potentiation was related to the first factor of the PCL-R (affective/interpersonal facet), and not to the second factor (antisocial deviance). Psychopathic traits did not influenced subjective evaluation of the emotional pictures, which were evaluated in the same way among the three groups. Anomalies in the processing of emotional stimuli manifest at a physiological level independently from affective self-reports.

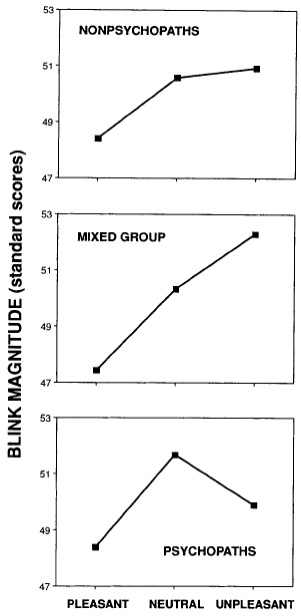

Figure 1.5. *Startle reflex responses during viewing of pleasant, neutral, and unpleasant pictures in three groups: non-psychopaths, mixed group, and psychopaths. From Patrick, Bradley, & Lang, 1993.*

Levenston, Patrick, Bradley, and Lang (2000) extended these findings analyzing startle reflex responses to specific content categories. Incarcerated psychopathic men and non-psychopaths (college students) viewed erotic or thrilling positive pictures, neutral pictures, and victims or direct threat unpleasant pictures while acoustic startle

probes were administered. Psychopaths manifested a startle reflex inhibition for both pleasant and unpleasant categories in relation to neutral. Concerning unpleasant contents, greater group differences were found for victim scenes, representing mutilations or attacks on others, where psychopaths showed a startle inhibition. This result could reflect an empathic deficit among psychopathic individuals (Aniskiewicz, 1979; Blair et al., 1997), who seem to have even a pleasurable response in front of others distress.

1.6 Assessment of Psychopathy

Several instruments have been developed for the evaluation and diagnosis of the psychopathic disorder. The most commonly used measure of psychopathy among incarcerated male offenders is the Psychopathy Checklist - Revised (Hare, 2003), that uses specific scoring criteria in a semi-structured interview, files, and collateral information, to assess traits and behavior related to psychopathy. Also a certain number of self-report measures have been developed in recent years, such as the Levenson Self-Report Psychopathy Scale (Levenson, Kiehl, & Fitzpatrick, 1995), and the Psychopathic Personality Inventory – Revised (Lilienfeld & Widows, 2005). The idea of evaluating psychopathy by asking psychopaths about themselves may seem illogical. It might seem pointless to evaluate a condition marked by dishonesty by asking individuals to respond honestly about their condition. Their lying is not limited to certain contingencies, they also frequently lie just for the fun of it, without experiencing anxiety or sense of guilt. Another problem of using self-report questionnaires is the fact that psychopaths often lack insight into their psychological problems and have no capability to perceive themselves as others perceive them. It is also problematic to ask individuals who do not experience emotions and feelings to evaluate the absence of them or to label their

affective experiences. Given these propensities toward dissimulation, self-report measures should be supplemented with other information, such as file data and observer qualitative evaluations. Nonetheless, self-report questionnaires are economical and easy administered, their validity is not influenced by interrater reliability, and they permit the detection of response styles in individuals, such as social desirability, positive impression management, and dissimulation.

1.6.1 Psychopathy Checklist – Revised (PCL-R)

The PCL-R (Hare, 2003) is considered the gold standard in psychopathy assessment. It is a 20 item scale widely used in research, clinical, and forensic settings. It uses a semistructured interview, file data, and collateral information to assess personality and behavioral psychopathic symptoms. Each item of the PCL-R is scored on a 3-point scale (0, 1, 2) according to the extent the specific item applies to the individual. Total score can range from 0 to 40, and a score of 30 is typically considered as a cuf off for the research on psychopathy. Several factor structures have been proposed for the PCL-R: an original 2-factor structure (Hare, 1991), a 3-factor model (Cooke and Michie, 2001), and a 4-factor model (Hare, 2003). The original PCL-R was thought to be composed of a Factor 1, described as Interpersonal/Affective, and a Factor 2, described as Social Deviance (see Tab. 1). Factor 1 is related to emotional and interpersonal components of psychopathy (e.g., lack of empathy or remorse, grandiosity, manipulativeness, charm), whereas factor 2 is related to traits indicative of antisocial behavior (e.g., impulsivity, juvenile delinquency, irresponsibility, lack of long-term goals). The PCL-R factor 1 has been found to be negatively associated with measures of anxiety (Hicks & Patrick, 2006), and positively associated with measures of social dominance (Verona, Patrick, & Joiner, 2001). Factor 2 of the PCL-R has

shown positive associations with measures of drug and alcohol abuse (Reardon, Lang, & Patrick, 2002; Smith & Newman, 1990), with anxiety, depression, and suicidal tendencies (Verona, Hicks, & Patrick, 2005; Hicks & Patrick, 2006). The PCL-R has some limitations as an assessment tool: it requires a long training, a long and careful interview, and access to official criminal records (non available in community populations).

PCL-R items

Interpersonal/Affective	**Social Deviance**
1. Glibness/Superficial Charm	1. Need for Stimulation/Proneness to Boredom
2. Grandiose Sense of Self-Worth	2. Parasitic Lifestyle
3. Pathological Lying	3. Promiscuous Sexual Behavior
4. Conning/Manipulative	4. Poor Behavioral Controls
5. Lack of Remorse or Guilt	5. Early Behavior Problems
6. Shallow Affect	6. Lack of Realistic, Long-Term Goals
7. Callous/Lack of Empathy	7. Impulsivity
8. Failure to accept Responsibility for own Actions	8. Irresponsibility
	9. Many Short-Term Marital Relationships
	10. Juvenile Delinquency
	11. Revocation of Conditional Release
	12. Criminal Versatility

Table 1. *Note: From Hare (1991)*

1.6.2 Levenson Self-Report Psychopathy Scale (LSRP)

The LSRP (Levenson et al., 1995) was developed to assess self-reported psychopathic traits in non-institutionalized samples. It consists of 26 items in a 4-point Likert scale format (from “Disagree Strongly” to “Agree Strongly”). It has a two factor structure (“Primary” and “Secondary”) that parallel the two factor of the PCL-R, named after a distinction proposed by Karpman (1941), who believed there were two different

types of psychopaths who manifested similar symptoms, but as a result of different causes. Primary Psychopaths were considered to be born with a predisposition toward meanness, callousness, and egocentricity, whereas Secondary Psychopaths were considered to behave "badly" as a consequence of environmental and social factors. The two subscales can also be differentiated on the basis of trait anxiety: high scorers on the Primary scale display low trait anxiety, whereas high scorers on the Secondary scale display high trait anxiety.

1.6.3 Psychopathic Personality Inventory – Revised (PPI-R)

The Psychopathic Personality Inventory was originally developed by Lilienfeld and Andrews (1996) to assess psychopathic traits in non-institutionalized and non-criminal samples. It has been recently revised by Lilienfeld and Widows (2005) and now comprises 154 items organized into 8 subscales assessing lower order facets of psychopathy. It also yields a total score representing global psychopathy. The PPI-R comprises validity scales intended to detect response styles in psychopaths: the Unlikely Virtues Scale (assessing positive impression management), the Deviant Scale (assessing malingering), and the Incoherent Responding Scale (assessing careless and random responding). Its eight factors are: Machiavellian Egocentricity (a willingness to manipulate others; e.g. "I sometimes try to get others to bend the rules for me if I can't change them any other way"), Social Influence (capability to dominate and influence others; e.g. "Even when others are upset with me, I can usually win them over with my charm"), Fearlessness (absence of anxiety and fear in dangerous situation; e.g. "Making a parachute jump would really frighten me"), Coldheartedness (lack of empathy and superficial affectivity; e.g. "I have had "crushes" on people that were so intense that they were painful"); Impulsive Nonconformity (disregard for traditions; e.g. "I

sometimes question authority figures"), Carefree Nonplanfullness (inability to plan the future; e.g. "I weigh the pros and the cons of major decisions carefully before making them"), Stress Immunity (absence of anxiety in negative and stressful situations; e.g. "I can remain calm in situations that would make many other people panic"), and Blame Externalization (a tendency to blame others for one's mistakes and failures). A factor analysis by Benning and colleagues (2003) demonstrated that the PPI has a two-factor structure resembling the two PCL-R factors. In this analysis, Social Influence, Stress Immunity, and Fearlessness loaded on the first factor (PPI-I), whereas Machiavellian Egocentricity, Impulsive Nonconformity, Blame Externalization, and Carefree Nonplanfulness loaded on the second factor (PPI-II). Coldheartedness, which assesses aspects related to the core features of psychopathy, such as lack of empathy, lack of remorse, and incapability to love, did not load on either factors.

1.6.4 Triarchic Psychopathy Measure (TriPM)

The TriPM is a self-report questionnaire developed by Patrick (2010) in order to measure psychopathy in non-institutionalized psychopaths from communities. Its structure reflects the triarchic conceptualization of psychopathy proposed by Patrick and colleagues (2009). The Disinhibition subscale comprises 20 items that capture tendencies toward impulsivity, irresponsibility, antisocial behavior and hostility. The Boldness subscale consists of 19 items selected to evaluate dominance, venturesomeness, and fearlessness. The Meanness subscale consists of 19 items evaluating tendencies toward cruelty, callousness, and lack of empathy. The sum of the three subscales (58 items) yields a Total Psychopathy Score. The three subscales demonstrated robust associations with several psychopathy measures and psychological constructs. Specifically, Disinhibition subscale scores are associated positively with the

Life-Style factor of the PCL-R, the Self-Centered Impulsivity subscale of the PPI, and negatively with measure of control and conscientiousness. The Boldness subscale showed positive correlation with the Interpersonal factor of the PCL-R, and the PPI Fearless Dominance, and negative correlations with measures of neuroticism and inhibition. The Meanness subscale showed positive associations with the Affective factor of the PCL-R, and the Machiavellian Egocentricity and Coldheartedness subscales of the PPI, and negative associations with measures of empathy and agreeableness (Hall et al., 2014).

1.6.5 Multidimensional Personality Questionnaire (MPQ)

The MPQ, in its Brief Form, was developed by Patrick, Curtin, and Tellegen (2002) in order to shorten the original version created by Tellegen (1982). It provides for an analysis of different personality traits across varying levels: it measures a range of discrete trait dispositions at a lower level, and also at broader structural levels, mapping into constructs of emotions and motivation.

There is a growing literature on the associations between MPQ traits and psychopathological disorders. Hence, if facets of psychopathy could be predicted from inventories of normal personality, data from community samples could be useful for the study of psychopathy.

The MPQ-BF includes 11 subscales: Wellbeing (having a happy disposition, being optimistic), Social Potency (enjoying visibility and dominance, being persuasive and strong), Achievement (being ambitious and enjoying challenging tasks), Social Closeness (being warm and affectionate, having close relationship), Stress Reaction (being sensitive to stress and negative events, anxious, and having unaccountable mood

changes), Alienation (feeling exploited and mistreated), Aggression (being physically violent and vengeful), Control (being reflective and cautious), Harm Avoidance (avoiding risks of injuries, disliking extreme adventures), Traditionalism (having high moral rules, endorsing religion), and Absorption (being able to imagine vividly and having experiences of altered awareness). The combination of scores on these subscales give rise to three higher order factors: Positive Emotionality, incorporating dispositions toward positive emotions and appetitive behavior, Negative Emotionality, incorporating disposition toward negative emotions and defensive behavior, and Constraints, entailing traits related to absence of impulsivity and behavioral restraint.

DiLalla (1989) investigated the relationship between MPQ and several diagnostic syndromes, and found an association between Negative Emotionality and antisocial personality disorder. Similarly, Krueger, Schmutte, Caspi, and Moffitt (1994) found an association between Negative Emotionality and Constraint, and delinquent and violent behavior. Verona and colleagues (2001) examined the associations between MPQ and PCL-R. Their analysis revealed a relationship between factor 1 of the PCL-R and high Social Potency and low Stress Reaction, and also a relationship between factor 2 of the PCL-R, and high Negative Emotionality scores and low Constraint scores. Interestingly, Benning and colleagues (2003) demonstrated how the two factors of the Psychopathic Personality Inventory – Revised (PPI-R) could be well predicted by primary trait scales of the MPQ-BF. Specifically, in regression analysis using the MPQ subscales, the PPI first factor (PPI-I) was significantly predicted by High Social Potency, low Stress Reaction, and low Harm Avoidance, whereas the PPI second factor (PPI-II) was significantly predicted by high Alienation, high Aggression, low Control, low Traditionalism, and low Social Closeness. Hence, the MPQ (and maybe other personality inventories) can be used to evaluate constructs underlying the PPI factors.

1.6.6 Interpersonal Reactivity Index (IRI)

The IRI (Davis, 1983) was not developed for the assessment of the psychopathic construct. It is a measure aimed at evaluating traits of emotional empathy and cognitive empathy in the general population. Being the lack of empathy central to psychopathy, it can be a valuable tool in the assessment of psychopathic traits.

Davis describes empathy as the "reactions of one individual to the observed experiences of another". The IRI comprises 28 items answered on a 5 points Likert scale, ranging from "Does not describe me well" to "Describes me very well". The instrument entails 4 subscales (of 7 items each): Perspective Taking scale (the capability to adopt the psychological point of view of other people), Fantasy scale (the capability to feel emotions and actions of fictitious characters of movies and books), Empathic Concern scale (evaluate the presence of feeling of concern for unlucky people), and Personal Distress scale (measuring the presence of feelings of stress and anxiety in tense situations).

1.7 Successful and Unsuccessful Psychopaths

In his landmark monograph, The Mask of Sanity (1941), Cleckley described several case studies of individuals who presented the core personality symptoms also observed in the typical and criminal psychopath, such as lack of empathy, callousness, egocentricity, and guiltlessness, but manifested those traits without aggressive and violent behavior, hence avoiding frequent arrests and encounters with the law. Cleckley described this population as "Successful" psychopaths, who embody the essential symptoms of psychopathy, but refrain from manifest antisocial acts. Probably, thanks to compensatory mechanisms such as high intelligence, a positive social and familiar

environment, and educational opportunities, they are able to express their personality tendencies in a more adaptive way.

"Successful" psychopaths are capable of functioning adaptively in community despite their underlying personality disease. They display superficial charm, manipulativeness, egocentricity, a parasitic lifestyle, lack of empathy, lack of guilt or remorse, and irresponsibility. They are cynical and callous, highly charismatic and smooth, and are often devoted to personal profit at the expense of moral norms. These arrogant, remorseless, and cunning individuals exploit family and friends in order to further their own interests and objectives. They can present with a charming, glib, and unethical behavior, and look for a way into positions of power disregarding the needs and wishes of others.

"Successful" psychopaths can be found at nearly any job occupation in society. In fact, some of their traits might be considered as valuable in some professions, such as politics, business, and law (Lykken, 1995). They often appear as ideal leaders and may tend to join some particular kinds of organizations, such as large financial corporations, because of the rewards they can offer in terms of self-enrichment and power positions. They could be noticed for having rapid promotions and rapid success because of their polish and cool decisiveness. Despite their personal charisma and charm, their acting without conscience and their selfish personality can have bad consequences and be destructive to the organizations that they work for and to society as a whole. Tactics such as exploitation, deception, lying, and manipulation can have serious negative consequences.

Due to the negative impact that "Successful" psychopaths can have on singular individuals and society, the study of psychopathy in community population is an area of growing interest, but limited by the fact that epidemiological studies do not typically

include assessment of psychopathic traits, and by the fact that there is a dearth of validated instruments for assessing psychopathy outside jails. The recruitment of psychopaths from the general population has also been a challenge because of the low rates of the disorders in non-institutional environments.

Studying psychopathy in general population can shed light on fundamental questions regarding the nature of the psychopathic construct. For example, it could help clarifying if there are some factors that protect against involvement in criminal and violent behavior. Furthermore, findings regarding criminal psychopaths may not generalize to criminal or noncriminal psychopaths residing in the community. For example, several biases could alter psychological and emotional responses in incarcerated samples. The atmosphere of prison could enhance exploitation of others, isolation and depression, frustration and aggressiveness, and also worsen health and physical conditions.

Studying "Successful" psychopaths can also help clarify if this personality disorder can be better conceived as a configuration of continuous and dimensional constructs, or as a constellation of discrete categories. It can help clarify if these community individuals represent less extreme examples of psychopathy, if they just express their pathology in a more adaptive way, and if there is an overlapping in the etiology and manifestations of the disorder.

There have been only a few studies of the psychophysiological correlates of psychopathy in "Successful" psychopaths. For example, Ishikawa, Raine, Lencz, Bihrle, and Lacasse (2001) studied successful (who never committed a crime) and unsuccessful (convicted of a crime) psychopaths in the community. Successful psychopaths exhibited reported lower scores at the PCL-R, factor 2, manifested higher heart reactivity to stressors. However, this sample reported a higher crimes rate than the average citizen.

Vanman, Mejia, Dawson, Schell, and Raine (2003) investigated startle reflex affective modulation (with neutral and negative pictures) in the same community sample. They found a reduced affective startle potentiation in psychopaths from the community. Studies employing a more representative community sample and more appropriate diagnostic instruments would be valuable.

1.8 Gender Differences

In our culture, there is a widely diffused stereotype stating that women are more emotional than men (Fischer & Manstead, 2000) and, in particular, women are believed to be more sensitive to negative events, such as fearful or threatening stimuli (Kring & Gordon, 1998). Due to an augmented reaction to unpleasant stimulation, women are also at higher risk for anxiety and depression (Sachs-Ericsson & Ciarlo, 2000). Several theories propose the existence of both biological and sociological contributors to this sex differentiation in emotional experience and manifestation. For example, differences in body weight and physical size, strength, and hormonal balance, may influence responses to threatening stimuli (Gordon & Riger, 1991), and social influences could reinforce differences in emotional expression between the two sexes.

Several studies reported brain differences between males and females in areas involved in the emotional regulation. For example, Goldstein and colleagues (2001) found a larger grey matter volume in prefrontal cortex, anterior cingulated cortex, and hippocampus in women, while men showed larger volume of the hypothalamus, frontomedial cortex, and amygdala. Women also displayed greater activity than men in the inferior frontal cortex during an eliciting sadness task (George, Ketter, Parekh, Herscovitch, & Post, 1996). In another study, men showed greater activation in the

inferior and medial frontal gyrus to positive visual stimuli, whereas women displayed greater activation in the medial and anterior cingulated gyrus in response to negative visual stimuli (Wrase et al., 2003). In an fMRI study, Sabatinelli, Flaish, Bradley, Fitzsimmons, and Lang (2004) found a greater extrastriate activity in men, compared to women, during erotic pictures viewing. Also neurotransmitters rates differ among genders: serotonin, a neurotransmitter important in mood and aggressivity regulation, is only 50% in women as compared with male (Nishizawa et al., 1997).

Bianchin and Angrilli (2012) investigated gender differences in affective psychophysiological responses in men and women while viewing emotional pictures. They found general greater startle reactivity, and a greater startle response to unpleasant stimuli, in women compared with men. Analyzing an ERPs Slow Positive Component (400-800 ms) they found, in left prefrontal sites, a greater amplitude to unpleasant stimuli compared with pleasant stimuli in women (where a greater positivity index a deeper processing of emotionally arousing stimuli), while men did not show this asymmetry. Kemp, Silberstein, Armstrong, & Nathan (2004) also found gender differences in the processing of visual emotional stimuli: women, compared with men, showed a greater processing of unpleasant pictures relative to neutral pictures. Kofler, Müller, Reggiani, and Valls-Solé (2001) investigated the influence of gender in a baseline startle paradigm and found greater startle amplitude in women compared to men.

Bradley, Codispoti, and Sabatinelli (2001) investigated sex differences in affective reactions while viewing emotional pictures. They found women to be more defensively reactive to negative stimuli, while men were found to be more aroused by erotic pictures than women. In fact, women responded with greater cardiac deceleration (an index of heightened attention), and greater electrodermal reactivity, while viewing

negative emotional pictures. These reflexive responses were also accompanied by subjective evaluation of greater unpleasantness. Negative stimuli prompted a greater defensive reaction in women than men, whereas for men unpleasant pictures might prompt a reaction of interest and attention. Men reacted with greater electrodermal responsivity and reported subjective evaluation of greater arousal and pleasantness when viewing erotic stimuli. Furthermore, whereas men reported feeling excited and sexy while viewing erotica, women reported feeling embarrassed. Corrugator and zygomatic EMG also indicated that women frowned more than men while viewing unpleasant pictures, and men smiled less than women while viewing pleasant pictures.

While gender differences in emotional regulation have been extensively studied in normal populations, only a few researchers attempted to study the psychopathic construct and its related emotional dysregulation in women and to validate specific assessment tools for female population.

Antisocial personality disorder and psychopathy are less prevalent in women compared to men. Crime rates and violent behavior are also lower in females. An epidemiological survey (Regier, Shapiro, Kessler, & Taube, 1984) found that 2-4% of men fulfilled criteria for antisocial personality disorder, whereas only 0.5-1% of women was diagnosed as having antisocial disorders. Also, the National Comorbidity Study (Kessler et al., 1994) found higher rates of antisocial personality disorder in men compared to women (5.8% versus 1.2%). Several studies reported higher rates of psychopathy in men compared to women and lower psychopathy scores for females using PCL-R and its derivatives (Rutherford, Cacciola, Alterman, & McKay, 1996; Forth, Brown, Hart, & Hare, 1996; Nicholls, Ogloff, Brink, & Spidel, 2005; Grann, 2000). Some Authors have suggested that psychopathy may manifests differently in males and females: the disorder seems to be associated with histrionic personality

disorder in women, and with antisocial personality disorder in men (Cale & Lilienfeld, 2002). It has also been argued that some traits associated with offending behavior express differently in the two genders: impulsivity may be expressed as violence and aggressivity against others in men, and prevalently as self-harming behavior in women (Forouzan & Cooke, 2005). Gender differences were also found for paranoid and borderline personality disorders, where paranoid disorder appears to be more prevalent in men, and borderline disorder seems more prevalent in women (Singleton, Gatward, & Meltzer, 1998). However, research on psychopathy has often ignored sex differences and developed assessment instrument and theories irrespective of gender.

In recent years, progresses have been made in identifying psychophysiological traits associated with emotional regulation in psychopathy, but most of the existing research investigated these aspects in incarcerated male samples, data including incarcerated females are particularly rare, and even more rare are data from non-incarcerated females. Sutton, Vitale, and Newman (2002) examined emotional reactions in women classified as psychopathic using the PCL-R. Startle probes were presented at 2.0 or 4.5 seconds after the onset of emotional pictures (lasting 6 seconds each). At 2.0 seconds, non-psychopaths and psychopaths with high anxiety scores exhibited the typical affective modulation of the startle reflex, whereas psychopaths with low anxiety scores showed inhibited reflex amplitudes during unpleasant pictures viewing. At 4.5 seconds, the three groups did not differentiate in their startle reflex modulation, and they all exhibited a normal potentiation of the reflex while viewing negative pictures. Therefore, in this study, it seemed that responding to unpleasant stimuli was delayed in psychopathic females with low anxiety traits, but not completely absent. Justus and Finn (2007) analyzed gender differences in affective startle reflex modulation in non-incarcerated samples. Men with high levels of psychopathy failed to show a potentiation

of the startle reflex during negative pictures viewing but only with early startle probe (2.0 seconds). Furthermore, both genders with low Harm Avoidance and low Anxiety scores did not show significant startle responses to aversive pictures. These results suggested that emotional impairment extend to non-incarcerated psychopathic individuals, but it may be influenced by factors such as gender, personality traits, and bias due to incarceration. Anderson, Stanford, Wan, and Young (2011) examined startle reflex affective modulation and P3 amplitude in a sample of non-incarcerated undergraduate females, using the PPI-R as assessment tool. They manifested a lack of startle reflex potentiation and also greater P3 positivity during an oddball task. This effect was clearly due to the core affective traits of psychopathy, rather than its antisocial traits. Vitale and Newman (2001) examined psychopathic traits in incarcerated women using the PCL-R. Women were asked to perform a card task that had already been used in psychopathic men for assessing response perseveration. Contrary to predictions and to results found in men, women did not perseverate during the task, when the PCL-R was used either as a dimensional or a categorical construct.

It is fundamental to further investigate such gender differences, to examine if some physiological aspects related to psychopathy are gender specific, to understand which factors might influence different expressions of the disorder in females versus males, and to elucidate which psychological traits of psychopathy are responsible for the impaired affective regulation observed in the disorder.

1.9 Aims of the Research Project

In the past years, research about the psychopathic construct has focused on institutionalized and criminal samples ("Unsuccessful" psychopaths), and there has

been a dearth of studies about psychopaths in non-institutionalized samples ("Successful" psychopaths). This limit reflects the fact that there is a low rate of psychopathic disorders outside prisons, and this makes easier to recruit participants in prisons. Also, the gold standard tool for assessing psychopathy (the PCL-R) is more adapt for criminal and antisocial individuals, and different instrument are needed for measuring psychopathic traits in individuals from the community. Furthermore, due to the fact that prison environments are populated by men, most of the existing research focused on exclusively male samples, and data about women are rare. Even more rare are studies on women from community.

Aim of the present research was to study subjective and psychophysiological emotional regulation, decision-making, and sensitivity to reward and punishment, in women from the community with low empathy and high psychopathic traits.

Studying psychopathy in community samples can help better understand if the disease manifests with discrete or continuous facets, which factors help "successful" psychopaths to behave in an adaptive way, and which is the core etiological aspect leading to the manifestation of the disorder. Studying female psychopathy is fundamental to investigate differences in the etiology and manifestation of the disease in the two genders. Psychopathic behavior damages other individuals and society as a whole.

CHAPTER 2

STUDY I: Affective Modulation of the Startle Reflex in Women with low and high Empathy Levels

2.1 Abstract

Empathy refers to the capability to understand feelings and thoughts of others and has a key role in moral and prosocial behavior. Emotional detachment and lack of empathy are core features of psychopathic personality and lead to aggressivity and antisocial behavior. We investigated the influence of empathy on subjective evaluation of affective pictures and emotional psychophysiological responses. Thirty-two women were divided into a low empathy and a high empathy group based on questionnaires scores. Participants viewed 96 IAPS pictures divided into pleasant (erotic and neutral), neutral, and unpleasant (mutilation and threat) while startle reflex and EEG were recorded. Unsignaled acoustic startle probes were presented on half of the trials in each valence category. Subjective evaluations of valence and arousal were assessed through the Self-Assessment Manikin. Results showed significant Group by Category interactions in subjective ratings of valence and arousal: low empathy participants rated the threat pictures as more pleasant, and the erotic, mutilation, and threat pictures as less arousing, compared to the high empathy participants. The two groups did not differ in their psychophysiological responses. Results showed greater startle reflex amplitude in response to threat compared to pleasant pictures, and reduced startle responses to erotic compared with neutral and unpleasant pictures. The P300 and the Slow Positive Wave showed greater amplitude for pleasant and unpleasant compared to neutral pictures.

Data showed a dissociation between verbal reports and psychophysiological measures. Individual differences in empathy and emotional detachment have an influence on cognitive evaluation of affective stimuli, but not on the emotional modulation of psychophysiological correlates.

2.2 Introduction

Empathy has been defined in several ways in past years and despite its importance there has been little agreement on its theoretical definition. In a broad sense, it refers to "the reaction of one individual to the observed experiences of another" (Davis, 1983). Researchers distinguish an affective and a cognitive component of empathy. The former refers to emotional and visceral reactions to another's affective state, the latter relates to an intellectual comprehension of thoughts and feelings of others. These two components of empathy are strongly interrelated and cannot be easily distinguished (Baron-Cohen & Wheelwright, 2004). Empathy is fundamental to emotional regulation, emotional communication, prosocial behavior, and social interaction, and is a key element of moral conduct (Hogan, 1969). A lack of empathy has been implicated in several psychopathologies, and is a cause of aggressive and antisocial behavior, impulsiveness, and acts of violence (Lauterbach & Hosser, 2007). A strong example is psychopathy, in which lack of empathy, emotional detachment, egocentrism, and callousness lead to criminal behavior with high recidivism rates (Jolliffe & Farrington, 2007).

The affective modulation of the startle reflex represents a valid paradigm for studying individual differences in emotional and physiological reaction to affective cues. The startle reflex is an automatic and defensive response to an abrupt and intense

stimulation. It consists of a sequential descending muscle contraction extending from the head through the truck and the knees and it is aimed at protecting the body from a sudden attack. Variations in the amplitude of the startle response reflect the activation of the motivational systems. A "match" between an aversive and threatening stimulus and the startle response potentiate the amplitude of the startle reaction, whereas a "mismatch" between an appetitive stimulus and the startle response will inhibit the reflex (Lang et al., 1998). Therefore, a typical affective modulation of the startle reflex will show a linear trend with inhibited startle responses to pleasant stimuli, and potentiated startle responses to unpleasant stimuli (Vrana et al., 1988). Startle reactions can be a useful index of the appetitive or aversive valence disposition of the individual, in relation to emotional stimuli.

Patrick and colleagues (1993) compared startle reflex responses in psychopathic men, non-psychopathic men, and a mixed group (assessed by means of the PCL-R). They found that startle responses of criminal psychopathic men during exposure to appetitive and aversive emotional stimuli was significantly smaller than during exposure to neutral stimuli. This phenomenon was related to the absence of empathy in psychopaths, rather than to antisocial behavior. Justus and Finn (2007) found an absence of the typical startle response potentiation during exposure to aversive stimuli in non-incarcerated men with psychopathic traits and high levels of emotional detachment. Sutton and colleagues (2002) reported attenuated startle reflex amplitude in incarcerated psychopathic women during exposure to unpleasant stimuli. These data were extended to non-incarcerated women with high psychopathic traits by Anderson and colleagues (2011), who reported a lack of affective potentiation of the startle reflex during the presentation of unpleasant pictures in a normal-range sample of students. This effect was clearly due to the emotional detachment component of psychopathy

rather than antisocial traits.

Elaboration of emotional and affective cues can also be investigated with ERPs component analysis. In the literature, active or passive exposure to emotional material has been generally associated with higher cortical positivity, as compared to neutral material, indicating a deeper elaboration of affective information. This positive waveform begins approximately 300 milliseconds after the stimulus onset (in the region of the P300) and continues for several seconds (Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000). The most studied components in emotional investigation is the P300, an index of attention, recognition, and working memory (Polich, 2007), and the Slow Positive Wave (SPW), a component related to memory processing and recalling (Azizian & Polich, 2007). Radilova (1982) found an augmented P300 amplitude for unpleasant and pleasant pictures (dead bodies and erotica) compared to neutral pictures, irrespective of the valence of the pictures. Similarly, Palomba and colleagues (1997) found a larger P300 in response to emotional stimuli (pleasant and unpleasant) than neutral stimuli. Dolcos and Cabeza (2002) observed a greater SPW positivity for arousing stimuli that were later recalled from memory. Amrhein and colleagues (2004) found enhanced amplitude for unpleasant and pleasant pictures compared to neutral pictures in the Slow Positive Wave interval. These results suggest a heightened attention to stimuli that activate the motivation systems of the brain (appetitive or aversive) and are essential for our survival.

Aim of this study was to investigate, in female students, the influence of low and high levels of empathy and emotional detachment on self-report ratings of perceived valence and arousal of emotional pictures (pleasant, neutral, and unpleasant), and also on affective modulation of startle reflex and ERPs components during passive exposure to emotional pictures.

We choose an exclusively female sample to avoid gender differences bias. Indeed, men and women respond differently to emotional foreground. For example, women rate emotional pictures with higher valence rates than to men. Furthermore, women respond with greater defensive reaction to threat and fear stimuli, while men are more aroused when viewing erotic stimuli (Bradley et al., 2001). Kofler and colleagues (2001) found fewer and reduced startle amplitude in men compared with women. Concerning ERPs components, Bianchin and Angrilli (2012) found a greater positivity in response to unpleasant pictures compared to pleasant pictures in female participant, while men did not show significant differences between the two categories. Furthermore, influence of empathic dysfunction and emotional detachment on psychophysiological responses has been so far studied prevalently in male psychopathic clinical population and there is a lack of studies on emotional regulation in healthy females from community.

We expected lower mean ratings for unpleasant pictures and higher mean ratings for pleasant pictures. We also expected higher perceived arousal for emotional pictures compared to neutral ones. We hypothesized, in participants with low empathy levels, a generally reduced rated arousal for each valence category, higher valence ratings for unpleasant pictures, and lower valence ratings for pleasant pictures, compared to participants with high levels of empathy. As regards affective modulation of the startle reflex, we hypothesized reduced reflex amplitude during exposure to pleasant pictures, and a potentiation of the reflex during exposure to unpleasant pictures. We also hypothesized an attenuation of the startle response in participants with low empathy in response to unpleasant stimuli compared to participants with high empathy levels. We expected emotional stimuli to elicit a higher cortical positivity relative to neutral stimuli, and reduced amplitude of the ERPs component (P300 and SPW) in participants

with low empathy levels compared to participants with high empathy levels.

2.3 Methods

Participants

Participants were 57 undergraduate female students at the University of Padova, who participated for course credit in psychology classes (Mean age=19.78 years, SD=0.83). After filling out a consent form, they completed the Fear Survey Schedule (Wolpe & Lang, 1964), to exclude students with specific phobias, and several computerized questionnaires aimed at investigating emotional and cognitive empathy, and the level of emotional detachment in participants: the Interpersonal Reactivity Index – IRI (Davis, 1983), the Psychopathic Personality Inventory – Revised – PPI-R (Lilienfeld & Andrews, 1996), and the Levenson Self-Report Psychopathy Scale – LSRP (Levenson et al., 1995).

The Interpersonal Reactivity Index is a 28 items self-report measure consisting of four subscales, each analyzing a different aspect of the global concept of empathy. The Perspective Taking (PT) scale assesses the individual's ability to spontaneously adopt the point of view of others, the Fantasy (FS) scale assesses the tendency to imagine themselves as being fictitious characters for movies or books. The Empathic Concern (EC) scale assesses the feeling of concern and compassion for others, while the Personal Distress (PD) scale assesses feelings of discomfort and apprehension in experiencing tense social situations.

The Psychopathic Personality Inventory – Revised is a 154-items self-report measure that assesses personality traits of psychopathy in noncriminal populations. The eight subscales of the PPI-R are: Machiavellian Egocentricity, Social Influence, Coldheartedness, Carefree Nonplanfulness, Fearlessness, Blame Externalization,

Impulsive Nonconformity, and Stress Immunity. We were interested in Coldheartedness subscale scoring, which is a measure of the tendency to callousness and emotional detachment.

The Levenson Self-Report Psychopathy Scale is a 26-items questionnaire that evaluates Primary Psychopathy (callousness, emotional detachment) and Secondary Psychopathy (antisocial behaviors) in community samples.

Thirty-two participants were selected based on questionnaires scoring (see Tab. 2.1): 16 students with relative low empathy levels (IRI), high coldheartedness (PPI-R), and high Primary Psychopathy scores (LSRP), and 16 students with relative high empathy levels (IRI), low coldheartedness (PPI-R), and low Primary Psychopathy scores (LSRP).

	Mean Low Empathy	**Mean High Empathy**	**SD Low Empathy**	**SD High Empathy**	**T Test**
Questionnaires					
Perspective Taking (IRI)	19.12	21.31	3.84	3.28	$t_{(30)}$=-1.73, n.s.
Fantasy (IRI)	20.56	23.00	3.83	3.56	$t_{(30)}$=-1.86, p=0.07
Empathic Concern (IRI)	17.44	20.81	2.37	1.51	$t_{(30)}$=-4.81***
Personal Distress (IRI)	17.25	19.06	2.91	3.62	$t_{(30)}$=-1.56, n.s.
Total IRI	74.37	84.19	8.94	6.02	$t_{(30)}$=-3.64**
Coldheartedness (PPI-R)	1.50	-0.69	0.71	0.49	$t_{(30)}$=10.15***
Primary Psychop. (LSRP)	28.62	24.50	5.38	3.56	$t_{(30)}$=2.56*

Table 2.1. *Interpersonal Reactivity Index, Coldheartedness (PPI-R), and Primary Psychopathy (LSRP). Mean scores, Standard Deviations and T Test for the Low Empathy group (n=16) and the High Empathy Group (n=16). (n.s.=non significant; *=p<0.05; **=p<0.01; ***=p<0.001).*

Procedure

Participants were seated in a comfortable recliner in a small, dimly lit room, and electrodes for orbicularis oculi's electromyographic activity and EEG registration were placed.

Ninety-six pictures were selected from the International Affective Picture System (IAPS) (Lang et al., 2008), a collection of standardized photographic materials. They comprised 16 erotic and 16 sport pictures, typically rated as pleasant, 32 neutral pictures (e.g. household objects), 16 mutilations and 16 fear pictures, typically rated as unpleasant. They were presented on the computer in a pseudo-randomized order. The unpleasant and pleasant pictures were overall equivalent in rated arousal and more arousing than the neutral pictures. Each of the pictures was shown for 5 s, followed by a 4-6 s intertrial interval. Acoustic startle probes were presented binaurally through headphones on half of the trials in each valence category, 3 s after picture onset. The acoustic startle stimulus was a 50 msec duration burst of white noise (100 dBA) with instantaneous rise time.

The participants were instructed to pay attention to each picture on the monitor and to ignore the brief noises heard over the headphones.

Participants saw then the 96 pictures again during a non-recording session and reported valence and arousal ratings for each picture through the computerized Self-Assessment Manikin - SAM (Bradley & Lang, 1994).

Finally, participants were debriefed.

Physiological Recording

We used a labVIEW program (Angrilli, 1995) for acquisition and analysis of psychophysiological data. The eyeblink component of the startle response was recorded with 4 mm Ag/AgCl electrodes placed on the orbicularis oculi muscle beneath the left eye. Impedance was kept below 5 kOhm. The EMG signal was sampled at a rate of 250 Hz and amplified with a gain of 10000. We used a 16 Hz first order low pass and a 340 Hz second order high pass and rectified and integrated the signal with a 100 ms time constant integrator. The raw signal was divided into epochs from 2000 ms before the onset to 6000 ms after the onset of the stimulus and visually inspected to reject artifacts or non-responses. The valid trials for each valence category were then averaged. We inspected the averaged signal and identified a 20 ms window centered on the startle response peak for each participant. The startle reflex amplitude for each valence category was calculated as the mean value of the EMG signal in this selected window. EEG was registered through three 10 mm Ag/AgCl electrodes placed in F7, F8, and Pz sites, according to the 10-20 International System (Jasper, 1958). We used linked mastoids as reference. Impedance was kept below 5 kOhm. The signal was amplified with a gain of 10000 and filtered with an 80 Hz second order low pass filter and a time constant of 10 s. Vertical eye movements were recorded through electrodes placed below and above the right eye. This signal was amplified with a gain of 4000 and filtered with an 80 Hz second order low pass filter and a time constant of 10 s. The EEG signal was divided in epochs from 2000 ms before the onset to 6000 ms after the onset of the stimulus and visually inspected to reject artifacts. The epochs were corrected by a 200 ms baseline preceding the onset of the visual stimulus and averaged separately for

each valence category. We analyzed the 320–440 ms window, corresponding to the P300 component, and the 600-800 ms window, corresponding to the Slow Positive Wave (see Fig. 2.1).

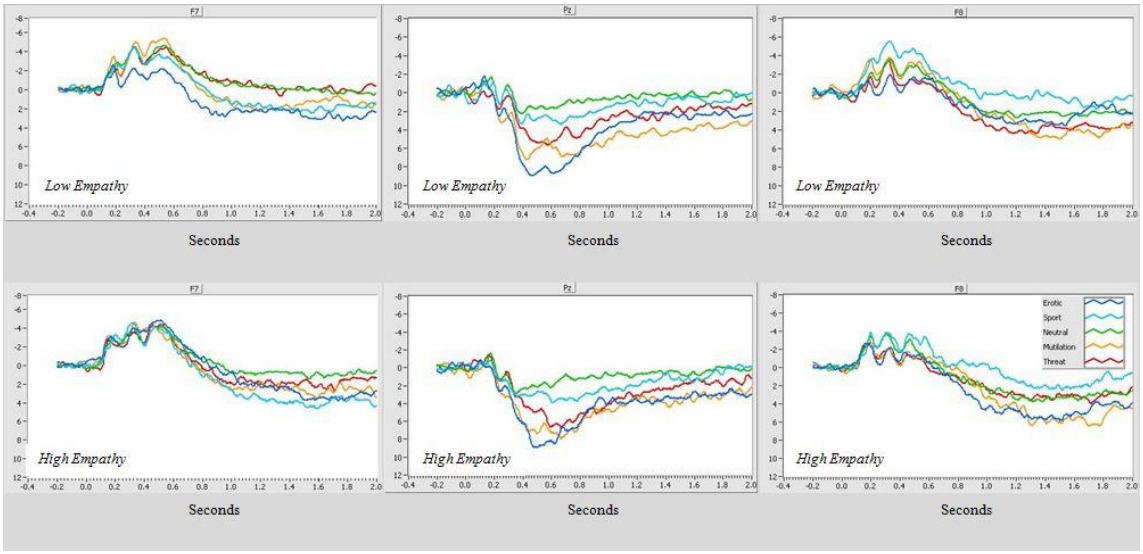

Figure 2.1. *Grand average waveforms at the three electrode locations (F7, Pz, F8) in Low Empathy (upper panels) and High Empathy (lower panel) participants for the five emotional categories (Erotic, Sport, Neutral, Mutilation, Threat).*

Statistical Analysis

Valence and arousal ratings of the pictures, collected through the Self-Assessment Manikin, were analyzed using repeated measures analyses of variance (ANOVA) with Group (Low vs. High Empathy) as a between-subjects factor and Stimulus (Erotic, Sport, Neutral, Mutilation, Fear) as a within-subjects factor.

Blink amplitudes were standardized within each participant, to reduce between-subjects variability. We calculated the mean and standard deviation of startle reflexes elicited during the observation of neutral pictures and then transformed the values of each valence category in z-score. Finally, we applied a T-score transformation to the z-scores (x=((z x 10) + 50)). Data were analyzed using ANOVA with Group as a

between-subjects factor (Low vs. High Empathy) and Stimulus as a within-subjects factor (Erotic, Sport, Neutral, Mutilation, Fear).

The P300 and Slow Positive Wave components mean average were analyzed using ANOVA, with Group (Low vs. High Empathy) as a between-subjects factor and Site (F7, Pz, F8) and Stimulus (Erotic, Sport, Neutral, Mutilation, Fear) as within-subjects factors.

The significance level was set at .05 for all analysis. Newman-Keuls post-hoc test further specified significant effects.

2.4 Results

Analysis of rated valence highlighted a significant Stimulus main effect ($F_{(4,120)}$=238.25, Ɛ=0.59, p<0.001, η^2p=0.89). Both groups of participants reported more perceived pleasantness for erotic pictures compared to neutral (p<0.001), mutilation (p<0.001) and fear (p<0.001) ones. Sport pictures were evaluated as more pleasant than neutral (p<0.001), mutilation (p<0.001), and fear (p<0.001) pictures. Participants perceived neutral slides as more pleasant compared to mutilation (p<0.001) and fear (p<0.001) slides. Rated valence was higher for fear images compared to mutilation ones (p<0.001). The Group x Stimulus interaction was also significant ($F_{(4,120)}$=2.62, Ɛ=0.59, p<0.05, η^2p=0.08). As seen in Figure 2.2, the Low Empathy group perceived the fear pictures as more pleasant than the High Empathy group (p<0.01).

Analysis of perceived arousal highlighted a significant Group main effect ($F_{(1,30)}$=6.16, p<0.05, η^2p=0.17): the Low Empathy group showed an overall reduced perceived arousal during the observation of the pictures. We also found a significant Stimulus main effect ($F_{4,120)}$=75.14, Ɛ=0.74, p<0.001, η^2p=0.71), where pleasant and unpleasant pictures were perceived as more arousing than neutral pictures (all

ps<0.001). Erotic slides were perceived as less arousing than mutilation (p<0.001) slides. Sport slides were rated as less arousing than mutilation (p<0.001) and fear (p<0.05) slides. Mutilation pictures received higher rating of perceived arousal as compared to fear pictures (p<0.001). The Group by Stimulus interaction was also significant ($F_{(4,120)}$=3.33, Ɛ=0.74, p<0.001, η^2p=0.10). As seen in Figure 2.3, the Low Empathy group attributed reduced self-perceived arousal ratings to erotic (p<0.05), mutilation (p<0.001), and fear (p<0.01) pictures compared to the High Empathy group.

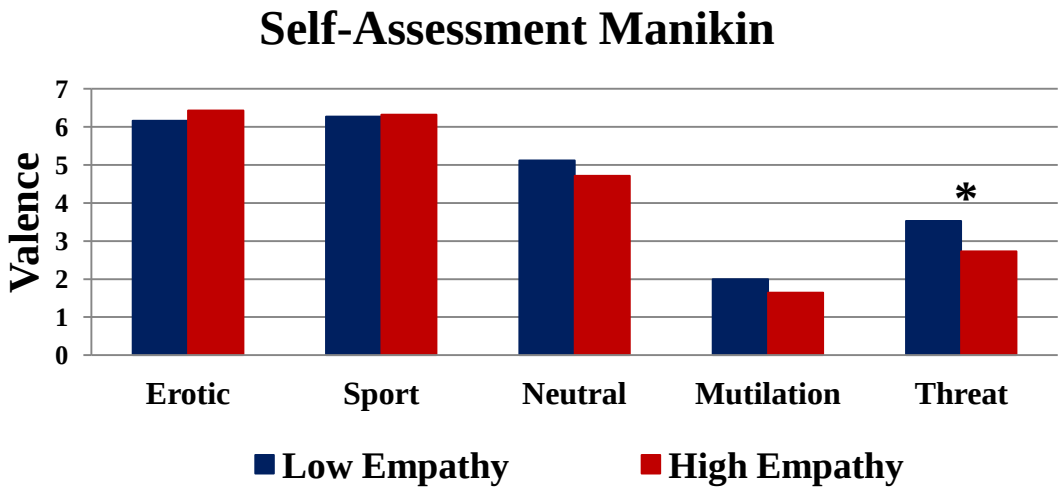

Figure 2.2. *Self-assessment of emotional valence elicited by IAPS pictures (erotic, sport, neutral, mutilation, fear) in Low and High Empathy groups. Data were collected through the Self-Assessment Manikin during a nonrecording session.*

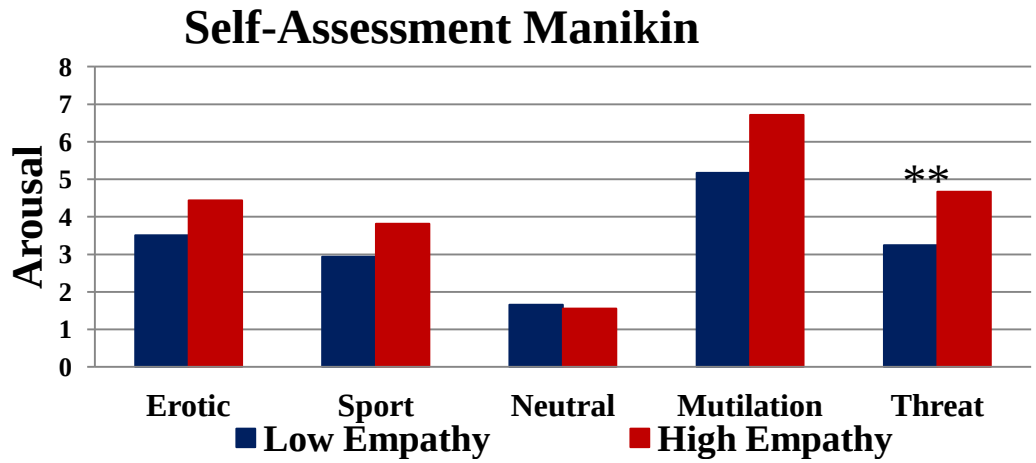

Figure 2.3. *Self-assessment of emotional arousal elicited by IAPS pictures (erotic, sport, neutral, mutilation, fear) in Low and High Empathy groups. Data were collected through the Self-Assessment Manikin during a nonrecording session.*

Three High Empathy and 1 Low Empathy participants were excluded from startle reflex analysis due to signal artifacts. ANOVA showed a significant Stimulus main effect ($F_{(4,104)}$=10.41, Ɛ=0.58, p<0.001, η^2p=0.29; Fig. 2.4). The startle elicited blink was potentiated for fear pictures compared to erotic (p<0.001) and sport (p<0.05) pictures. Mutilation pictures elicited an enlarged startle reflex compared to erotic (p<0.01) pictures. The startle blink amplitude resulted inhibited for erotic slides compared to sport (p<0.01) and neutral (p<0.001) slides. There was neither Group effect nor a Group by Stimulus interaction.

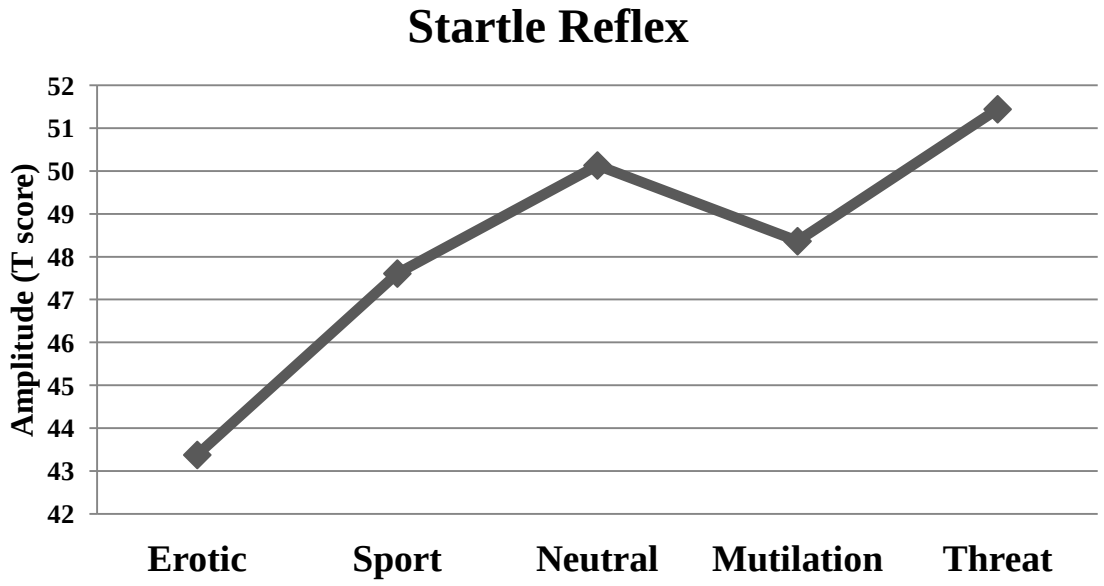

Figure 2.4. *Mean amplitude of the startle elicited blink (T score transformed) in participants for the five stimuli condition.*

Analysis of the P300 component (320-440 ms) revealed a significant Site effect ($F_{(2,60)}$=73.52, Ɛ=0.85, p<0.001, η^2p=0.71): greater negativity was elicited in the two frontal sites compared to the posterior site (p<0.001), and also a greater amplitude was found in the left frontal site compared to the right frontal site (p<0.05). Data also revealed a Stimulus main effect ($F_{(4,120)}$=7.26, Ɛ=0.67, p<0.001, η^2p=0.19). As seen in Figure 2.5 both pleasant and unpleasant pictures elicited greater positivity than neutral ones. Specifically, erotic pictures elicited greater positivity than sport (p<0.001), neutral

(p<0.001), and both mutilation and threat pictures (p<0.05). Sport images prompted a reduced cortical positivity compared to mutilation images (p<0.05). There was neither a Group effect nor a Group by Stimulus interaction.

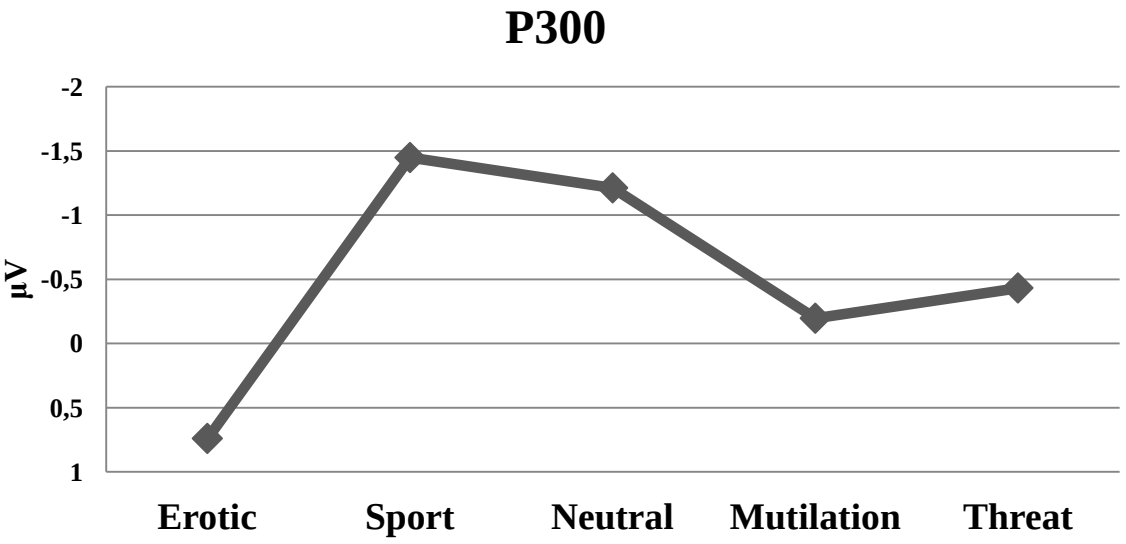

Figure 2.5. *Averaged evoked potentials recorded from F7, Pz, F8 in the 320-440 ms window (P300) for the five emotional stimuli.*

The Slow Positive Wave (600-800 ms) revealed a significant Site effect ($F_{(2,60)}$=78.94, Ɛ=0.97, p<0.001, η^2p=0.62). A greater positivity was found in the posterior site (Pz) compared to the two frontal sites (p<0.001). Also, a larger negativity was found in the left frontal compared to the right frontal site (p<0.05). Furthermore, a significant main effect of Stimulus was found ($F_{(4,120)}$=9.84, Ɛ=0.70, p<0.001, η^2p=0.12). As seen in Figure 2.6, erotic elicited greater positivity than sport and neutral pictures (p<0.001). Mutilation pictures elicited greater positivity than sport (p<0.05) and neutral pictures (p<0.001). Threat slides prompted larger positive amplitudes compared to sport (p<0.05) and neutral slides (p<0.01). Neither a Group effect nor a Group by Stimulus effect was found.

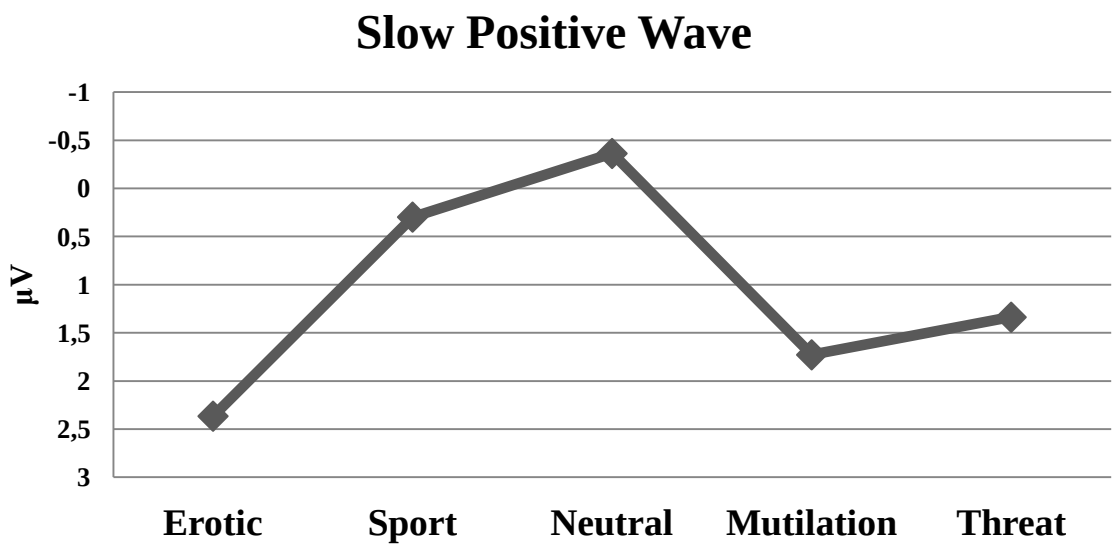

Figure 2.6. *Averaged evoked potentials recorded from F7, Pz, F8 in the 600-800 ms window (Slow Positive Wave) for the five emotional stimuli.*

2.5 Discussion

The aim of this study was to examine the influence of different levels of empathy and emotional detachment on subjective evaluation of valence and arousal elicited by emotional pictures and on affective modulation of psychophysiological responses.

Data collected through the Self-Assessment Manikin (SAM) confirmed the hypothesis. As regard self-perceived valence, both groups of participants rated erotic and sport pictures as the most pleasant and mutilation and fear pictures as less pleasant. As regards self-perceived arousal, emotional pictures (pleasant and unpleasant) were evaluated as more arousing than neutral pictures. Furthermore, different levels of empathy had an influence on evaluation of valence and arousal elicited by emotional stimuli. Participants with low empathy levels rated fear stimuli as more pleasant compared to participants with high empathy levels. Moreover, erotic, mutilation, and fear pictures were rated as less arousing by the Low Empathy group, indicating a

reduced perceived bodily activation in these participants, compared to the High Empathy group.

Startle reflex data showed an overall reduction of the response amplitude to erotic stimuli (compared to sport, neutral, mutilation and fear stimuli) and a potentiation of the response to fear stimuli compared to pleasant pictures (erotic and sport) in both group of participants. The absence of inhibition to sport pictures might be due to the fact that participants were women. Sports and thrilling activities might be rated as more pleasant by men, while women could find them of little interest. The mutilation pictures elicited a startle response similar to neutral and sport pictures, even though both groups rated these pictures as the most arousing and the less pleasant. This incongruence might be due to the fact that mutilation and blood stimuli require a sustained attentional processing and the acquisition of information. Differently from fearful and threatening cues, that are rapidly processed as dangerous by the individual and elicit a "fight or flight" active response, mutilation cues signal that an unpleasant event already occurred, and elicit a passive response of static observation. Another possible reason for these results might be related to the fact that mutilation stimuli do not prompt a fear response, strongly related to a potentiation of the startle reflex, but rather an emotional reaction of disgust. Similar results were found by Sarlo, Buodo, and Palomba (2010), who highlighted in both blood phobics and controls a lack of startle blink facilitation during the viewing of mutilation images, showing how blood stimuli did not elicit a defense reaction.

P300 and Slow Positive Wave components showed a greater amplitude during exposure to pleasant and unpleasant pictures compared to neutral pictures in both groups, reflecting data from the literature, which reports higher cortical positivity for emotional pictures as an index of deeper elaboration of affective information (Radilova, 1982; Palomba et al., 1997).

These data showed dissociation between verbal reports and affective modulation of the psychophysiological response. Physiological markers of emotional disposition were not congruent with the different subjective ratings of valence and arousal in the two groups of participants. These results seem to suggest that different levels of empathy and emotional detachment do not mediate the psychophysiological responses. Another possible interpretation is that the questionnaires scorings and the subjective feelings expressed through the SAM are not based on an accurate perception of bodily state. Self-reports are the product of several processes, and individual differences may reflect differences in cognitive processes, in mood disposition and be also influenced by social, situational, and cultural imperatives. Therefore, empathy and psychopathy questionnaires might assess the way a person perceives him/herself, and do not reflect the individual's inner state and the neural activity in motivational circuits. Self-reports are often considered to be the main tools for measures of emotion, but perhaps physiological data might be a valid complementary instrument to assess the real emotional disposition of the person in different situations. However, our sample size was reduced. Subsequent studies on more numerous samples could find differences in affective modulation of startle reflex in participants with low and high empathy levels.

CHAPTER 3

STUDY II: Emotional Psychophysiological Responses in Women with low and high General Startle Reactivity

3.1 Abstract:

General startle reactivity manifests with high inter-individual variability, which is often considered as task-irrelevant noise and normalized across participants. Aim of the study was to analyze associations between general startle reactivity and state anxiety, and also to investigate if differences in startle reflex reactivity were associated with differences in empathy and emotional detachment, with differences in perceived pleasantness and arousal of emotional stimuli, and with affective modulation of startle reflex and cortical responses (ERPs). We administered 111 healthy women 10 startle probe in absence of any experimental manipulation and asked them to complete the State-Trait Anxiety Inventory and to rate the perceived aversiveness of the heard noise. Twenty-one Low Responders (low general startle reflex) and 22 High Responders (high general startle reflex) were selected and they were administered the Interpersonal Reactivity Index, the Psychopathic Personality Inventory – Revised, and the Levenson Self-Report Psychopathy Scale. They also viewed 96 IAPS pictures divided into pleasant (erotic, sport), neutral, and unpleasant (mutilation, threat), while startle reflex and EEG were registered. Subjective evaluations of arousal and valence were collected through the Self-Assessment Manikin. Analysis of the initial sample (111 women) showed positive correlations between general startle reactivity measured beneath the left eye and state anxiety, between state anxiety and perceived noise aversiveness, and also between general startle reactivity and perceived noise aversiveness. Also, data analysis

of the two selected groups revealed, in Low Responders, lower empathy scores, a flattened modulation of the startle response, and reduced cortical responses while viewing emotional stimuli. No interaction between emotional stimuli and rated arousal and valence were found. General startle reactivity can underlie important information about psychological constructs and clinical disorders.

3.2 Introduction:

The startle reflex is a defensive response to a surprising and intense stimulation, aimed at protecting the body from a sudden attack. It is an automatic and involuntary subcortical response, and therefore not influenced by intentional control (Grillon & Baas, 2003). It manifests with a forward thrusting of the head and a descending flexor wave reaction, extending from the head through the trunk and the knees (Landis & Hunt, 1939). Amplitudes and latencies of this reflex in human are generally measured by recording the eyeblink reflex, the most consistent and persistent component of the startle pattern. Although this response can be elicited by intense visual and tactile stimuli with a fast rise time, most startle studies use acoustic stimuli.

The utility of employing startle reflex in psychological studies is due to the fact that its amplitude can be influenced by experimental manipulations and psychological or motivational states induced in the individual. Therefore, studying inhibition or potentiation of the reflex related to specific contexts or personality traits, can provide valuable information about the psychological and affective state of the individual, and be a collateral tool for subjective reports, which are easily biased by personal, social, and cultural beliefs. For example, a typical effect observed employing emotional stimuli, is an inhibition of the reflex in response to appetitive and positive stimuli, and a potentiation of the reflex in response to aversive and negative stimuli. Vrana and

colleagues (1988) were the first Authors to examine the effect of affective pictures on modulation of the startle reflex. They observed a linear trend in startle reflex amplitude: smaller amplitudes were elicited during pleasant pictures viewing, whereas greater amplitudes were elicited during negative pictures viewing. This common linear trend can be altered in some pathologies involving abnormalities in affective modulation, such as psychopathy. Patrick and colleagues (1993) found that psychopathic incarcerated men lacked potentiation of the startle reflex in response to emotional negative pictures compared to non-psychopaths and a mixed group. This finding has been interpreted as the result of an impairment of the fear response system in psychopaths and amygdala has been proposed as the source of this deficit, because of its key role in the fear-potentiated startle phenomenon.

General (or baseline) startle reactivity, in absence of any experimental manipulation, can be considered as the basic neural excitability within the startle reflex pathway (Giakoumaki et al., 2010). It is coherent and stable in the same individual across time (Larson, Ruffalo, Nietert, & Davidson, 2000), but manifests with large inter-individual variability in its amplitude. Such variability is often considered as a task-irrelevant noise in startle paradigms and therefore standardized across participants, to reduce the influence of arbitrary between-subjects variability, while maintaining within-subjects variability related to specific experimental cues. However, these differences in general startle reactivity might have an influence on the proportion of inhibition or potentiation of the startle reflex amplitude.

Differences in general startle reactivity might be due to the activity of brain areas that have an influence on the modulation of the startle reflex, such as limbic and cortical structures. The acoustic startle reflex is mediated by a simple neural pathway, including a synapsis from the auditory nerve fibers to the cochlear root neurons, a

synapsis from the cochlear root neurons to the nucleus reticularis pontis caudalis, and finally a synapsis from the nucleus reticularis pontis caudalis to motor neurons (Davis, 2006). The nucleus reticularis pontis caudalis receives several projections from the amygdala, a key structure in fear responses associated to a specific threat cue. Lesions to the amygdala confirm its role in mediating startle reflex responses. For example, Angrilli and colleagues (1996) found an overall inhibited startle reflex response contralateral to the lesion in a male patient with right amygdala damage. Another region that seems to have a role in influencing startle reflex amplitude is the bed nucleus of the stria terminalis (BNST), a structure that has a role in mediating more sustained responses to a non specific cue and has a prolonged influence on behavior after the threat happened. In fact, situation of generalized anxiety can cause a potentiation of the startle reflex. For example, Gewirtz and colleagues (1998) observed a gradual potentiation of the startle reflex amplitude over the course of aversive conditioning paradigm, indexing a response to chronic stress. Such effect is absent after damages to the BNST. Also, an enhancement of the startle response amplitude was found when individuals where placed back in a room where they had previously received electric shocks (Ameli et al., 2001). Böcker, Baas, Leon Kenemans, and Verbaten (2004) reported how startle reflex was affected by the aversive nature of the experimental context itself, observing greater general startle reactivity before a fear conditioning task during which shocks were administered, compared to an experimental context in which no aversive stimuli were expected. Anxiogenic situations such as darkness also potentiate startle: the reflex is facilitated when elicited in complete darkness compared to an illuminated room, both in children and adult individuals (Grillon, Pellowski, Merikangas, & Davis, 1997; Grillon et al., 1999).

Some studies found an association between manifested clinical anxiety disorders and greater general reactivity of the startle response. For example, an enhanced baseline startle reactivity has been found in patients with post-traumatic stress disorders (Morgan et al., 1996; Butler et al., 1990; Orr et al., 1997; Grillon et al., 1999; Morgan et al., 1995; Grillon & Morgan, 1999). Grillon, Morgan, Davis, and Southwick (1998) found a difference between post-traumatic stress disorder patients and controls in highly stressing context: patients manifested with greater general startle reactivity than controls and such difference was related to state anxiety rather that trait anxiety. An augmented general startle reactivity in baseline conditions was also found in panic disorder patients (Ludewig et al., 2005).

Aim of the present study was to investigate relationship between state anxiety and general startle reactivity in healthy young individuals. Similarly to findings observed in studies with clinical populations, we expected a positive correlation between amplitude of startle reflex elicited in a baseline paradigm (in absence of any experimental manipulation) and state anxiety reported by participants during the experimental session. Also, the purpose of the present study was to examine whether differences in the general startle reactivity could indicate individual differences in affectivity and emotional processing. Specifically, we expected that participants with low general startle reactivity and high general startle reactivity would have differed in some personality traits related to emotional activation and affective regulation, such as empathy and emotional detachment. Furthermore, it was hypothesized that participants with low general startle reactivity (presumably reflecting a reduced activity of brain area influencing the startle response, such as the amygdala) would also have attenuated affective modulation of the startle reflex in response to emotional stimuli compared to participants with high general startle reactivity. Also, we expected reduced self-

perceived arousal for emotional pictures, greater rated pleasantness for negative pictures, and reduced perceived pleasantness for positive pictures in participants with low general startle reactivity compared to participants with high general startle reactivity, reflecting a reduced perceived reaction in response to emotional cues. During the task also ERPs components were registered. A typical effect observed during tasks requiring emotional processing, is a greater elicited cortical positivity of ERPs components in response to arousing emotional stimuli compared to neutral stimuli (e.g. Delplanque et al., 2005; Keil et al., 2002). We expected attenuated amplitude of the components in response to emotional stimuli in participants with low general startle reactivity compared to participants with high general startle reactivity.

We chose an exclusively young female sample because literature reports reduced startle reflex amplitudes in elderly individuals (Ellwanger et al., 2003; Ludewig et al., 2003). Also, a difference in startle reflex amplitude has been found between the two genders. For example, Kofler and colleagues (2001), and Bianchin and Angrilli (2012) found reduced general startle reactivity in men compared to women. Furthermore, males and females react slightly differently to emotional cues. For example, Bradley and colleagues (2001) reported how women reported higher perceived pleasantness while viewing pleasant pictures and responded with greater defensive reactions to aversive stimuli, whereas men perceived greater arousal when viewing erotic pictures.

3.3 Methods:

Participants

One hundred and eleven (111) undergraduate healthy females (Mean age=23.31 years: SD=2.13 years) were recruited from Psychology classes at University of Padova.

All participants received course credit. They were asked to refrain from caffeine, nicotine, and alcohol for at least two hours before the beginning of the experimental session, since these substances could alter the general amplitude of the startle response (Grillon, Sinha, & O'Malley, 1994). All participants that had specific phobias were excluded from the study, as well as participants who were under treatment with psychoactive drugs and those who had hearing deficits. The procedure was approved by the Faculty Ethics Committee.

Procedure

After filling out a consent form, participants completed the Trait portion of the State-Trait Anxiety Inventory – STAI (Spielberger, 1983). This self-report questionnaire is divided into two separate forms of 20 items each: the State form asks to report how the individual is feeling in that precise moment, whereas the Trait form asks the individual to indicate how he or she generally feels in daily life.

To assess normal hearing in participants and eventually exclude those who had hearing impairment, hearing threshold was evaluated with an on-line test that measured sensibility of the ears at different frequencies, ranging from 30 Hz to 16 kHz (http://www.phys.unsw.edu.au/jw/hearing.html). A Sennheiser HD-202 headphone was used. All participants reported normal hearing capacity.

Participants were seated in a comfortable recliner in a dimly lit and electrically isolated room and electrodes for eyeblink reflex registration were placed beneath both eyes (orbicularis oculi muscle). The acoustic startle probe consisted of a 50 ms, 100 dB burst of white noise with instantaneous rise time, presented binaurally through headphones. A total of 10 unpredictable and unsignaled probe stimuli were delivered, with an intertrial interval varying between 6 and 23 seconds.

Startle probes were administered in a baseline paradigm, in absence of any experimental manipulation. Participants were simply asked to watch a fixation point and ignore the noises heard over the headphones.

Participants were then asked to rate the aversiveness of the heard noises on a Likert scale ranging from 0 ("not aversive noise") to 10 ("extremely aversive noise").

The State-Trait Anxiety Inventory (State form) was administered again at the end of the experimental session and then participants were debriefed.

Twenty-one participants with the lowest (M=2.13 μV) and 20 participants with the highest (M=45.74 μV) general startle reactivity registered in the first experimental session were recalled to attend a second session of the experiment. The two groups did not differ in their mean age ($t_{(39)}$=1.15, p=0.26).

Upon arrival, participants read and signed a consent form and they were administered the Interpersonal Reactivity Index – IRI (Davis, 1983), the Psychopathic Personality Inventory – Revised – PPI-R (Lilienfeld & Andrews, 1996), and the Levenson Self-Report Psychopathy Scale – LSRP (Levenson et al., 1995).

The Interpersonal Reactivity Index is a self-report questionnaire investigating emotional and cognitive facets of empathy. It comprises 4 subscales of 7 items each: the Perspective Taking scale (PT) assessing the capability to adopt others point of view, the Fantasy scale (FS) assessing the capability to imagine themselves as fictitious characters of book or movies, the Empathic Concern scale (EC) evaluating feeling of concern and compassion for unfortunate others, and the Personal Distress scale (PD) evaluating feelings of discomfort in tense social contexts.

The Psychopathic Personality Inventory – Revised is a self-report measure assessing psychopathic traits in non-criminal populations. It comprises 154 items

divided into 8 subscales: Machiavellian Egocentricity, Social Influence, Coldheartedness, Carefree Nonplanfulness, Fearlessness, Blame Externalization, Impulsive Nonconformity, and Stress Immunity. A particular interest in this research was to the Coldheartedness subscale, assessing emotional detachment and lack of empathy.

The Levenson Self-Report Psychopathy Scale is a self-report measure divided into two subscales. The Primary Psychopathy scale (16 items) evaluates callousness and emotional detachment traits, whereas the Secondary Psychopathy scale (10 items) assesses antisocial behavior.

After completing the questionnaires, participants were accommodated in a recliner in a dimly lit room and electrodes for startle reflex and cortical indexes were attached.

Participants were instructed that a series of pictures would have been displayed on a computer monitor and they were asked to look carefully at them. Pictures were taken from the International Affective Picture System (Lang et al., 2008). We selected 32 pleasant (16 erotic and 16 sport), 32 neutral (e.g. household objects), and 32 unpleasant (16 mutilation and 16 threat) emotional pictures.

Each pictured was shown for 5 seconds with an inter-trial interval (black screen) varying from 4 to 6 seconds. Pictures were presented in a pseudo-randomized order so that 3 or more images of the same valence category could not be presented consecutively. The positive and negative pictures did not differ in their standardized rated arousal and had higher arousal than the neutral ones.

During the task participants were asked to wear headphones and they were told that they would have randomly heard a sound irrelevant to the task and that they could have ignored it. Acoustic startle probes were administered in half of the pictures for

each valence category (16 probes for the neutral pictures, and 8 probes for erotic, sport, mutilation, and threat pictures). The white noise had an instantaneous rise time, with a 50 ms duration, and a 100 dB intensity.

After the recording, participants were asked to view the 96 pictures again and to rate perceived valence and arousal for each image by means of the Self-Assessment Manikin (SAM). SAM is a non-verbal pictorial assessment technique aimed at assessing pleasure and activation associated with an individual's affective reaction to a wide variety of pictures (Bradley & Lang, 1994).

Physiological Recording

Acquisition and data analysis were performed using a labVIEW program (Angrilli, 1995). The eyeblink response (startle reflex) was recorded placing two Ag/AgCl electrodes on the orbicularis oculi muscle beneath both eyes in the first selection phase (111 participants) and beneath the left eye in the second experimental session (low and high general startle responders). Impedance was kept below 5 kOhm. The EMG signal was sampled at a rate of 250 Hz and amplified with a gain of 10000. The signal was filtered with a 16 Hz first order low pass and a 340 Hz second order high pass and rectified and integrated with a 100 ms time constant integrator. The raw signal was divided into epochs from 2000 ms before the onset of the pictorial stimulus to 6000 ms after the onset of the stimulus and visually inspected to reject artifacts. Valid trials where then averaged separately for each valence category. A 20 ms window was centered on the startle response peak of the averaged signal for each single participant. Startle reflex amplitude for each stimulus category was calculated as the mean value of the EMG signal in this 20 ms window. EEG was registered with 3 Ag/AgCl electrodes placed in F7, F8, and Pz sites, according to the International 10-20 System (Jasper,

1958). Linked mastoids were used as reference. Impedance was kept below 5 kOhm. The signal was amplified with a 10000 gain and filtered with an 80 Hz second order low pass and a 10 s time constant. Eye movements were recorded with electrodes placed below and above the right eye (gain 4000; second order low pass filter 80 Hz, time constant 10 s). The EEG signal was divided into 8000 ms epochs (from 2000 ms before the stimulus onset to 6000 ms after the stimulus onset) and visually inspected to reject artifacts. Epochs were then corrected by a 200 ms baseline and averaged separately for each valence category. We analyzed a 200-280 ms window, corresponding to the P200 component, a 360-420 ms window, corresponding to the P300 component, and the Slow Positive Wave between 600 and 800 ms (see Fig. 3.1).

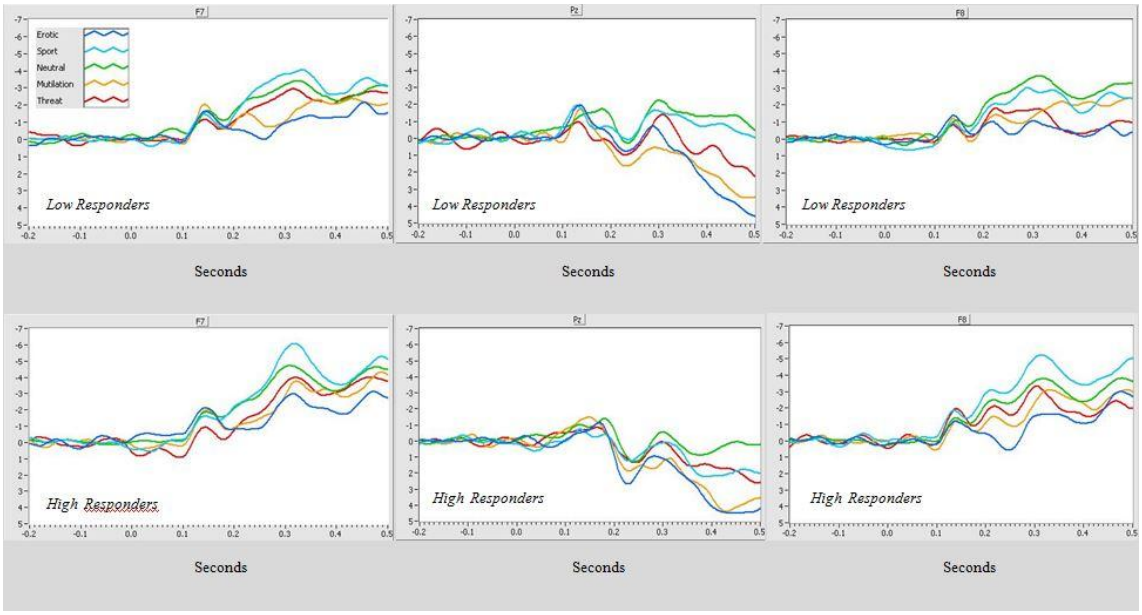

Figure 3.1. *Grand average waveforms at the three electrode locations (F7, Pz, F8) in Low Responders (upper panels) and High Responders (lower panel) participants for the five emotional categories (Erotic, Sport, Neutral, Mutilation, Threat).*

Statistical Analysis

State and Trait Anxiety raw scores measured by the State-Trait Anxiety Inventory in 111 participants were used for data analysis and the association between startle reflex magnitude, measured in both eyes, and anxiety scores was analyzed using Pearson's correlation. Furthermore, the relationship between startle reflex magnitude and perceived noise aversiveness was examined. Also, we analyzed associations between perceived noise aversiveness and State Anxiety.

Concerning analysis on the two selected groups (Low Responders vs. High Responders), analysis were effectuated on questionnaires scores, Self-Assessment Manikin (SAM) ratings, startle reflex amplitudes, and ERPs components.

Questionnaires mean scores (IRI, PPI-R, LSRP) were compared between the two groups through T Test analyses.

SAM data were elaborated, for both valence and arousal, using a mixed ANOVA with Group as between-subject factor (Low Responders vs. High Responders) and Stimulus as within-subject factor (Erotic, Sport, Neutral, Mutilation, Threat).

Eyeblink amplitudes were normalized within each participant to reduce between-subject variability. Mean and standard deviation of the startle response elicited during neutral pictures viewing were calculated and then transformed in z-score. Then, a T-score transformation was applied to the z-score ($X=((z \times 10) + 50)$). Data were analyzed using ANOVA with Group (Low Responders vs. High Responders) and Stimulus (Erotic, Sport, Neutral, Mutilation, Threat) factors.

P200, P300, and Slow Positive Wave mean average were analyzed using ANOVA with Group (Low Responders vs. High Responders) and Stimulus (Erotic, Sport, Neutral, Mutilation, Threat) factors.

The significance level was set at .05 for all analysis. Newman-Keuls post-hoc test further specified significant effects.

3.4 Results:

Concerning data on 111 participants, no correlations were found between startle reflex amplitude of the left eye and Trait anxiety scores. Instead, startle amplitude elicited beneath the left eye showed a significant positive correlation with State Anxiety scores measured at the end of the session ($r_{(109)}$=0.23, p<0.05; see Fig. 3.2).

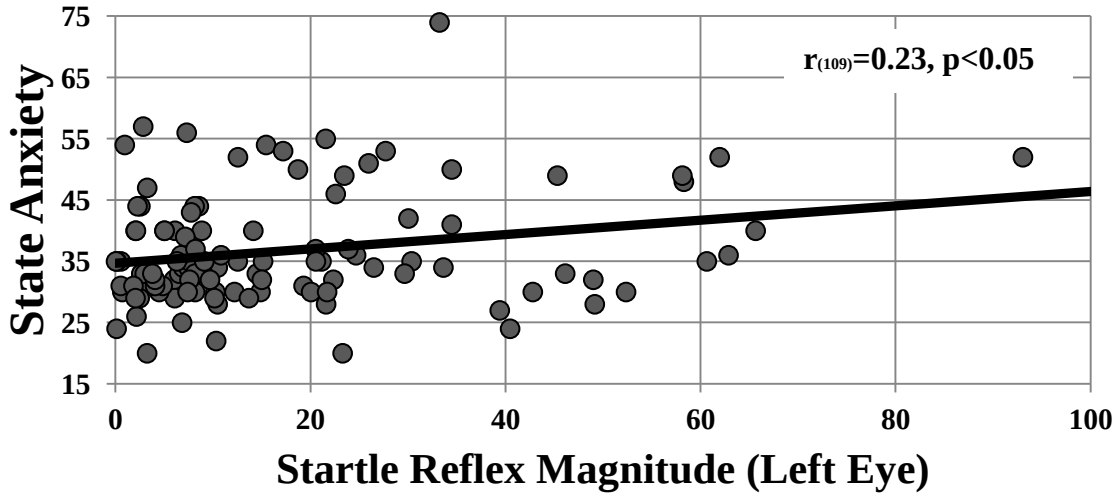

Figure 3.2. *Correlation between startle reflex magnitude, measured below the left eye, and State Anxiety measured at the end of the experimental session.*

No significant correlations were found between startle reflex magnitude registered in the right eye and neither Trait Anxiety measured at the beginning of the experimental session nor State Anxiety measured at the end of the session. Finally, both left and right eye's startle reflex responses showed a significant positive correlation with subjective noise aversiveness ($r_{(109)}$=0.34, p<0.001 for the left eye, and $r_{(109)}$=0.24, p<0.05 for the right eye): the higher the reflex magnitude, the higher the perceived aversiveness of the acoustic startle probe (see Fig. 3.3 and 3.4).

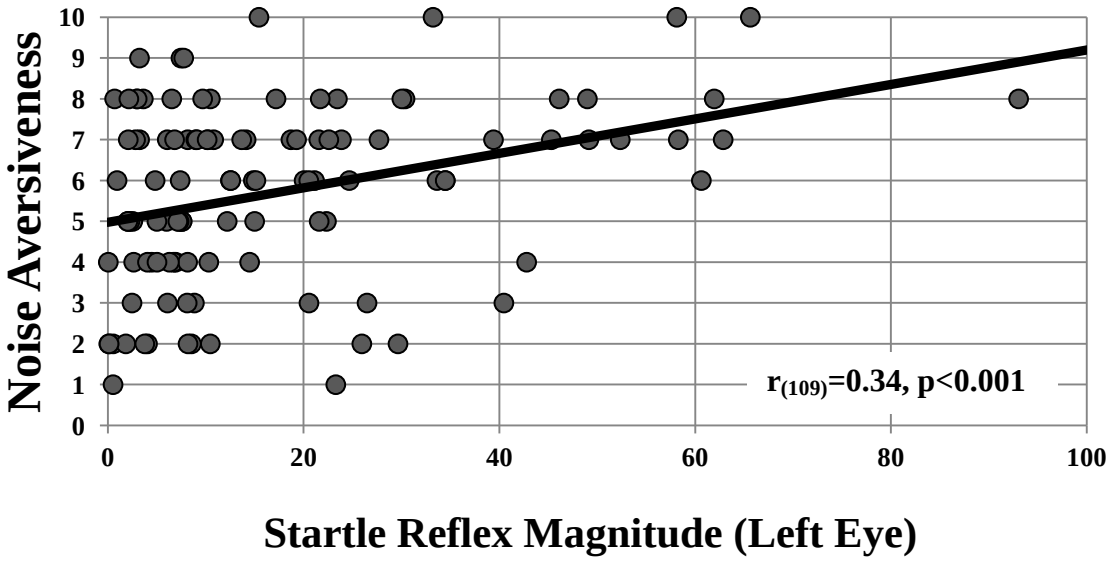

Figure 3.3. *Correlation between startle reflex magnitude, measured below the left eye, and perceived noise aversiveness on a 10-point Likert scale.*

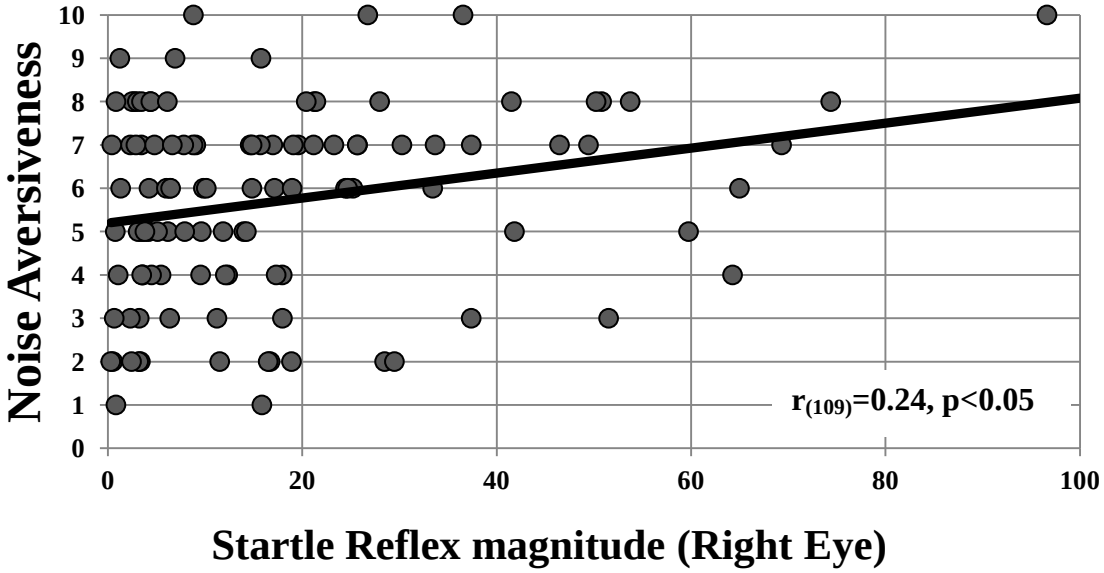

Figure 3.4. *Correlation between startle reflex magnitude, measured below the right eye, and perceived noise aversiveness on a 0-10 Likert scale.*

Also, a positive significant correlation was found between State Anxiety, measured at the end of the experimental session, and perceived noise aversiveness

($r_{(109)}$=0.28, p<0.05): greater anxiety levels were associated with greater perceived aversiveness of the acoustic noise heard through headphones (see Fig. 3.5).

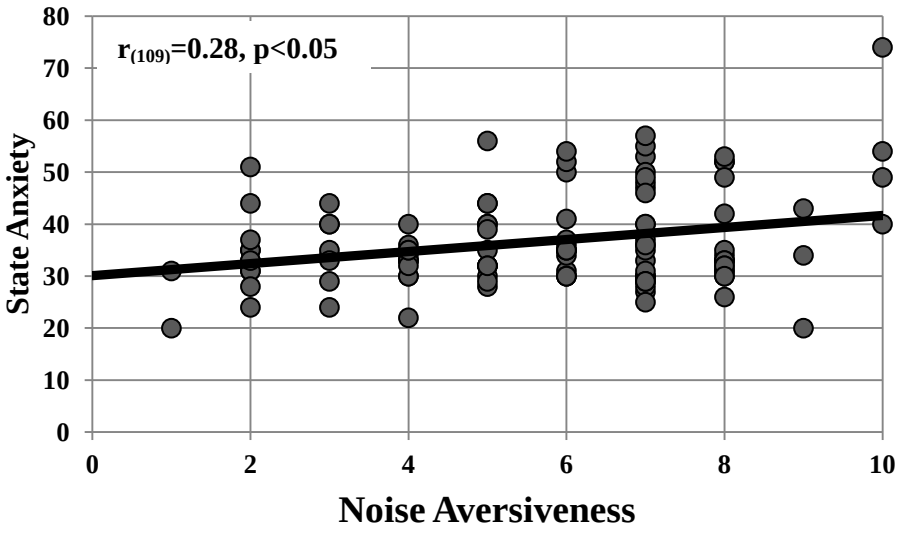

Figure 3.5. *Correlation between State Anxiety raw score and subjective noise aversiveness measured on a 0-10 analogue scale.*

Analyses of questionnaires data scores on the two selected groups (Low Responders vs. High Responders) revealed significant differences between the groups in the Interpersonal Reactivity Index (IRI) scores, whereas no differences were found for other measures (PPI-R and LSRP). Specifically, the Low Responders showed lower mean scores on the total IRI scores, as well as on the Perspective Taking subscale, compared to the High Responders. Differences in mean scores almost reached significance also for the Fantasy and the Empathic Concern scale (see Tab. 3.1).

	Mean Low Responders	Mean High Responders	SD Low Responders	SD High Responders	T Test
Questionnaires					
Perspective Taking (IRI)	17.90	21.15	2.84	3.28	$t_{(39)}$=-3.38**
Fantasy (IRI)	14.48	16.15	2.99	2.92	$t_{(39)}$=-1.81, p=0.08
Empathic Concern (IRI)	17.33	19.99	2.71	3.09	$t_{(39)}$=-1.84, p=0.08
Personal Distress (IRI)	16.43	17.25	4.43	2.92	$t_{(39)}$=-0.70, n.s.
Total IRI	66.14	73.55	9.60	8.83	$t_{(39)}$=-2.57*
Coldheartedness (PPI-R)	0.39	0.37	0.94	1.05	$t_{(39)}$=0.08, n.s.
Primary Psychop. (LSRP)	35.71	34.25	3.36	3.43	$t_{(39)}$=1.37, n.s.

Table 3.1. *Interpersonal Reactivity Index, Coldheartedness (PPI-R), and Primary Psychopathy (LSRP). Mean scores, Standard Deviation and T Test for the Low Responders (n=21) and the High Responders (n=20). (n.s.=non significant; *=p<0.05; **=p<0.01; ***=p<0.001).*

Analysis of rated valence (Self-Assessment Manikin) revealed a significant Stimulus main effect ($F_{4.156}$=344.68, ε=0.74, p<0.001, η^2p=0.90; see Fig. 3.6): erotic stimuli were rated as more pleasant than all other stimulus categories (all ps<0.001), participants attributed greater pleasantness scores to sport pictures compared to neutral, threat, and mutilation ones (all ps<0.001), more perceived pleasantness was reported for neutral compared to mutilation and threat pictures (all ps<0.001). Finally, rated valence was higher for threat images compared to mutilation ones (p<0.001). Also, a main effect

of Group was found ($F_{(1,39)}$=5.28, p<0.05, η^2p=0.11). Low Responders attributed, in general, lower pleasantness mean scores to all stimulus categories, compared to High Responders group. No Stimulus by Group interaction was found.

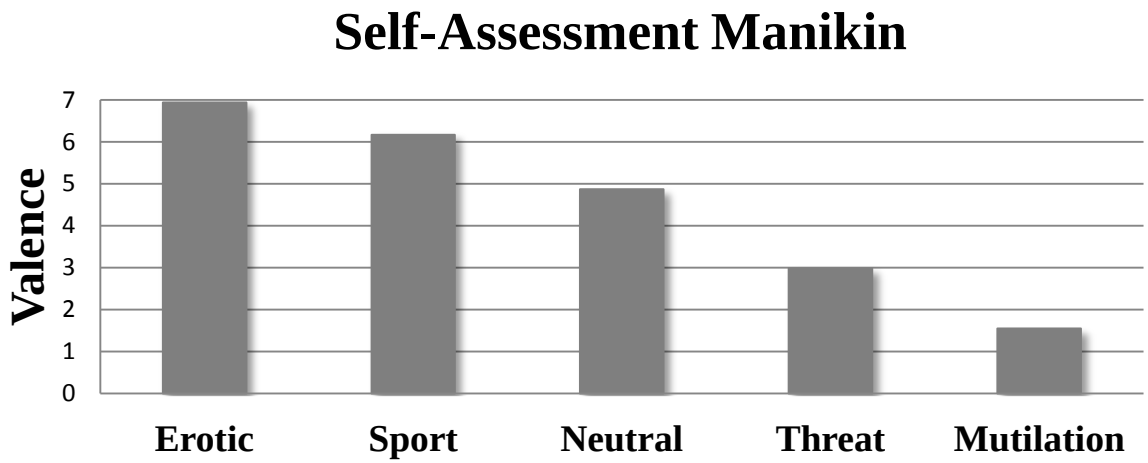

Figure 3.6. *Self-Assessment of emotional valence elicited by IAPS pictures (erotic, sport, neutral, threat, mutilation) in Low and High Responders groups. Data were collected through the Self-Assessment Manikin during a non-recording session.*

Analysis of rated arousal highlighted a significant Stimulus main effect ($F_{(1,156)}$=104.86, ε=0.73, p<0.001, η^2p=0.73): pleasant and unpleasant pictures were rated as more arousing than neutral pictures (see Fig. 3.7). Specifically, erotic were rated as more arousing than sport (p<0.001), neutral (p<0.001), and threat (p<0.01) slides, and less arousing than mutilation slides (p<0.001). Sport received higher arousal ratings than neutral (p<0.001) slides, and lower arousal ratings than threat (p<0.05) and mutilation (p<0.001) pictures. Neutral were perceived as less arousing than all other stimulus categories (all ps<0.001). Threat pictures were rated as less arousing compared to mutilation ones (p<0.001).

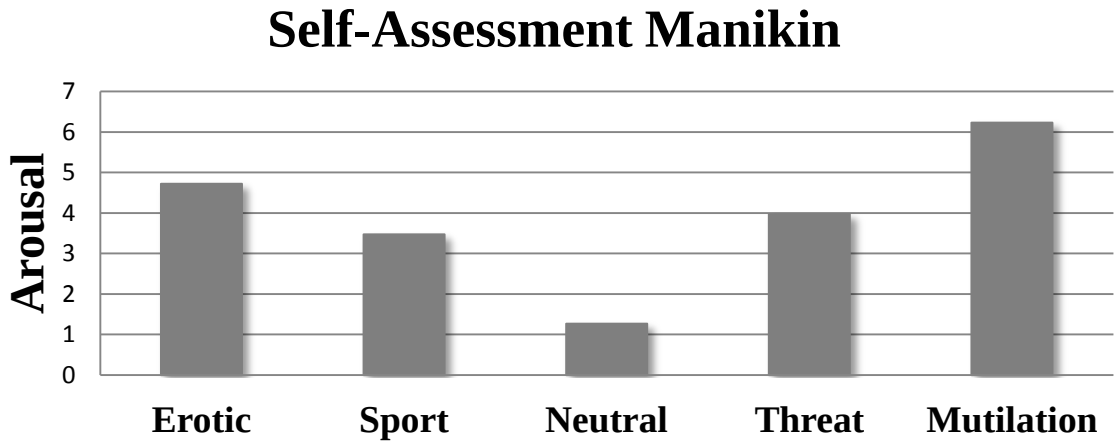

Figure 3.7. *Self-Assessment of emotional arousal elicited by IAPS pictures (erotic, sport, neutral, threat, mutilation) in Low and High Responders groups. Data were collected through the Self-Assessment Manikin during a non-recording session.*

Startle data analyses showed a significant Stimulus main effect ($F_{(4,156)}$=12.07, ε=0.85, p<0.001, η^2p=0.24): as seen in Figure 3.8, the startle reflex response was inhibited for erotic compared to sport (p<0.05), neutral, mutilation, and threat pictures (all ps<0.001). Startle amplitude was potentiated during viewing of threat compared to erotic (p<0.001) and sport images (p<0.01). Also, a Stimulus by Group interaction was found

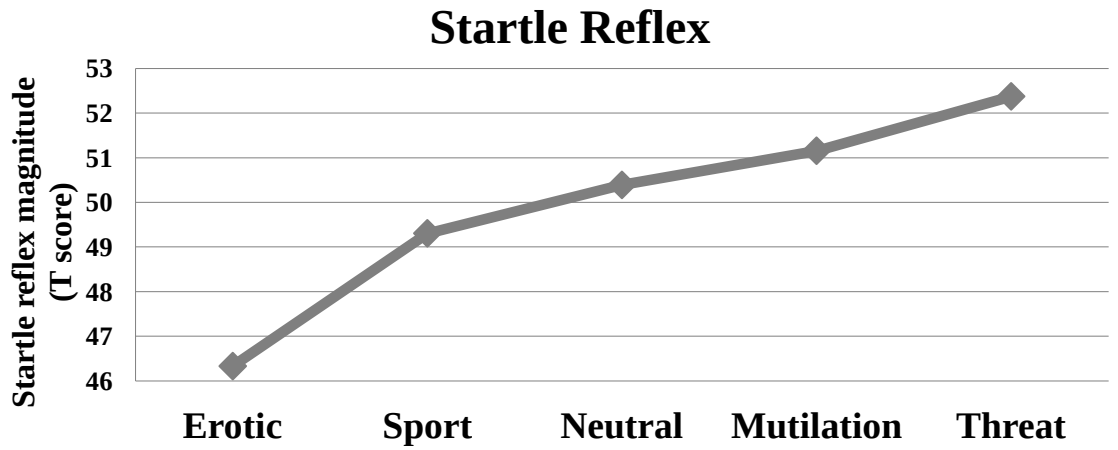

Figure 3.8. *Startle reflex magnitude (T score) during viewing of five emotional stimuli (Erotic, Sport, Neutral, Mutilation, Threat).*

($F_{(1,56)}$=3.45, ε=0.85, p<0.001, η^2p=0.08). As seen in Figure 3.9, the High Responders group displayed an inhibition of the startle reflex in response to erotic stimuli, as compared to sport (p<0.01), neutral, mutilation, and threat stimuli (all ps<0.001), whereas the Low Responders group did not show such inhibition in response to pleasant slides, nor a potentiation in response to unpleasant slides. A comparison between groups showed a significant difference (p<0.01) for the erotic category, with the High Responders group displaying a consistent inhibition for this category compared to the Low Responders group, in which no such inhibition occurred.

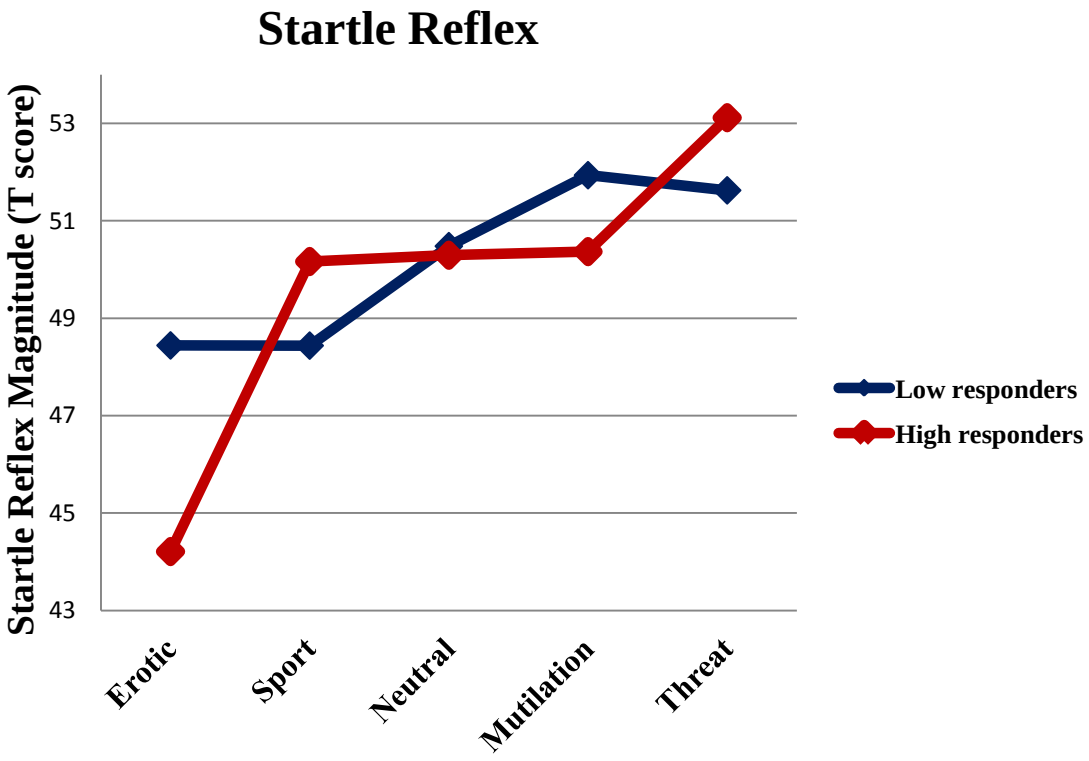

Figure 3.9. *Startle reflex magnitude (T score) during viewing of five emotional stimuli (Erotic, Sport, Neutral, Mutilation, Threat) for Low and High Responders.*

Analysis of the P200 component (200-280 ms) revealed a significant Site effect ($F_{2,78)}$=26.70, ε=0.71, p<0.001, η²p=0.41): greater positivity was elicited in the parietal site compared to the two frontal sites (all ps<0.001). Data also revealed a main effect of

Stimulus ($F_{(4,156)}$=26.83, ε=0.87, p<0.001, η^2p=0.41). As seen in Figure 3.10, erotic elicited greater positivity than sport, neutral, and threat pictures (all ps<0.001). Sport elicited smaller positive amplitudes compared to both threat and mutilation pictures (all ps<0.001). Threat elicited higher cortical positivity than sport and neutral pictures (all ps<0.001) and reduced positivity compared to mutilation pictures (p<0.05). Also, a Site by

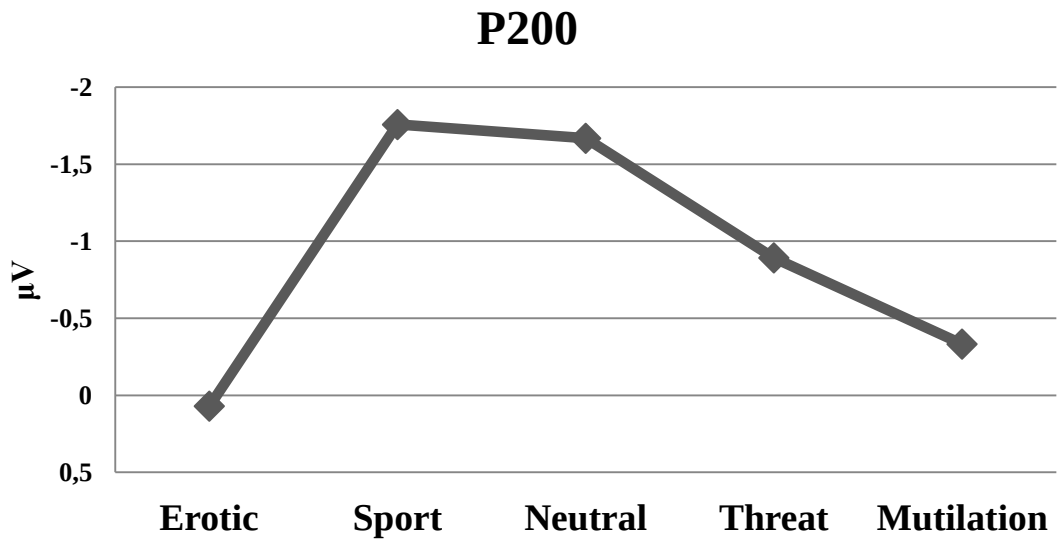

Figure 3.10. *Averaged evoked potentials recorded from F7, Pz, F8 in the 200-280 ms window (P200) for the five emotional stimuli.*

Stimulus interaction ($F_{(8,312)}$=2.69, ε=0.78, p<0.05, η^2p=0.06), and a Site by Stimulus by Group interaction ($F_{(8,312)}$=2.16, ε=0.78, p<0.05, η^2p=0.05) were found. As seen in Figure 3.11, while the two groups elaborated the five stimulus categories similarly in frontal sites, a difference was found in the parietal site (Pz), where the High Responders manifested a greater cortical positivity while viewing erotic pictures compared to the Low Responders group (p<0.01).

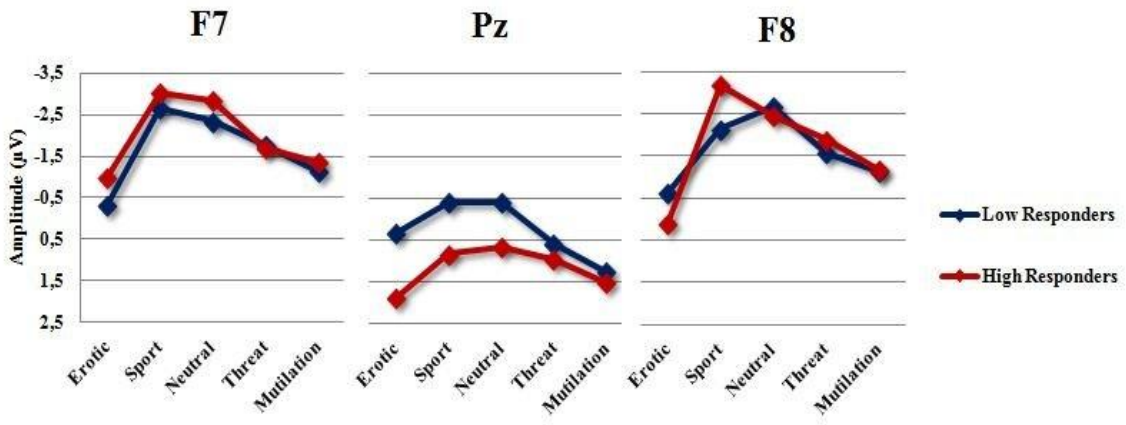

Figure 3.11. *Averaged evoked potential recorded from F7, Pz, F8 in the 200-280 ms window (P200) for the five emotional stimuli in Low Responders and High Responders.*

Analysis of the P300 component (360-420 ms) revealed a significant Site main effect ($F_{(2,78)}$=18.57, ε=0.67, p<0.001, η^2p=0.32): a greater positive amplitude was elicited in the parietal site compared to the two frontal sites (all ps<0.001). Furthermore, a significant main effect of Stimulus was found ($F_{(4,156)}$=18.15, ε=0.74, p<0.001, η^2p=0.31). As seen in Figure 3.12, erotic prompted greater positive mean amplitudes than all other stimulus categories (all ps<0.001). Sport elicited reduced relative positivity compared to threat

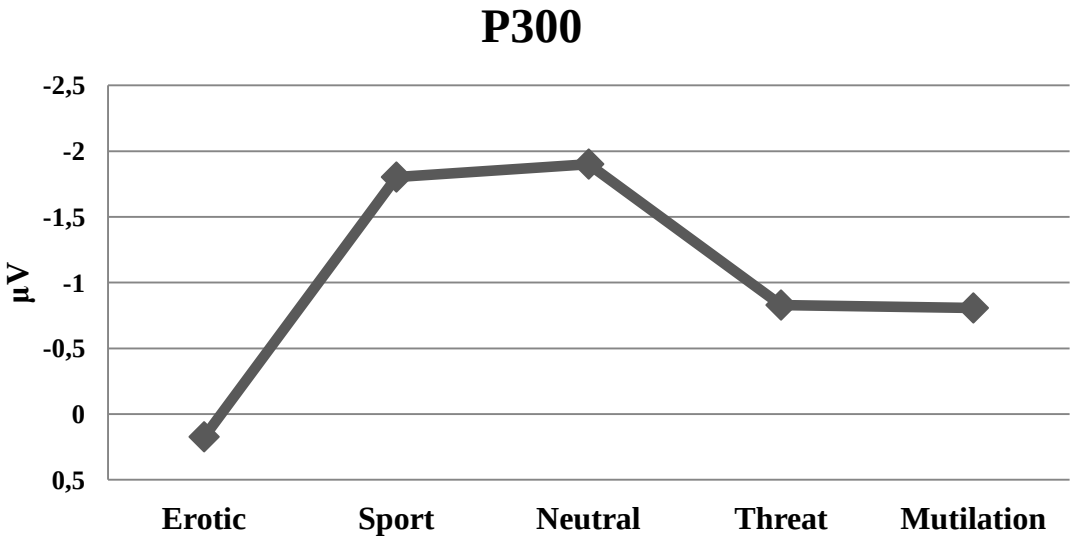

Figure 3.12. *Averaged evoked potentials recorded from F7, Pz, F8 in the 360-420 ms window (P300) for the five emotional stimuli.*

(p<0.001) and mutilation slides (p<0.01). A greater amplitude was found in response to threat and mutilation slides compared to sport (p<0.01) and neutral ones (p<0.001). Also analyses revealed a significant Site by Stimulus interaction ($F_{(8,312)}$=6.60, ε=0.86, p<0.001, η^2p=0.14). As seen in Figure 3.13, erotic and threat pictures elicited greater positive amplitudes in right frontal site compared to the left frontal site (p<0.05 and p<0.001, respectively). No Site by Stimulus by Group interaction was found.

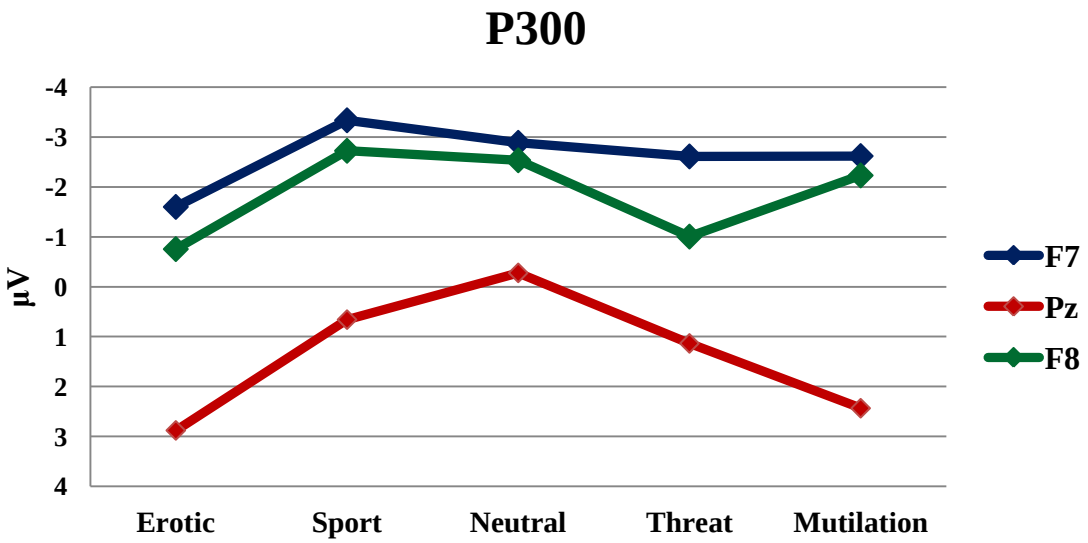

Figure 3.13. *Averaged evoked potentials recorded from F7, Pz, F8 in the 360-420 ms window (P200) for the five emotional stimuli.*

The Slow Positive Wave (600-800 ms) revealed a significant Site main effect ($F_{(2,78)}$=23.73, ε=0.75, p<0.001, η^2p=0.38): a larger positivity was found in the posterior site compared to the frontal sites (all ps<0.001). Also a Stimulus effect was found ($F_{(4,156)}$=42.92, ε=0.80, p<0.001, η^2p=0.52; see Fig. 3.14): erotic pictures prompted greater cortical positive amplitudes than sport, neutral, threat (all ps<0.001), and mutilation ones

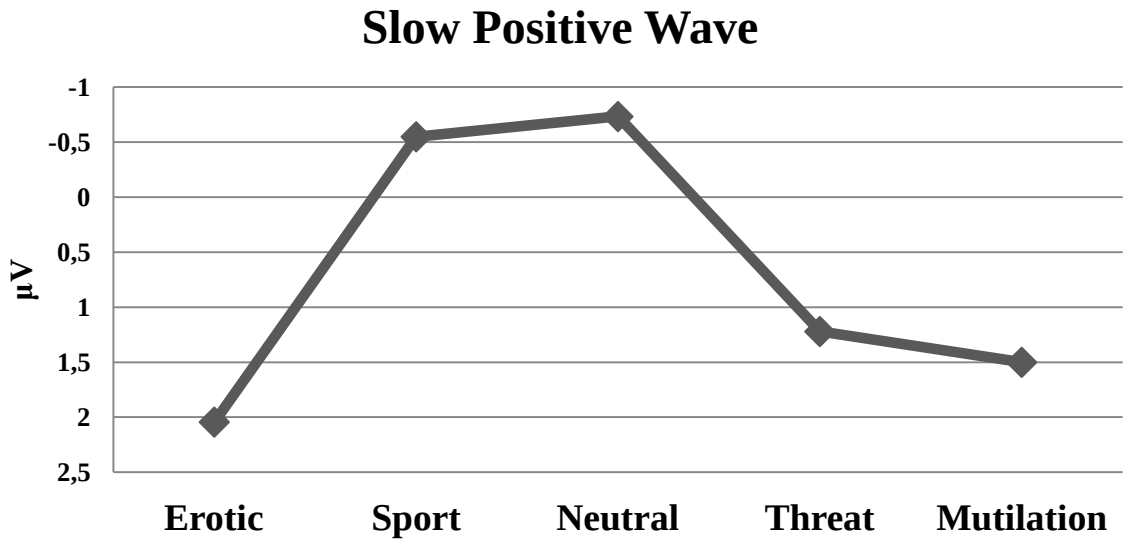

Figure 3.14. *Averaged evoked potentials recorded from F7, Pz, F8 in the 600-800 ms window (Slow Positive Wave) for the five emotional stimuli.*

($p<0.05$). Sport images elicited reduced amplitudes compared to both unpleasant categories (all $ps<0.001$), and greater amplitudes were observed while viewing mutilation pictures compared to threat pictures ($p<0.001$). Furthermore, a significant Site by Stimulus ($F_{(8,312)}=11.18$, $\varepsilon=0.77$, $p<0.001$, $\eta^2p=0.22$) and a Site by Stimulus by Group interactions were found ($F_{(8,312)}=2.31$, $\varepsilon=0.77$, $p<0.05$, $\eta^2p=0.02$). As seen in Figure 3.15, High Responders group showed a reduced cortical positivity while viewing erotic pictures in right frontal site, compared to Low Responders group ($p<0.05$).

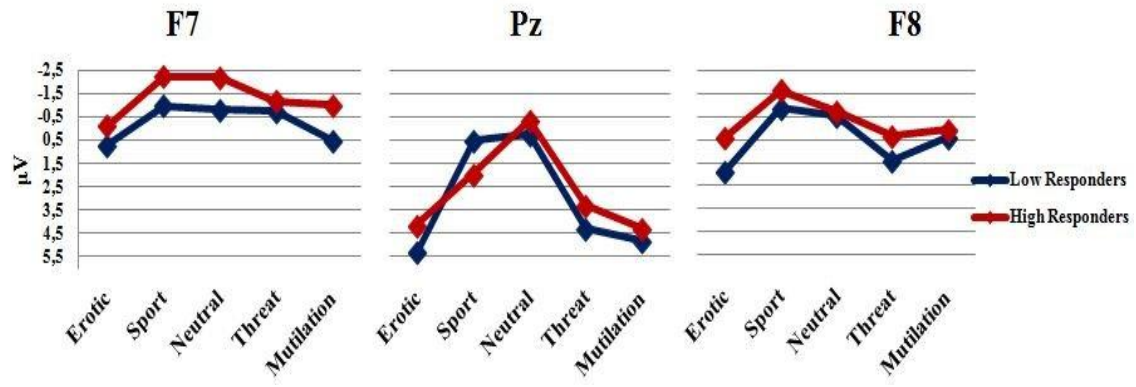

Figure 3.15. *Averaged evoked potential recorded from F7, Pz, F8 in the 600-800 ms window (Slow Positive Wave) for the five emotional stimuli in Low Responders and High Responders.*

3.5 Discussion:

Aim of the study was to investigate associations between general startle reactivity in a baseline paradigm, state anxiety, and perceived noise aversiveness to acoustic startle probes in young women from community. Furthermore, a main purpose of the present research was to investigate the influence of different levels of general startle reactivity on affective modulation of the startle reflex, on cortical responses to emotional stimuli, and on subjective evaluation of affective cues. Furthermore, we examined associations between general startle reactivity and personality traits, such as empathy and emotional detachment.

Most of the studies in literature focused on modulation of startle reflex in varying experimental context, and research on general startle reactivity has been disregarded since startle amplitudes in baseline conditions was considered independent from the task and normalized between participants to cancel individual differences. However, clinical data revealed how differences in general startle reactivity could be a valid indicator of psychological disorders. For example, augmented baseline startle reactivity has been related to post-traumatic stress disorder (Butler et al., 1990; Grillon, Morgan, Southwick, Davis, & Charney, 1996; Grillon and Morgan, 1999; Morgan et al., 1996; Orr et al., 1997).

Results on 111 females revealed a positive correlation between left eye's general startle reactivity and state anxiety measured at the end of the experimental session, whereas no significant correlations were found between right eye's startle response and state anxiety. Trait anxiety did not show significant correlation with startle reflex amplitudes. This is probably due to the fact that a stable personality factor such as trait anxiety is overruled by state anxiety induced by the novel laboratory context. This finding is coherent with results by Grillon and colleagues (1998), showing how PTSD

patients did not differ from controls in general startle reactivity, but showed augmented baseline startle amplitudes in a moderately stressful context. Our finding reveals how a novel context can prompt, in healthy individuals, a contextual state of apprehension and anxiety, which lead to enhanced general startle reactivity. It is fundamental to assess general state anxiety of individuals during psychophysiological experimental sessions in a novel laboratory. Associations found for the left eye, but not for the right eye, might be due to the fact that facial expressivity in response to negative emotional stimuli is generally more intense in the left hemiface, controlled by the right hemisphere (Dimberg & Patterson, 2000; Schwartz, Ahern, & Brown, 1979). Also, results revealed a positive correlation between general startle reactivity and perceived noise aversiveness. Hence, individuals with triggered larger startle reflex are also the most annoyed and frightened by the loud and aversive acoustic stimulus. Angrilli and colleagues (2008) found similar results in neurological patients with orbitofrontal lesions: they manifested reduced general startle reactivity together with a reduced perceived aversiveness of the acoustic startle probe. Furthermore, a positive association was found between state anxiety and rated noise aversiveness: individuals with greater contextual anxiety also perceived the acoustic noises as more annoying and negative. The three variables (general startle reactivity, state anxiety, and noise aversiveness) revealed consistent associations among them. Those relationships could be influenced by cortical and subcortical structures. For example, neurons sensitive to both rapid changes and high intensity of sensorial stimuli are present in afferent regions of the amygdala (Armony & LeDoux, 1997; Yeomans, Li, Scott, & Frankland, 2002), and can influence startle reflex when a dangerous and sudden stimulation is reached. Also the bed nucleus of the stria terminalis (BNST) plays a role in mediating responses to chronic stress and prolonged threats (Davis, 1998), influencing individual's behavior long after the threatening stimulus has been presented (Davis, 2006). A contextual

stressful situation, such as an experimental laboratory setting, as well as continuous and unpredictable loud and sudden noises, can activate the BNST which has a modulating effect on the startle reflex circuit at the level of the nucleus reticularis pontis caudalis.

Concerning analysis of the two groups differing in their general startle reactivity in baseline conditions (Low Responders vs. High responders), we found differences in the mean total score on the Interpersonal Reactivity Index, as well as differences on the Perspective Taking subscale of the questionnaire, which assesses the ability to adopt another's psychological point of view. Therefore, individuals with low general startle reactivity seem to differ from individuals with elevated startle reactivity in some personality traits, such as empathy. Empathy is defined as the ability to understand and feel the emotional states of another individual (Cohen & Strayer, 1996) and a lack of empathy is a core trait of some personality disorders, such as psychopathy, and is considered the main factor influencing aggressive and antisocial behavior observed in this disorder. A key neural structure involved in empathic responses, and structurally and functionally impaired in psychopaths, is the amygdala (Adolphs, 2002). This structure is also involved in fear and threat responses to emotionally negative stimuli and has a mediating role in the startle reflex generation, sending afferents to the nucleus reticularis pontis caudalis. A reduced activity of the amygdala could inhibit general startle reactivity and also impair empathic adaptive responses in individuals.

Self-Assessment Manikin analyses revealed, for both valence and arousal ratings, results consistent with the literature (Bradley & Lang, 1994): both groups attributed higher valence ratings to pleasant pictures, and lower valence ratings to unpleasant pictures. Greater perceived arousal scores were attributed to pleasant and unpleasant pictures compared to neutral ones. Also, the Low Responders group reported overall reduced valence ratings for all stimulus categories compared to the High

Responders group. A possible interpretation of this result is that Low Responders, being less empathic and showing a reduced general physiological reactivity, were also less interested in the emotional task and evaluated all stimuli as less pleasant, choosing lower scores on the Self-Assessment Manikin scale.

Startle data showed the typical linear trend in affective modulation (e.g. Vrana et al., 1988): the reflex amplitude was inhibited while viewing pleasant (erotic) pictures, and potentiated while viewing unpleasant (threat) pictures compared to pleasant ones. Furthermore, the two groups differed in their startle response to emotional stimuli: while High Responders showed an affective modulation of the startle reflex, with an inhibition in response to erotic stimuli, Low Responders manifested a flattened response, without the classical linear trend reported in literature. Neither inhibition while viewing positive pictures, nor potentiation while viewing negative pictures were observed. This finding resembles evidence found in psychopathic research: Patrick and colleagues (1993) reported an absence of startle reflex potentiation in psychopathic incarcerated men while viewing threatening pictures. In this study, incapacity to adequately respond to fear stimuli has been attributed to amygdala impairment. Similarly, in our sample of Low Responders a lower reactivity of the amygdala could be implicated in the lower general reactivity manifested and also in the impaired fear-potentiated startle observed. Some evidence supports a role for the amygdala also in processing valuable biological stimuli and positive emotions (Baxter & Murray, 2002) and this function might be implicated in the lack of inhibition for positive pictures observed in our study.

Coherently with findings from literature, which reports greater cortical positivity in response to emotional stimuli (Olofsson et al., 2008), P200, P300, and Slow Positive Wave showed greater amplitudes during exposure to pleasant and unpleasant compared

to neutral pictures. The P200 component is located around the centro-frontal and parieto-occipital regions of the scalp, is typically elicited during response to visual stimuli, and seems to be related to attention and memory processes. At parietal site, Low Responders manifested, compared to High Responders, a reduced cortical positivity while viewing erotic stimuli. The P300 component is a positive component typically showing its maximum amplitude over the parietal cortex, but Delplanque and colleagues (2005) observed greater amplitudes over fronto-central sites using emotional stimuli as distractors. It is related to attentional and memory processes, mental resource allocation, and it shows greater amplitudes in response to arousing stimuli, both positive and negative. Our study revealed greater cortical positivity in response to erotic and threat pictures in the right frontal site compared to the left frontal site. This asymmetry could be related to right hemispheric superiority for the perception of emotional stimuli, and particularly for stimuli of negative valence (Etcoff, 1989; Silberman & Weingartner, 1986). The Slow Positive Wave is involved in working memory and memory formation (Azizian & Polich, 2007) and its neural sources are generally located in the occipital and parietal cortex. Data revealed, in the right frontal site, a reduced cortical positivity in response to erotic stimuli for the High Responders compared to the Low Responders. Bradley and colleagues (2001) reported that whereas men felt excited and sexy while viewing erotica, women reported feeling embarrassed. This embarrassment might have been greater in High Responders due to their higher empathy and reactivity to emotional stimuli, hence on the long term (600-800 ms) they might have diverted their attention from such stimuli.

In conclusion, different baseline startle magnitudes were associated with different empathy levels. A dissociation between subjective evaluation (Self-Assessment Manikin) and emotional psychophysiological responses (startle reflex, ERPs) has been found: whereas different levels of general startle reactivity did not

differentiate among groups for subjective evaluation of emotional stimuli, a low startle reactivity was associated with both attenuated affective modulation of the startle reflex and reduced cortical processing of emotional stimuli. This dissociation between subjective evaluations and psychophysiological subcortical and cortical measures might be due to the fact that individuals express subjective evaluation of emotional states based on cognitive and sociocultural variables, rather than on accurate perception of bodily states.

These findings suggest that baseline startle response, which variability is generally considered as task-irrelevant noise, can underlie important information about psychological individual differences. It would be interesting to investigate such relationship also in male populations. General startle reactivity could have important clinical applications for studying anxiety disorders, psychopathy, and other psychopathologies.

CHAPTER 4

STUDY III: Decision-making in Women with high Psychopathic Traits

4.1 Abstract:

Psychopaths are often impaired at learning from punishment, manifest with perseveration and impulsivity, and are highly responsive to immediate reward and gratification. Aim of the study was to investigate decision-making capabilities and punishment/reward sensitivity in healthy women from community with high psychopathic traits (n=22), compared to a control group (n=21). Participants were asked to perform Iowa Gambling Task (IGT) while EEG signals was registered. IGT requires choosing between decks of cards yielding high gains, but higher losses (disadvantageous decks), or decks of cards yielding low gains, but lower losses (advantageous decks). After a card is selected, a feedback appears informing about positive or negative outcomes. Women with psychopathic traits manifested perseverative responses and an impaired punishment/reward sensitivity, picking a higher number of cards from disadvantageous decks compared to controls, even if reporting greater confidence in their choice after picking from advantageous compared to disadvantageous decks. We analyzed the Feedback-Related Negativity (FRN), a component elicited in response to negative outcomes, and the Slow Negative Complex (SNC), a component elicited by feedback in orbitofrontal sites. Women with psychopathic traits showed smaller negative FRN amplitudes in response to punishing feedback compared to controls, indexing a reduced sensitivity to monetary loss, and greater SNC amplitudes in response to gain feedback compared to controls, revealing higher sensitivity to immediate rewards compared to control participants. Women with

psychopathic traits manifest, similarly to findings on psychopathic men, behavioral perseveration, impulsivity, and a dysregulation in punishment/reward sensitivity during a decision-making task.

4.2 Introduction:

Psychopathy is a personality disorder characterized by antisocial behavior in the context of affective and interpersonal detachment (Benning, Patrick, Blonigen, Hicks, & Iacono, 2005). Diagnosis of psychopathy is generally based on two main dimensions: Emotional Detachment, which includes personality traits such as superficial charm, grandiosity and egocentricity, affective shallowness, lack of empathy, lack of remorse or guilt, lying and manipulativeness; and Antisocial Behavior, which entails markers of an impulsive and violent life-style, early behavioral problems, juvenile delinquency, proneness to boredom, sensation seeking, poor planning, and irresponsibility.

Individuals with psychopathy show little concern about the effects that their bad actions can have on other individuals or even on themselves. They often commit impulsive and not planned crimes where the probability of being caught in the act is high. Also, they are impaired at apprehending information associated with punishment and at appropriately responding to stimuli associated with punishment. For example, they manifest impairments in aversive conditioning (Flor, Birbaumer, Hermann, Ziegler, & Patrick, 2002) and in passive avoidance learning (Blair et al., 2004; Newman & Kosson, 1986), an impaired recognition of negative facial expression (Blair et al., 2004), and impaired electrodermal responses to negative vocal expressions (Verona et al., 2004). Being unable to learn from punishment, they often manifest impulsive and perseverative behavior, and incapability to inhibit previously rewarded choices when presented with changing contingencies (Whiteside & Lynam, 2001).

Decision-making tasks, generally investigating individual's capability to select a good option from different choices, to predict positive or negative outcomes, and to learn from rewarding or punishing choices, can be a valid tool to examine maladaptive or perseverative responses in psychopaths. Both cognitive reasoning and emotional processing can have an influence on decision-making. Cognitive reasoning requires a rational evaluation of risks and benefits associated with a choice, whereas emotional processing involves affective responses to different options and can unconsciously guide decisions (Seguin et al., 2007).

Several tasks exist in literature aimed at investigating decision-making abilities. A common and valid tool is the Iowa Gambling Task (IGT), specifically ideated to examine rewarding and punishing sensitivity to real-life decisions, and focused on emotional aspects of economic decisions (Bechara et al., 1994). During the task, individuals are asked to choose between decks of card that yield high gains, but higher losses (disadvantageous decks), or decks of cards that yield low gains, but also smaller losses (advantageous decks). Van Honk and collaborators (2002) examined, in participants, with low and high psychopathic traits, performance on the Iowa Gambling Task. High Psychopaths, compared to Low Psychopaths, did not learn from punishing feedbacks during the task and showed maladaptive responses, compared to Low Psychopaths. Newman and colleagues (1987) asked incarcerated psychopaths and non-psychopaths to perform a monetary card task examining maladaptive response perseveration. They were asked to pick cards from a desk in which the probability of being punished increased by 10% with every block of 10 cards. Psychopaths played more cards than non-psychopaths, and lost a greater amount of money during the task. Blair and colleagues (2006) also investigated decision-making in psychopathic individuals and a control group using the Differential Reward/Punishment learning task, in which participants had to choose between two objects that were associated with

different levels of reward or punishment. Data revealed a significant impairment, in psychopaths, when they had to choose between objects with different levels of reward and also when they had to choose between objects associated with different levels of punishment. Koenigs and colleagues (2010) administered the Ultimatum Game and the Dictator Game to primary and secondary psychopaths, and to a control group. The Ultimatum Game a first player decides how to split a sum of money, and a second player can decide whether to accept or reject the offer. In the Dictator Game, a first player decides how to split a sum of money, and the second player simply receives the part of money decided by the first player. Primary psychopaths (high in emotional detachment) accepted a significantly lower rate of unfair Ultimatum and Dictator Games offers. Mahmut, Homewood, and Stevenson (2008) investigated performance at the Iowa Gambling Task in undergraduate male students with high psychopathic traits, compared with students with low psychopathic traits, and observed how high psychopaths performed significantly worse during the task. Blanchard, Bassett, and Koshland (1977) investigated sensitivity to reward in control groups and incarcerated psychopaths who were asked to choose between small immediate rewards and three times larger rewards available after delays of hours or days. Psychopaths manifested a reduced willingness to delay gratification compared to controls.

Several ERPs components have been related to emotional decision-making. For example, Gehring and Willoughby (2002) analyzed a negative component elicited in response to feedback informing individuals about monetary losses and wins. They observed greater negativities when the feedback informed about a monetary loss compared to feedback informing about a positive outcome. This component appeared at 256 ms after the stimulus onset (feedback) and showed its maximum amplitude in medial-frontal sites. Bianchin and Angrilli (2011) found a fronto-central negative

component (Feedback-Related Negativity), occurring at 260 ms) elicited by feedback informing about a monetary outcome during a gambling task. It showed greater negativities in response to monetary losses compared to gains.

To our knowledge, no studies to date have specifically investigated psychophysiological central correlates of economic reward and punishment in psychopathic population, employing the Iowa Gambling Task. Potts and collaborators studied cortical responses to monetary loss and gain in students with low and high impulsivity, a personality trait also present in psychopathic individuals. Highly impulsive participants manifested a reduced negativity of a medial frontal ERPs component in response to punishing trials, compared to low impulsive participants. Externalizing pathology is also a construct describing a tendency toward impulsivity and antisocial behavior. Bernat and collaborators (2011) investigated the influence of this construct on responses to positive and negative feedback during a gambling task. They found the P300 component following the feedback to be reduced in highly externalizing individuals, in response to both positive and negative outcomes, indexing an aspecific hyporesponsivity to both types of feedback in these individuals.

While perseveration and reward and punishment sensitivity has been extensively studied in psychopathic men, little is known about emotional decision-making and behavioral regulation in psychopathic women. A study by Vitale and Newman (2001) reported normal performance in a card task examining response perseveration in incarcerated women, contrary to predictions based on results found in men. A possible explanation for this result is that women were assessed using the PCL-R, a tool validated in male samples, whereas studies on factor structure of the PCL-R in women are very limited (Dolan & Vollm, 2009). Other investigating tools might be more adapt for assessing psychopathy-related traits in these populations and psychopathy in women

could manifests differently from men. For example, Cale and Lilienfeld (2002) reported how the disorder seems to be related to histrionic personality disorder in females, and to antisocial personality disorder in males. Forouzan and Cooke (2005) argued that offending behavior and impulsivity could manifests with violence against other in men, and with self-harming behavior in women.

Aim of the present research was to investigate behavioral and psychophysiological correlates of decision-making in women with high psychopathic traits from community (compared to a control group), selected with the Multidimensional Personality Questionnaire – Brief Form (MPQ-BF; Patrick et al., 2002). Participants performed Iowa Gambling Task (Bechara et al., 1994) while electroencephalographic responses were recorded.

We hypothesized that women with high psychopathic traits would have preferred disadvantageous decks to advantageous ones. In fact, disadvantageous decks yielded to high and immediate economical gains, particularly attractive to psychopaths, and also to high economical punishments, to which psychopaths from literature seem to be less sensitive. Also, we expected women with high psychopathic traits to show an incapability to learn from punishment and hence to be more confident in their choices after picking from disadvantageous decks. Furthermore, we hypothesized a reduced negativity of the Feedback-Related Negativity in response to bad outcomes, indexing a reduced sensitivity to punishment in women with psychopathic traits, and also a general reduced elaboration of losses and a hypersensitivity to gains in a later negative component registered over orbitofrontal sites, in line with high impulsivity and need for immediate gratification manifested in psychopaths (Blanchard et al., 1977) and their insensitivity to aversive cues (e.g. Flor et al., 2002; Blair et al., 2004). We also hypothesized that the two selected groups would have differed in their psychopathic

traits measured with the Levenson Self-Report Psychopathy Scale (LSRP; Levenson et al., 1995), with the Interpersonal Reactivity Index (IRI; Davis, 1983), and with the Psychopathic Personality Inventory – Revised (PPI-R; Levenson & Widows, 2005), coherently with the group selection effectuated by MPQ scores.

4.3 Methods:

Participants

Four-hundred and forty-five (445) undergraduate women were recruited to take part in the study. They were attending Economics (n=81), Law (n=85), Medicine (n=62), Psychology (n=67), Political Sciences (n=73), and Engineering (n=81) Schools at University of Padova.

After filling out a consent form, they were administered the Multidimensional Personality Questionnaire – Brief Form (MPQ-BF; Patrick et al., 2002). It is a 154-item questionnaire aimed at measuring several personality traits in community samples. It includes 11 subscales: Wellbeing (measuring optimistic and positive tendencies), Social Potency (measuring persuasiveness and dominance predispositions), Achievement (assessing ambitions through success and power), Social Closeness (measuring the capability to have close and affectionate relationships), Stress Reaction (evaluating sensitivity to stressful and negative events and anxiety in daily life), Alienation (evaluating individual's tendency to feel exploited and mistreated), Aggression (measuring the tendencies toward violence and revenge), Control (assessing cautiousness and being reflective), Harm Avoidance (measuring avoidment of dangerous risks and extreme adventures), Traditionalism (evaluating the presence of strict moral norm and religiosity), and Absorption (assessing experiences of altered awareness).

Although the MPQ-BF is not a questionnaire specifically built for measuring psychopathic traits, a growing literature investigated the associations between MPQ and clinical disorders. These associations permit to predict psychopathological manifestations from inventories of normal personality from community samples. Also, psychopathic traits have been found to be related to some MPQ subscales. For example, Verona and colleagues (2001) found a correlation between factor 1 (Emotional Detachment) of the PCL-R (Hare, 1991), and high Social Potency and low Stress Reaction scores. Benning and colleagues (2003) demonstrated that specific subscales of the MPQ could be good predictors of the two factors of the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996). Specifically, regression analysis revealed how the first factor of the PPI (assessing social influence, stress immunity, and fearlessness) was well predicted by high Social Potency, low Stress Reaction, and low Harm Avoidance scores, whereas the second factor of the PPI (assessing machiavellian egocentricity, impulsive nonconformity, blame externalization, and carefree non planfulness) was well predicted by high Alienation, high Aggression, low Control, low Traditionalism, and low Social Closeness.

Therefore, we assumed specific MPQ-BF subscales scores could be used as valid indexes of primary psychopathy (PPI's first factor). Two groups of participants were selected: a control group (n=21), and a detached group, with high primary psychopathy traits (n=22). The two groups differed significantly in their Social Potency, Harm Avoidance, and Stress Reaction scores (see Tab. 4.1). Controls had scores in the normal range of population, whereas Detached were selected as having high Social Potency, low Harm Avoidance, and low Stress Reaction scores.

	Mean Controls	Mean Detached	SD Controls	SD Detached	T Test
MPQ-BF					
Social Potency	-0.49	1.88	0.40	0.15	$t_{(41)}$=-26.22***
Harm Avoidance	0.25	-0.45	0.71	1.02	$t_{(41)}$=2.63*
Stress Reaction	-0.35	-1.59	0.45	1.14	$t_{(41)}$=7.29***

Table 4.1. *MPQ's Social Potency, Harm Avoidance, and Stress Reaction scores (z-scores). Mean scores, Standard Deviation, and T Test for Controls (n=22) and Detached (n=21) groups. (*=p<0.05; **=p<0.01; ***=p<0.001).*

Procedure

Participants filled out a consent form, were seated in a recliner in a dimly lit room and electrodes for electroencephalographic (EEG) registration were placed.

They were asked to perform a computerized version of the original Iowa Gambling Task developed by Bechara and colleagues (1994), modified for ERPs registration. Participants saw four decks of cards on the computer screen (see Fig. 4.1, panel a). Using the mouse, they could click on a card on any of the four decks. Every time they selected a card, a message was displayed (see Fig. 4.1, panel b) asking participants how confident they were in their decision, from "not at all" (1) to "very firm" (4). A feedback then appeared (see Fig. 4.1, panel c) informing participants about the amount of money won (economic reward) or lost (economic punishment) after the selection. On the bottom of the computer screen there was a message informing about the total amount the subject had won and that changed according to gains and losses

after each card selection. Once the money was added or subtracted the face of the card disappeared, and participants could select a new card.

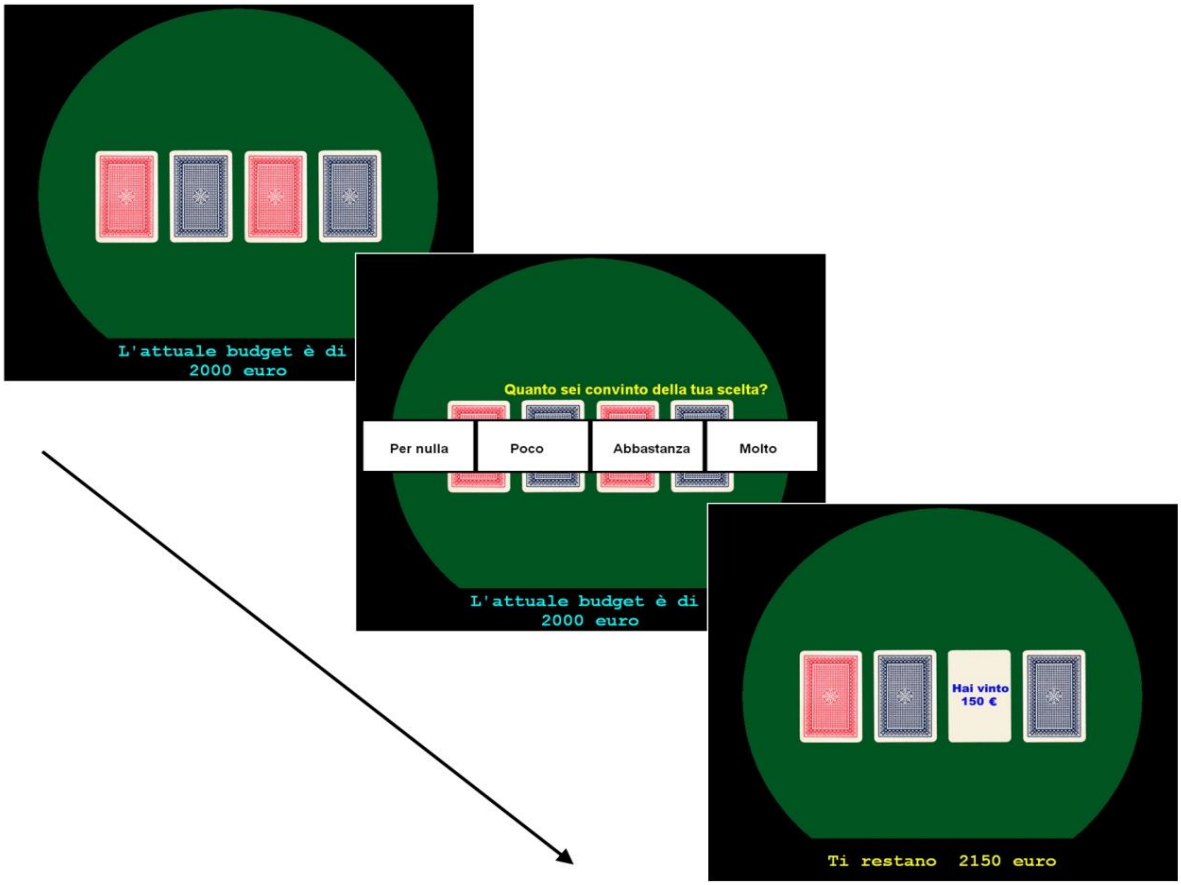

Figure 4.1. *Panel a: Four decks of card displayed on the computer screen. Participants had to choose one card on any of the decks. Panel b: Confidence in the choice. Participants had to indicate how confident they were in their choice from "not at all" to "very firm". Panel c: Feedback informing about gains or losses.*

Each deck of cards contained 50 cards, and the task ended after participant had selected a total of 150 cards. Two of the decks were disadvantageous: they yielded immediate high gains, but lead to greater economic losses in the long term. Possible outcomes for these decks were: +1000, +600 (high gain), -200, -300 (high loss) €. Two of the decks were advantageous: they yielded frequent small gains and smaller long-term losses. Possible outcomes for these decks were: +100, +50 (low gain), -25, -75

(low loss) €. The initial budget was 2000 €. To familiarize themselves with the game, participants were trained with a short version of the task (12 total picks), in which the four decks were not differentiated by rules or contingencies. Before beginning the task, participants were given the following verbal instructions: "In front of you on the screen, there are four decks of cards. You have to select one single card at a time on any decks you choose by clicking on it with the mouse. Each time you select a card a message will appear, asking you how confident you are in your choice, from "not at all" to "very firm". A feedback will then appear and tell you if you won or lost money. You are free to switch from one deck to another any time you want. The goal of the task is to win as much money as possible, and you must keep on playing until the task will stop. You will start with a 2000 € credit. The computer does not make you lose money randomly. You may find yourself losing money on all the desks, but some of the decks will make you lose more money than the others. At the end of the experimental session, you'll receive real credit based on how much you were able to win during the gambling task (26, 39, or 52 €)."

At the end of the task, participants completed the Levenson Self-Report Psychopathy Scale (LSRP; Levenson et al. 1995), the Interpersonal Reactivity Index (IRI; Davis, 1983), and the Psychopathic Personality Inventory - Revised (PPI-R; Lilienfeld & Widows, 2005).

The LSRP is a self-report measure developed to assess psychopathic traits in non-institutionalized samples. In consists of the subscales: a "Primary Psychopathy" scale (16 items), measuring predispositions toward meanness, shallow affectivity, and egocentrism, and a "Secondary Psychopathy" scale (10 items), assessing maladaptive and antisocial behavior.

The IRI evaluated emotional and cognitive empathy in normal population. It comprises 4 subscales (7 items each): the Perspective Taking scale (PT); the Fantasy scale (FS), the Empathic Concern scale (EC), and the Personal Distress scale (PD).

The PPI-R assesses psychopathic traits in community populations and non-criminal samples. It comprises 154 items divided into 8 subscales: Machiavellian Egocentricity, Social Influence, Fearlessness, Coldheartedness, Impulsive Nonconformity, Carefree Nonplanfullness, Stress Immunity, and Blame Externalization.

After receiving credit for their collaboration (26, 39, or 52 €), participants were debriefed.

Physiological Recording

EEG data were collected through 38 tin electrodes using SynAmps amplifiers (NeuroScan Labs, Sterling, USA): 31 electrodes were mounted on an elastic cap according to the 10-20 International System (Jasper, 1958), two electrodes were applied below the eyes, two on the two external cantii, one on the nasion, and two on the mastoids. Impedance was kept below 5 kOhm in all sites. EEG data were acquired in DC mode, with a 30 Hz low pass filter, and a 500 Hz sampling rate. Cz was used as an on-line recording reference, and then data were converted off-line to the original Average Reference. Eye-movement calibration was performed at the beginning of the experiment in order to correct for ocular artifacts (Brain Electrical Source Analysis package – BESA, 5.1 version; Berg & Scherg, 1994). After eye artifact correction, each trial was visually inspected and eventually rejected if any remaining artifact from different sources was detected. All epochs (1000 ms after feedback onset) were baseline corrected by a 500 ms interval preceding feedback onset. Analyses were conducted in two temporal intervals (stimulus locked on feedback onset), chosen on the basis of

visual inspection and past literature (Gehring & Willoughby, 2002; Bianchin & Angrilli, 2011; Yamaguchi et al., 2001; Bernat et al., 2011): from 260 to 350 ms in a frontocentral area (Fz-FCz) for Feedback-Related Negativity analysis, and from 350 to 500 ms in an orbitofrontal area (Io1-Nz-Io2) for a Slow Negative Complex.

Statistical Analysis

Levenson Self-Report Psychopathy Scale, Psychopathic Personality Inventory – Revised, and Interpersonal Reactivity Index scores were compared between groups by means of t tests.

We used a t test to analyze differences in the mean number of picks from the advantageous decks in the two groups. We divided picks into blocks consisting of 10 trials each, and analyzed the middle blocks of trials, from pick 51 to pick 100. This decision was due to the fact that the first 50 picks were considered as a training, in which participants played by trial and error, whereas in the last part of the game (last 50 picks) all participants had understood rules and contingencies of the game. As regards the confidence in the choice rated after each pick (from "1" to "4"), we used a mixed ANOVA with Group (Controls vs. Detached) as a between-subject factor, and Decks (advantageous, disadvantageous) as a within-subject factor.

Feedback-Related Negativity (FRN) and Slow Positive Complex (SPC) components were separately analyzed using ANOVA, with Group (Controls vs. Detached) as a between-subject factor, and Condition (Loss vs. Gain), and Contingency (Low vs. High) a within-subject factors. Condition factor refers to the two possible outcomes revealed by the feedback: a loss of money or a gain of money, whereas Contingency factor refers to the two possible level of both the gain or loss, which could

be low after picking from the advantageous decks, or high after picking from the disadvantageous decks.

The significance level was set at .05 for all analysis. Newman-Keuls post-hoc test further specified for significant effects.

4.4 Results

The two groups differed in their mean scores on the LSRP "Primary Psychopathy" subscale, on all the IRI subscales and IRI total score, and on Machiavellian Egocentricity, Social Influence, Fearlessness, Impulsive Nonconformity, Coldheartedness, and Stress Immunity (see Tab. 4.2). Detached participants manifested lower mean scores on Perspective Taking, Empathic Concern, Personal Distress, Fantasy scale and total IRI. They had higher scores on Levenson's Primary Psychopathy scale, on Machiavellian Egocentricity, Social Influence, Fearlessness, Coldheartedness, Impulsive Nonconformity, and Stress Immunity.

	M Controls	**M Detached**	**SD Controls**	**SD Detached**	**T Test**
Questionnaires					
Perspective Taking (IRI)	25.00	19.32	3.51	6.13	$t_{(41)}$=3.70***
Empathic Concern (IRI)	28.05	19.59	2.44	4.94	$t_{(41)}$=7.06***
Personal Distress (IRI)	20.86	11.95	5.55	2.75	$t_{(41)}$=6.71***
Fantasy (IRI)	25.67	18.68	5.24	7.38	$t_{(41)}$=3.56***
Total (IRI)	99.57	69.55	8.52	14.49	$t_{(41)}$=8.23***

Primary Psychopathy (LSRP)	25.86	45.91	3.21	6.01	$t_{(41)}$=-13.55***
Secondary Psychopathy (LSRP)	21.10	22.59	3.33	3.57	$t_{(41)}$=-1.42, n.s.
Machiavellian Egocentricity (PPI-R)	-0.14	1.95	0.72	1.13	$t_{(41)}$=-7.20***
Social Influence (PPI-R)	-0.63	1.64	0.87	1.03	$t_{(41)}$=-7.81***
Fearlessness (PPI-R)	-0.25	1.23	0.79	0.99	$t_{(41)}$=-5.00***
Coldheartedness (PPI-R)	-0.19	2.79	0.93	1.54	$t_{(41)}$=-7.61***
Impulsive Nonconformity (PPI-R)	-0.25	0.90	0.78	0.80	$t_{(41)}$=-4.77***
Carefree Nonplanfulness (PPI-R)	-0.26	-0.32	1.14	0.80	$t_{(41)}$=0.18, n.s.
Stress Immunity (PPI-R)	-0.49	1.14	0.77	0.85	$t_{(41)}$=-6.56***
Blame Externalization (PPI-R)	-0.20	0.24	0.95	0.86	$t_{(41)}$=-1.59, n.s.

Table 4.2. *Levenson Self-Report Psychopathy Scale (LSRP), Interpersonal Reactivity Index (IRI), and Psychopathic Personality Inventory – Revised (PPI-R). Mean scores, Standard Deviation, and T Test for Controls (n=22) and Detached (n=21) groups. (n.s.=non significant; *=p<0.05, **=p<0.01, ***=p<0.001).*

Behavioral data revealed a significant difference in the mean number of advantageous pick between Controls and Detached ($t_{(41)}$=2.45, p<0.05), in the middle block of picks (51-100). Detached participants picked a significant lower number of cards from the advantageous decks (see Fig. 4.2).

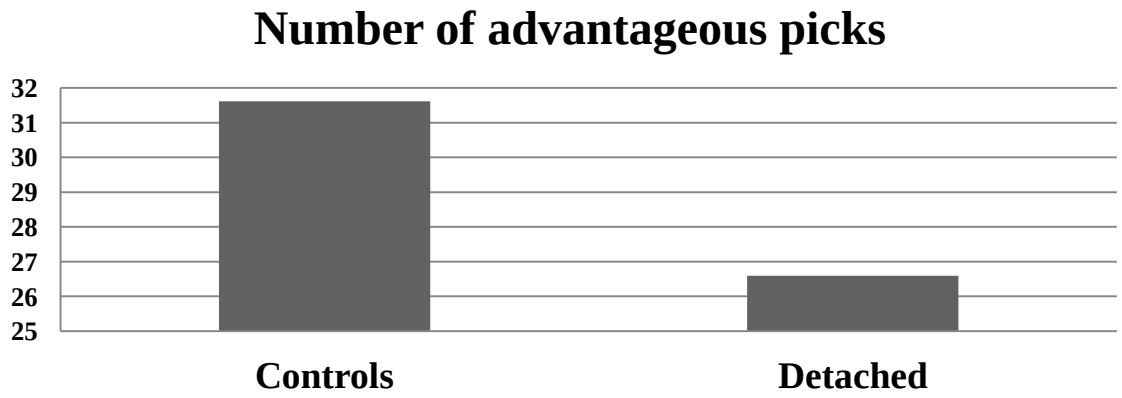

Figure 4.2. *Mean number of picks from the advantageous decks in the two groups (Controls and Detached) in the middle block of trials (51-100).*

Data analysis on confidence in the choice revealed a Deck main effect ($F_{(1,40)}$=5939.46, p<0.001, η^2p=0.99): as seen in Figure 4.3, both groups of participants manifested greater confidence when picking from advantageous decks compared to disadvantageous decks. Neither Group nor Group by Decks interaction were found.

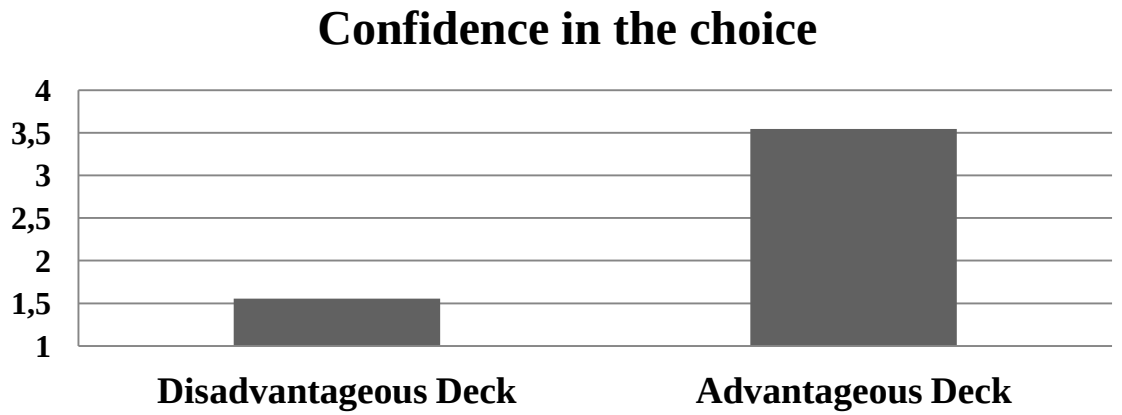

Figure 4.3. *Confidence in the choice after picking from disadvantageous and advantageous decks, for both groups of participants.*

Analysis of the Feedback-Related Negativity (FRN; see Fig. 4.4) revealed a significant main effect of Condition ($F_{(1,34)}$=20.20, p<0.001, η^2p=0.37). As seen in Figure 4.5, losses elicited a significantly greater negativity compared to gains. Also, a main effect of Group was found ($F_{(1,34)}$=6.45, p<0.05, η^2p=0.16; see Fig. 4.6): the FRN was significantly more negative in Controls compared to Detached. Furthermore, a contingency effect was found ($F_{(1,34)}$=7.69, p<0.01, η^2p=0.18): high contingencies (high losses or gains) elicited greater negativity compared to low contingencies (low losses or gains). Neither Group by Condition, nor Group by Contingency, nor Condition by Contingency, nor Group by Condition by Contingency interactions were found.

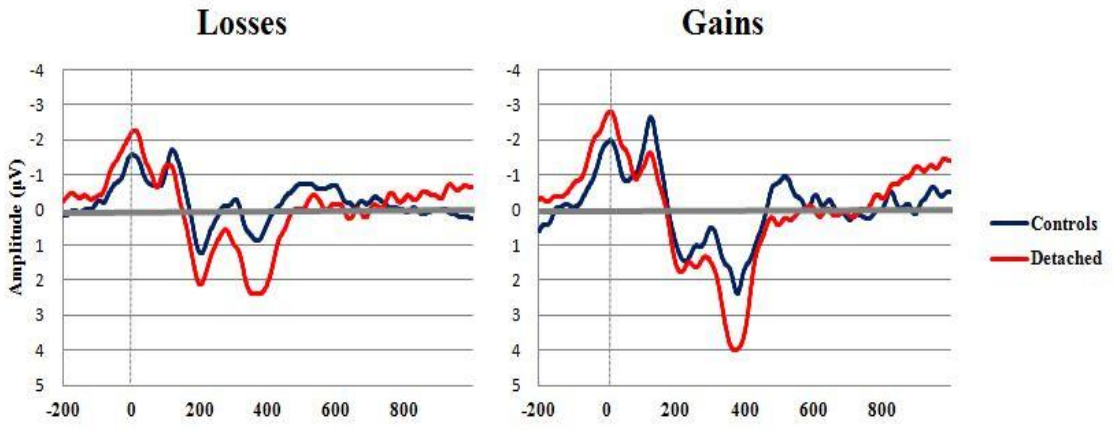

Figure 4.4. *Feedback-Related Negativity – FRN (260-350 ms), registered in frontocentral sites (Fz-FCz), elicited by losses (left panel) and gains (right panel) in Controls and Detached.*

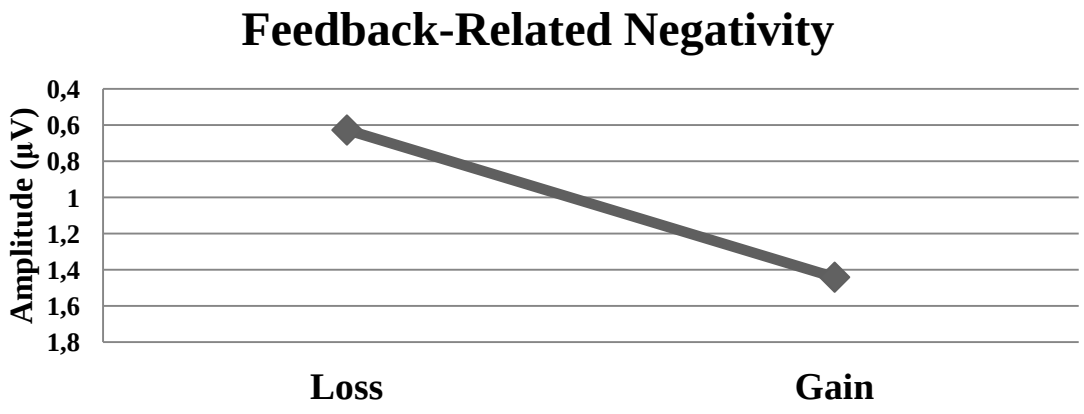

Figure 4.5. *Feedback-Related Negativity – FRN (260-350 ms), registered in frontocentral sites (Fz-FCz) elicited by losses and gains.*

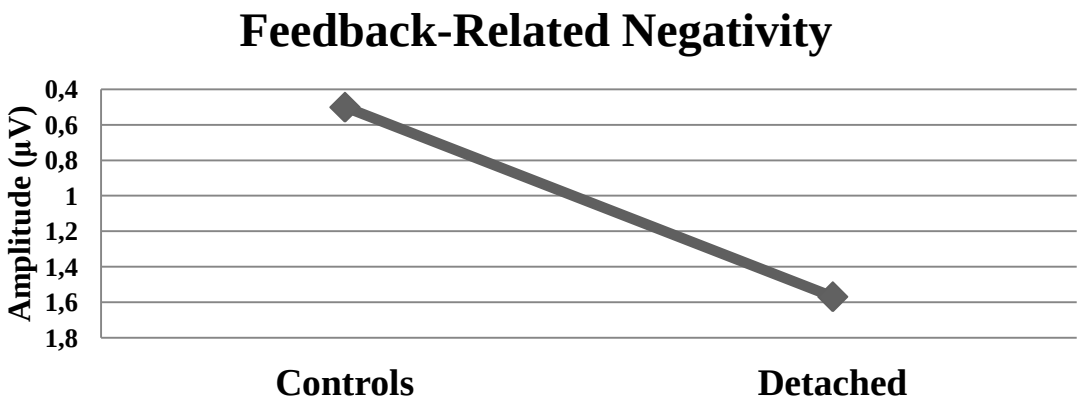

Figure 4.6. *Feedback-Related Negativity – FRN (260-350 ms), registered in frontocentral sites (Fz-FCz), in Controls and Detached.*

Analysis of the Slow Negative Complex (SNC; see Fig. 4.7) revealed a significant main effect of Condition ($F_{(1,34)}$=49.77, p<0.001, η^2p=0.59), a significant main effect of Contingency, ($F_{(1,34)}$=5.45, p<0.05, η^2p=0.14), and a significant interaction Condition by Contingency ($F_{1,34)}$=4.80, p<0.05, η^2p=0.12): gains elicited greater negative amplitudes compared to gain (all ps<0.001). Also, whereas amplitudes elicited by low losses did not differ from amplitudes elicited by high losses, low gains elicited greater negative amplitudes compared to high gains (p<0.01). Furthermore, a Group by Condition interaction was found ($F_{(1,34)}$=4.18, p<0.05, η^2p=0.11; Fig. 4.8): in both Controls and Detached groups, gains elicited greater negativities compared to losses (p<0.01 and p<0.001, respectively). The two groups did not differ in their amplitudes elicited by losses, whereas Detached showed greater negative amplitudes in response to gains compared to controls (p<0.001).

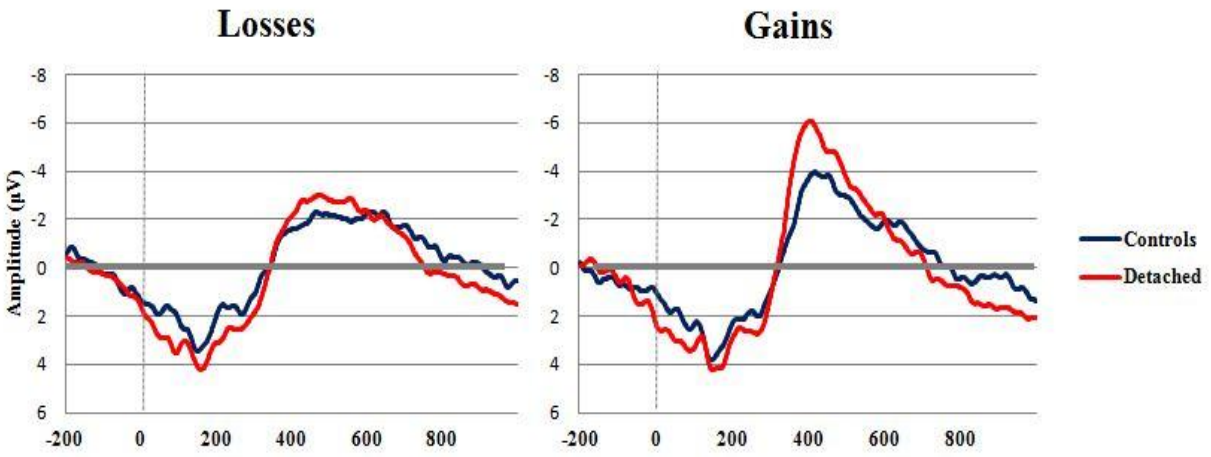

Figure 4.7. *Slow Negative Complex– SNC (350-500 ms), registered in orbitofrontal sites (Io1, Nz, Io2), elicited by losses (left panel) and gains (right panel) in Controls and Detached.*

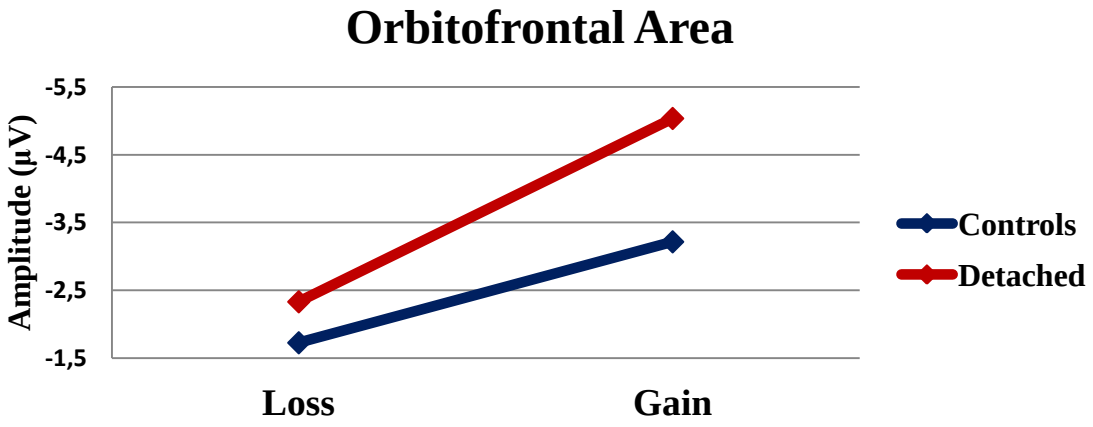

Figure 4.8. *Slow Negative Complex - SNC (350-500 ms), registered in orbitofrontal sites (Io1, Nz, Io2), elicited by losses and gains, in Controls and Detached.*

4.5 Discussion:

Aim of the present study was to examine behavioral and psychophysiological aspects associated with emotional decision-making in healthy women with high psychopathic traits. In line with research on psychopathy in men, evidencing deficits in learning from punishment, maladaptive perseverations, and hypersensitivity to rewards (Van Honk et al., 2002; Newman et al., 1987; Blair et al., 2006; Koenigs et al., 2010;

Mahmut et al., 2008; Blanchard et al., 1977), we expected women with high psychopathic traits to manifests similar impairments while performing the Iowa Gambling Task: perseverative responses when picking cards from disadvantageous decks, impaired learning from punishment, higher sensitivity to rewarding stimuli, and lower sensitivity to punishing stimuli. Participants with high psychopathic traits and control group were selected based on MPQ's Social Potency, Stress Reaction, and Harm Avoidance subscales scores. In fact, scorings on these three subscales have been found to be good predictors of PPI's primary psychopathy factor (Benning et al., 2003). We expected that the two groups selected with this tool would have also differed on other questionnaires scores assessing psychopathy-related traits (Levenson Self-Report Psychopathy Scale, Psychopathic Personality Inventory - Revised, Interpersonal Reactivity Index).

Women with high psychopathic traits (Detached) manifested lower mean scores on Perspective Taking, Empathic Concern, Personal Distress, Fantasy scale, and on total IRI scores. Therefore, women with high primary psychopathy traits, also lacked emotional and cognitive empathy, being impaired at adopting the psychological point of view on another person (Perspective taking), at perceiving feelings of fictitious characters from movies or books (Fantasy), at feeling apprehension fro unlucky people (Empathic Concern), and at feeling anxious or stressed in tense contexts (Personal Distress). These results are coherent with literature, showing how a core trait of primary psychopathy is the emotional deficit and a lack of empathy (e.g., Blair et al., 2007; Blair, 1999; Blair et al., 2002; Verona et al., 2004; Eisenbarth et al., 2013). Also, Detached participants (with high primary psychopathy traits) coherently reported higher scores on LSRP's Primary Psychopathy mean score (measuring predispositions toward egocentrism, meanness, and callousness) compared to the control group. Detached

women also reported higher scores on PPI-R's Machiavellian Egocentricity, measuring willingness to manipulate others, on Social Influence, assessing predispositions to dominate other individuals, a construct similar to Social Potency measured by MPQ, on Fearlessness (construct similar to MPQ's Harm Avoidance subscale), on Coldheartedness, evaluating lack of empathy and superficial affectivity, Impulsive Nonconformity, testing disregard for traditions, and on Stress Immunity (construct similar to MPQ's Stress Reaction subscale). These data confirm how the Multidimensional Personality Questionnaire can be a valid tool for assessing psychopathic traits in community samples.

Behavioral data on Iowa Gambling Task revealed how Detached women picked a significantly higher number of cards from disadvantageous decks compared to control group. Nevertheless, both groups of participants manifested greater confidence in their choices after picking cards from advantageous compared to disadvantageous decks. These results seem to suggest that even if detached women became aware of which were the good decks of cards (that permitted to yield a conspicuous amount of money in the long-term), they presented a maladaptive response, perseverating in their choices to pick cards from bad decks (that yielded immediate high rewards but lead to a loss of money in the long-term). Hence, women with high psychopathic traits manifested an enhanced sensitivity to great rewards and a hyposensitivity to punishment stimuli, which manifested with perseverative responses during the task. These results reflect findings on psychopathic men, indexing impairments in learning from punishing feedbacks and maladaptive responses during Iowa Gambling Task (van Honk et al., 2002; Mahmut et al., 2008).

Feedback-Related Negativity showed overall greater negative amplitudes in Controls compared to Detached group. This component is generally elicited by a

feedback revealing a negative outcome (Gehring & Willoughby, 2002). This finding suggests a general reduced sensitivity, in women with high psychopathic traits, to monetary loss and punishment. Neural source of this component has been located in the anterior cingulate cortex (ACC), a structure with a key role in decision-making, impulses regulation, emotional control, reward anticipation, error detection and conflict monitoring (Decety & Jackson, 2004; Jackson et al., 2006; Bush et al., 2000). Psychopathy has been associated with ACC dysfunctions and impairments in this structure have been shown to cause perseverative behavior (Mesulam, 2002), deficit in error monitoring (Swick & Jovanovic, 2002), and impaired response inhibition (Kiehl, Smith, Hare, & Liddle, 2000).

The Slow Negative Complex, measured over orbitofrontal sites, revealed greater negativity in response to gain feedback, compared to loss feedback, and a greater negativity in response to rewards in Detached compared to Control participants. Therefore, women with high psychopathic traits manifested greater sensitivity to immediate gratifications compared to controls. Orbitofrontal areas seem to have a key role in decision-making and patients with orbitofrontal damages show impaired performances at the Iowa Gambling Task (Bechara, 2004). This area is involved in instrumental learning and response reversal, which results to be impaired in psychopathic individuals (LaPierre et al., 1995). Damages of the orbitofrontal cortex cause "acquired sociopathy", characterized by impulsivity, disinhibition, and lack of empathy (Bechara et al., 1994).

Our findings seem to suggest that women with high psychopathic traits do show impairment in punishment/reward regulation, in behavioral inhibition, and manifest with perseverative responses while performing an emotional decision-making task.

CHAPTER 5

STUDY IV: Associations between triarchic model of Psychopathy and Narcissism

5.1 Abstract:

This study examined differential associations between the several domains of the triarchic conceptualization of psychopathy (boldness, meanness, and disinhibition; Patrick, Fowles, & Krueger, 2009), as measured by the triarchic psychopathy measure (Patrick, 2010), and the narcissistic construct, as assessed by the Narcissistic Personality Inventory (Raskin & Terry, 1988), in 472 undergraduate students (221 males, 251 females). NPI scores were computed using Raskin's 7-factor solution (Authority, Exhibitionism, Superiority, Entitlement, Exploitativeness, Self-Sufficiency, Vanity), and Kubarych's 2-factor solution (Power, Exhibitionism). We hypothesized associations between boldness/meanness domains and grandiose factors of narcissism (Authority, Entitlement, Self-Sufficiency, Power), and between boldness/disinhibition domains and vulnerable factors of narcissism (Vanity, Exhibitionism). Also, we hypothesized gender differences in the narcissistic construct between men and women. As regards Raskin's factors, boldness correlated with all subscales, meanness was related to scoring on authority, entitlement, exploitativeness, and self-sufficiency, and disinhibition was associated with scoring on exhibitionism and exploitativeness. Entitlement and exploitativeness manifested differently in men and women. Entitlement was predicted by both boldness and meanness in men, and only by meanness in women. Exploitativeness was predicted in women by boldness and meanness, and by boldness in men. As regards Kubarych's factor, power was associated with both boldness and meanness, whereas exhibitionism was related to boldness and disinhibition. Different

narcissistic facets are related to specific configurations of psychopathic traits. The Narcissistic Personality Inventory captures both grandiose and vulnerable aspects of narcissism.

5.2 Introduction:

Psychopathy has been conceptualized and assessed in several ways in the past decades. The most widely used instrument in clinical and research settings is the Psychopathy Checklist – Revised (PCL-R; Hare, 1991; Hare, 2003), mainly developed in criminal populations. Earlier research on PCL-R indexed the presence of two main factors defining the psychopathic construct: a first factor, describing the affective and interpersonal facets of psychopathy (e.g., lack of empathy, callousness, egocentricity), and a second factor, describing social deviance and life-style facets of psychopathy (e.g., impulsivity, irresponsibility, antisocial behavior). More recent analysis of the PCL-R factorial structure evidenced three factors (Cooke & Michie, 2001), and four factors (Hare, 2003; Hare & Neumann, 2008). Lilienfeld and Andrews (1996), with the development of the Psychopathic Personality Inventory (PPI), proposed a conceptualization of psychopathy more focused on personality traits, representing core facets described by Cleckley's The Mask of Sanity (1941), and eliminating items specifically referring to criminal and antisocial behavior. This rendered the instrument not only valid for criminal populations, but also for community samples. The PPI comprises 8 subscales and three higher order factors have been identified among them (Benning et al., 2005): a Fearless Dominance factor, capturing manipulativeness, social dominance, and lack of fear and anxiety, an Impulsive Antisociality factor, measuring impulsivity, blame externalization, and rebellious nonconformity, and a Coldheartedness factor, evaluating tendencies toward callousness, lack of empathy, and

lack of guilt. The dominant theoretical perspective subtended by these and other instruments is that psychopathy is a unitary syndrome arising from a core underlying deficit.

Recently, Patrick and colleagues (2009) argued that progresses in understanding this complex construct could be made by conceptualizing psychopathy as a constellation of separable phenotypic aspects, reflecting different neurobiological sources. They proposed a triarchic conceptualization of psychopathy, in an effort to integrate and help clarify historical theories and assessment models, which widely differ in the emphasis they place on several psychopathic domains. The model can be viewed as a meta-conceptualization of the psychopathic construct, rather than a new theory of psychopathy aimed at replacing existing models. The triarchic model defines psychopathy in terms of three different domains, with distinct developmental and neurobiological bases: boldness, meanness, and disinhibition. Boldness entails aspects such as self-confidence, social dominance, social effectiveness, emotional resiliency, high tolerance for uncertainty and risk, and good resilience in stressful or threatening context. The concept is related to, but not synonymous with, fearlessness. A neurological basis of boldness manifestations seems to be a genotypic disposition entailing a reduced sensitivity of the defensive motivational system of the brain to stimuli signaling threat or punishment, including the amygdala (Fowles & Dindo, 2009; Kramer, Patrick, Krueger, & Gasperi, 2012; Patrick et al., 2012; Patrick & Bernat, 2009). Meanness comprises deficient empathy, superficial affectivity, exploitativeness, cruelty and destructiveness, absence of concern for others, and manipulativeness. Similarly to boldness, low dispositional fear seems to play a role in phenotypic meanness, together with other dispositional factors arising from constitutional and environmental influences, that combine with dispositional fearlessness to produce a

maladaptive and harmful expression of this disposition as compared to a more benign and adaptive expression in the form of boldness (Patrick et al., 2012). Disinhibition encompasses a general tendency toward impulsivity, lack of planfulness, impaired affective regulation, sensitivity to immediate gratification, deficient behavioral restraint, aggression, and substance abuse. Disinhibition is theorized to reflect impairment in prefrontal cortex and anterior cingulate cortex, which have a key role in behavioral inhibition and affect regulation (Patrick, 2008). Disinhibition per se does not constitute psychopathy, and the Triarchic model proposes that it is when disinhibition is coupled with boldness and/or meanness that a diagnosis of psychopathy can be made.

To measure the three domains described by the triarchic model, Patrick (2010) developed the Triarchic Psychopathy Measure (TriPM), a 58-item self-report inventory. The Boldness scale comprises 19 items taken from the Boldness Inventory (Patrick et al., 2010), capturing aspects such as social efficacy, venturesomeness, and emotional stability. The Disinhibition scale comprises 20 items derived from the Externalizing Spectrum Inventory (ESI; Krueger, Markon, Patrick, Benning, & Kramer, 2007), a 415-item instrument measuring tendencies toward substance abuse, aggressivity, dishonesty, and impulsivity. Items comprised in the Meanness scale were also derived from specific callous-aggressive subscales of the Externalizing Spectrum Inventory (ESI; Krueger et al., 2007), assessing empathy and relational aggression. The three subscales can be summed to yield a Total Psychopathy score. The Triarchic Psychopathy Measure showed evidences for associations with other psychopathy measure, such as PCL-R and PPI-R, and other psychopathy-related personality traits, such as sensation seeking, narcissism, aggressivity, and empathy (Drislane, 2011; Drislane, Patrick, Hall, Poythress, & Lilienfeld, 2012). Sellbom and Phillips (2012), for example, found associations between Boldness and narcissism, poor behavioral inhibition, and thrill

seeking, between Meanness and low empathy, poor behavioral inhibition, and Machiavellianism, and between Disinhibition and sensation seeking and impulsivity.

The triarchic measure of psychopathy has already had an impact on the field, and several studies analyzed its relation with psychopathic traits measured with more traditional instruments. Also, analyzing association between triarchic psychopathy and other psychological traits might be interesting and help better clarify relationship and common constructs underlying different psychopathologies. A personality disorder often associated with psychopathy is narcissism (Lee & Ashton, 2005; Paulhus & Williams, 2002; Gustafson & Ritzer, 1995), a construct entailing entitlement, grandiosity, high self-esteem, superiority, and dominance. To date, research on narcissism and its correlates with other personality disorders has generated a complex and poorly defined picture of the construct, and also factor analysis of the Narcissistic Personality Inventory (Raskin & Terry, 1988), the most widely used tool for narcissism assessment, has not yet clearly evidenced a defined structural composition of the instrument. A better understanding of the NPI's dimensional structure and different constructs embedded within the instrument could help clarify the narcissistic construct and the way it is related to other psychological traits.

Individuals diagnosed with a narcissistic personality disorder are characterized by abnormal feelings of self-importance, grandiosity, and entitlement. They lack of empathy and need constant admiration from others. Symptoms of the disorder, as defined by the DSM-V (APA, 2013), include: impairments in self-functioning, with excessive reference to others for self-definition and unawareness of own personal motivation; impairments in interpersonal functioning, with impairments at understanding feelings of others and callous affectivity; grandiosity and self-centeredness, with the firm belief to be better than other people; attention and

admiration seeking, with continuous attempts to attract the attention of others. There may be gender differences in the manifestation of narcissism (Eagly, Makhijani, & Klonsky, 1992; McCann & Biaggio, 1989; Tschanz & Turner, 1998). Men usually obtain higher NPI total scores and are from 50% to 75% more likely to be diagnosed with narcissistic personality disorder (APA, 2000; Carroll, 1989; Watson, Grisham, Trotter, & Biderman, 1984; Watson, Taylor, & Morris, 1987). In fact, narcissistic personality resembles the masculine sex-role stereotype in our culture, such as physical aggression, need for power and leadership, and authoritative style (Salman Akhtar & Thompson, 1982; Carroll, 1989; Haaken, 1983). Tschanz and colleagues (1998) reported how exploitative tendencies and feelings of entitlement were more central to the narcissistic construct in men compared to women. Women's exploitativeness and entitlement tendencies might be related to more coercitive types of influence tactics (Ryan, Weikel, & Sprechini, 2008).

Several studies support the existence of two dimensions of narcissism: grandiose and vulnerable (Miller & Campbell, 2008; Pincus et al., 2009; Wink, 1991). Grandiose and adaptive narcissism entails a flamboyant and dominant style, arrogant attitudes, inflated self-esteem, and interpersonal behaviors characterized by exploitativeness, entitlement, and exhibitionism (Pincus & Lukowitsky, 2010). Such construct is associated with psychological health and resilience (Sedikides, Rudich, Gregg, Kumashiro, & Rusbult, 2004; Wallace, Ready, & Weitenhagen, 2009). Vulnerable and maladaptive narcissism describes an emotionally fragile and socially withdrawn style, low self-esteem, and internalizing pathology (Pincus & Lukowitsky, 2010). This construct is associated with aggression and impaired interpersonal relationship (Campbell, Rudich, & Sedikides, 2002; Locke, 2009). Other Authors underlines bright and dark sides of narcissism. On the bright side, narcissistic individuals manifest with

tendencies toward becoming leaders (Brunell et al., 2008), to succeed in job interviews (Paulhus, Westlake, Calvez, & Harms, 2013), and are talented at selling their ideas as excellent even when they are not (Goncalo, Flynn, & Kim, 2010). On the dark side, narcissistic individuals fail to learn from mistakes and punishment, manifest overconfidence in decision-making (Campbell, Goodie, & Foster, 2004), present with poor ethic at work (Blair, Hoffman, & Helland, 2006), and place their own needs before long-term organizational needs (Campbell, Bush, Brunell, & Shelton, 2005).

The most widely used measure of narcissism is the Narcissistic Personality Inventory (NPI; Raskin & Terry, 1988). The NPI (Raskin & Terry, 1988) is a 40-item forced-choice measure such that individuals have to choose between a "narcissistic alternative" and a "non-narcissistic alternative" for each item. To date, controversies persist about its factorial structure, and several solutions have been proposed ranging from two to seven factors. Also, Cain and colleagues (2008) noted that this instrument embeds both adaptive and maladaptive contents, rendering even harder to understand which specific constructs the instrument measures and what the total score might indicate. Raskin and Terry (1988), using Principal Component Analysis (PCA) identified a seven-factor solution for the instrument: Authority (e.g. "I have a natural talent for influencing people"), Self-Sufficiency (e.g. "I like to take responsibility for making decisions"), Superiority (e.g., "I am an extraordinary person"), Exhibitionism (e.g. "I will usually show of if I get the chance"), Exploitativeness (e.g. "I find it easy to manipulate people"), Vanity (e.g. "I like to show off my body"), and Entitlement (e.g., "I will never be satisfied until I get all that I deserve"). More recently, Kubarych and colleagues (Kubarych, Deary, & Austin, 2004) evidenced a two factors solution using a combination of PCA and confirmatory factor analytic (CFA) approach: Power and Exhibitionism. Corry and colleagues (Corry, Merritt, Mrug, & Pamp, 2008) also

identified two similar main factors in the NPI structure: Leadership/Authority and Exhibitionism/Entitlement.

Since the Triarchic Psychopathy Measure has shown its construct validity and its utility for investigating the psychopathic construct, as well as its associations with other traditional psychopathy measures, aim of the study was to verify associations between the three subscales of the TriPM (Italian version). Also, aim of the study was to analyze associations between the psychopathic construct, as measured by the TriPM, and narcissistic personality, as measured by the NPI. We expected greater positive correlation between boldness/meanness TriPM subscales (measuring social dominance, self-confidence, and callousness), and narcissistic domains such as Authority, Entitlement, Self-Sufficiency (Raskin factorial solution), and Power (Kubarych factorial solution). We also expected positive associations between Disinhibition TriPM subscale (measuring tendency toward impulsivity and aggressivity) and Vanity, Exhibitionism (Raskin factorial solution), and Exhibitionism (Kubarych factorial solution). Also, we expected gender differences in the narcissistic construct between men and women. In particular, we expected women to manifest exploitative and entitlement tendencies differently from men (Tschanz et al., 1998; Ryan et al., 2008).

5.3 Methods:

Participants

Participants in this study were 472 undergraduate students (221 males, 251 women; mean age=22.38 years, SD=2.43 years) at the University of Padova, attending different Schools: Engineering (n=173), Economics (n=40), Medicine (n=66), Sciences (n=33), Law (n=56), Human Sciences (n=15), and Psychology (n=173). They were

administered the Italian version of the Triarchic Psychopathy Measure (Sica et al., in preparation) and the Narcissistic Personality Inventory (Raskin & Terry, 1988) via online procedure. For recruitment, announcements were published on School's public blackboard and social networks. Participants were told that they could have won 52 euro for their collaboration (four winners were randomly extracted among all participants).

Materials

Triarchic Psychopathy Measure. The Triarchic Psychopathy Measure (TriPM; Patrick, 2010; see Appendix 1) is a 58-item self-report measure of three domains of boldness, meanness, and disinhibition. Items are answered using a 4-point Likert scale: "True", "Somewhat true", "Somewhat false", and "False". The Italian translation of the TriPM was performed by several independent translators and a back-translation. For validation, the questionnaire was administered to undergraduates and prisoners samples. For undergraduate sample, alpha coefficients for boldness, meanness, and disinhibition were .79, .74, and .72, respectively. Intercorrelation between scores on the three subscales were .22 between Boldness and Meanness ($p<0.001$), .07 between Boldness and Disinhibition ($p<0.05$), and .49 between Meanness and Disinhibition ($p<0.001$). For prison sample, alpha coefficients for boldness, meanness, and disinhibition were .76, .76, and .77, respectively. Intercorrelation between scores on the three subscales were .16 between Boldness and Meanness ($p<0.001$), -.06 between Boldness and Disinhibition ($p<0.001$), and .49 between Meanness and Disinhibition ($p<0.001$). These results are highly similar to that found in a large sample of North American college students and among criminals (Sellbom & Phillips, 2013; Stanley, Wygant, & Sellbom, 2013; Strickland, Drislane, Lucy, Krueger, & Patrick, 2013).

Narcissistic Personality Inventory. Narcissism was assessed with the 40-item form of the Narcissistic Personality Inventory (NPI; Raskin & Terry, 1988). Each item consists of two forced choices between a narcissistic and a non-narcissistic sentence (see Appendix 2). Scorings on this questionnaire were performed using Raskin and Terry's seven-factor solution (Authority, Exhibitionism, Superiority, Entitlement, Exploitativeness, Self-Sufficiency, Vanity) and Kubarych's two-factor solution (Power, Exhibitionism).

Statistical Analysis

In order to evaluate intercorrelation between the three TriPM subscales, we computed Pearson correlations. Also, Pearson correlations coefficients were calculated between TriPM subscales and NPI's factors (Raskin: Authority, Exhibitionism, Superiority, Entitlement, Exploitativeness, Self-Sufficiency, Vanity, Kubarych: Power, Exhibitionism). In addition, to evaluate the unique contribution of each TriPM scale to prediction of NPI scores after controlling for the other two TriPM scales, we conducted regression analyses in which all the three TriPM scales were entered simultaneously as predictors. We used an alpha of $p<0.05$ in all tests of statistical significance.

5.4 Results:

Correlation coefficients for the TriPM subscales are presented in Table 5.1. Disinhibition did not show a significant association with Boldness, whereas a strong positive correlation was found between Disinhibition and Meanness ($r=0.50$, $p<0.001$). Boldness scale was positively associated with Meanness ($r=0.25$, $p<0.001$).

	Disinhibition	Boldness	Meanness
Disinhibition		r=-.07	**r=.50*** **
Boldness	r=-.07		**r=.25*** **
Meanness	**r=.50*** **	**r=.25*** **	

Table 5.1. *Pearson Correlations (r) between Disinhibition, Boldness, and Meanness (TriPM) in undergraduate participants (N=472).*
(=p<0.05; **=p<0.01; ***=p<0.001).*

Table 5.2 shows correlations and regression coefficients between TriPM subscale (Boldness, Meanness, Disinhibition) and Raskin's NPI subscales. Disinhibition was associated with NPI total score (r=0.13, p<0.01), Exhibitionism (r=0.25, p<0.001), Entitlement (r=0.23, p<0.001), and Exploitativeness (r=0.19, p<0.001). Relationships between Disinhibition and NPI Total score, and between Disinhibition and Entitlement were not significant when controlling for the other two TriPM scales. Scores on Boldness scale were associated with NPI total scores (r=.62, p<0.001), and with all NPI subscales: Authority (r=0.66, p<0.001), Exhibitionism (r=0.42, p<0.001), Superiority (r=0.42, p<0.001), Entitlement (r=0.22, p<0.001), Exploitativeness (r=0.40, p<0.001), Sufficiency (r=0.45, p<0.001), and Vanity (r=0.25, p<0.001). Scores on Meanness were associated with NPI total score (r=0.40, p<0.001), and also with Authority (r=0.28, p<0.001), Exhibitionism (r=0.27, p<0.001), Superiority (r=0.16, p<0.001), Entitlement (r=0.45, p<0.001), Exploitativeness (r=0.33, p<0.001), and Sufficiency (r=0.30, p<0.001). Relationships with Exhibitionism and Superiority became non significant after controlling for TriPM Disinhibition and Boldness scales.

	Disinhibition	Boldness	Meanness
	r/β	r/β	r/β
Narcissistic Personality Inventory			
NPI Total Score	**.13****/.06	**.62*******/.57*****	**.40*******/.23*****
Authority	.01/-.02	**.66*******/.62*****	**.28*******/.14****
Exhibitionism	**.25*******/.27*****	**.42*******/.44*****	**.27*****/.02
Superiority	.01/.01	**.42*******/.41*****	**.16*****/.06
Entitlement	**.23*****/.04	**.22*******/.12****	**.45*******/.40*****
Exploitativeness	**.19*******/.13****	**.40*******/.37*****	**.33******/.17****
Sufficiency	-.01/**-.21*****	**.45*******/.35*****	**.30*******/.32*****
Vanity	.03/.04	**.25*******/.25*****	.09/.01

Table 5.2. *Relations between Triarchic Psychopathy Measure (TriPM) and Narcissistic Personality Inventory (NPI) – Raskin's factors in Undergraduate Participants (N=472): Pearson Correlations (r) and Standardized Regression Coefficients (β).*
(=p<0.05; **=p<0.01; ***=p<0.001).*

Also, to test for gender differences, correlation and regression analyses between TriPM subscales and NPI 7 factors were conducted separately in men (n=221) and women (n=251). As seen in Table 5.3, Boldness mean scores were good predictors of Entitlement scores in men (β=0.21, p<0.01), but not in women. Entitlement in women was predicted by meanness (β=0.52, p<0.001). Meanness scores were good predictors of Exploitativeness in Women (β=0.25, p<0.001), but not in men. Exploitativeness in men was predicted by boldness (β=0.33, p<0.001).

	Disinhibition		Boldness		Meanness	
	r/β		r/β		r/β	
	Male	Female	Male	Female	Male	Female
NPI						
Tot.	.11/.09	.12/.02	**.59***/.58*****	**.62***/.56*****	**.32***/.21****	**.42***/.28*****
Aut.	-.04/-.01	.01/-.04	**.67***/.65*****	**.65***/.60*****	**.19**/.12***	**.32***/.20****
Exh.	**.29***/.33*****	**.19**/.19****	**.37***/.41*****	**.47***/.47*****	**.26*****/.05	**.28*****/.08
Sup.	-.02/.01	.01/.01	**.40***/.39*****	**.41***/.40*****	.09/.04	**.15***/.06
Ent.	**.19****/.10	**.23*****/-.02	**.23**/.21****	**.18****/.06	**.33***/.26****	**.52***/.52*****
Exp.	.13/.14	**.21****/.12	**.31***/.33*****	**.42***/.38*****	**.17***/.06	**.40***/.25*****
Suf.	-.09/**-.26*****	-.10/**-.16***	**.36***/.27*****	**.48***/.43*****	**.32***/.42*****	**.20**/.19****
Van.	.02/.04	.02/.03	**.26***/.26*****	**.26***/.26*****	.09/.04	.10/.02

Table 5.3. *Relations between Triarchic Psychopathy Measure (TriPM) and Narcissistic Personality Inventory (NPI) – Raskin's factors in Males (n=221) and Females (n=251): Pearson Correlations (r) and Standardized Regression Coefficients (β). Tot.=NPI Total Score; Aut.=Authority; Exh.=Exhibitionism; Sup.=Superiority; Ent.=Entitlement; Exp.=Exploitativeness; Suff.=Self-Sufficiency; Van.=Vanity.*
(=p<0.05; **=p<0.01; ***=p<0.001).*

Table 5.4 presents results of correlational and regression analyses for TriPM scales and Kubarych's NPI subscales. Boldness and Meanness were both predictors of Power scores (β=0.55, p<0.001, and β=0.29, p<0.001, respectively). Disinhibition and Boldness scores predicted Exhibitionism scores (β=0.20, p<0.001, and β=0.46, p<0.001, respectively).

	Disinhibition	Boldness	Meanness
	r/β	r/β	r/β
Narcissistic Personality Inventory			
Power	**.10***/-.01	**.62*******/.55*****	**.43*******/.29*****
Exhibitionism	**.19*******/.20*****	**.46*******/.46*****	**.26*****/.05

Table 5.4. *Relations between Triarchic Psychopathy Measure (TriPM) and Narcissistic Personality Inventory (NPI) – Kubarych's factors in Undergraduate Participants (N=472): Pearson Correlations (r) and Standardized Regression Coefficients (β).*
(=p<0.05; **=p<0.01; ***=p<0.001).*

5.5 Discussion:

A triarchic model of psychopathy has been recently proposed by Patrick and colleagues (2009), aimed at clarifying historical debates on the psychopathic construct and help better understanding the neurobiological basis of this syndrome. The triarchic model defines psychopathy in terms of three different domains: Boldness, Meanness, and Disinhibition. Previous research showed that psychopathy, defined on the basis of its classical characterization (Cleckley, 1941; Hare, 1993), is positively associated with the narcissistic construct. In particular, associations have been found between primary psychopathy (characterized by lack of empathy, callousness, egocentrism, and manipulativeness) and narcissism (Lee & Ashton, 2005; Paulhus & Williams, 2002).

Narcissism is a complex construct and to date confusion persists about its definition and its several subdomains. Also, the Narcissistic Personality Inventory (NPI; Raskin & Terry, 1988), the most widely used instrument for narcissism assessment, has not yet a defined factorial structure, and several solutions have been proposed in the last decades (e.g., Raskin & Terry, 1988; Kubarych et al., 2004; Corry et al., 2008). Studying the relationship between a new triarchic model of psychopathy and narcissism

could help clarify what the NPI effectively measures and highlight similarities and differences underlying these two psychopathologies.

Aim of the study was to analyze intercorrelations among the three TriPM scales, to observe correlations between TriPM subscales and NPI subscales scores, and to test for gender differences in the manifestation of narcissism.

A moderate correlation was found between Meanness and Disinhibition, and a lower correlation was found between Meanness and Boldness. No associations were found between Boldness and Disinhibition. These findings are highly similar to that found in North American samples (Sellbom & Phillips, 2013; Stanley et al., 2013; Strickland et al., 2013). A lack of association between Boldness and Disinhibition might be due to the fact that these two constructs have different underlying neurological bases, and represents different and separate manifestations of the disorder. Whereas boldness entails adaptive and positive aspects of psychopathy, such as self-confidence, emotional resilience, and high tolerance in stressful situations, disinhibition represents the more vulnerable and maladaptive side of psychopathy, with tendencies toward impulsivity and an impaired behavioral control. A high correlation between meanness and disinhibition might be due to the fact that individuals who are mean, cruel, and exploitative (meanness), might also manifest impulsive and irresponsible behavior (disinhibition) due to the fact that they do not care about the negative consequences their actions could have on others, hence they lack moral and social inhibitors that usually stop people from hurting others. A positive association between Meanness and Boldness is probably related to their common genotypic disposition and neurobiological bases. A reduced sensitivity of the defensive motivational system and of the amygdala causes both a lack of empathy and apprehension for others (meanness) and a lack of fear and social dominance in daily living (boldness).

NPI Total score strongly correlated with boldness, moderately correlated with meanness, and marginally with disinhibition. This last association disappeared after controlling for boldness and meanness. These findings seem to suggest that the NPI is more an index of grandiose and adaptive narcissism (with enhanced self-esteem, social dominance, and arrogant attitudes), well represented by boldness and meanness constructs, rather than an index of vulnerable narcissism, characterized by fragile personality and internalizing pathology, and aggressivity (more represented by TriPM disinhibition).

The boldness scale was a good predictor of all the NPI subscales (Raskin's factorial solution), indexing the major contribution of this scale to the narcissistic construct as measured by the NPI. Meanness predicted scorings on authority, entitlement, exploitativeness, and self-sufficiency, evidencing how manifestations of these aspects might be related to manipulativeness, and an absence of concern for others. Disinhibition was related to exhibitionism and exploitativeness, evidencing how these manifestations of narcissism are related to the vulnerability and incapability to control impulses.

Tschanz and colleagues (1998) and Ryan and colleagues (2008) reported how exploitativeness and feelings of entitlement might manifest differently in men and women. Our data showed how entitlement was predicted by both boldness and meanness in men, and by meanness in women. Exploitativeness was predicted by both boldness and meanness in women, and only by boldness in men. Different psychological constructs might underlie the manifestation of these narcissistic facets in men and women. Feelings of entitlement in men seem to be due to a sense of social dominance and high self-confidence, coupled with cruelty and a lack of empathy. In women entitlement manifests as a consequence of mean attitudes. Exploitativeness

manifests in women as a consequence of their tendencies to dominate and be mean to others. They might try to influence others in a coercitive and cruel way. Men exploit others as a consequence of their feeling of power and dominance, without the intention of being cruel or aggressive.

Power factor of the NPI resulted as a mixture of both boldness and meanness, whereas exhibitionism factor resulted as a mixture of both boldness and disinhibition. The power facet of narcissism seems to be an expression of grandiose narcissism, with a dominant and arrogant style, leadership tendencies, and high self-esteem. The exhibitionism facet seems to underlie vulnerability and a fragile emotionality, attention seeking, and a constant need for others approval.

In this study, several phenotypic domains of narcissism, as operationalized by the Narcissistic Personality Inventory, were found to be represented by distinctive configurations of psychopathic traits (boldness, meanness, disinhibition) in a manner consistent with our expectation. Psychopathy, conceptualized as a triarchic construct, is associated with narcissistic traits. Also, the narcissistic personality inventory seems to capture both the grandiose aspects of narcissism (predicted by boldness and meanness), and the maladaptive and vulnerable aspects of the construct (predicted by boldness and disinhibition).

CHAPTER 6

GENERAL DISCUSSION

6.1 A summary of main findings

Psychopathy is a personality disorder characterized by a lack of empathy, shallow affect, egocentricity, manipulativeness, irresponsibility, and impulsive and criminal behavior. It shows associations with other personality disorders, such as antisocial personality disorder and narcissism. Two types of psychopaths can be defined: "Unsuccessful" psychopaths are characterized by emotional detachment and criminal behavior, whereas "Successful" psychopaths exhibit emotional detachment and immoral behavior, but they keep themselves away from legal troubles and do not commit criminal and violent acts. Several studies have been conducted in forensic contexts with unsuccessful male psychopaths, whereas psychopathic manifestations in "Successful" psychopaths from community are unexplored. Also, most findings regard male psychopaths, whereas there is a dearth of studies about main aspects of the disorder in females.

In this thesis, three studies have been described that were meant to investigate behavioral and psychophysiological emotional responses in "successful" women with low empathy and high psychopathic traits. A forth study aimed at investigating relationships between the psychopathic construct and narcissism.

The first study examined the influence of empathy, measured through the Interpersonal Reactivity Index – IRI (Davis), and emotional detachment on emotional responses in healthy women. Startle reflex and EEG data were registered whereas

participants viewed a set of emotional IAPS pictures from five different categories (erotic, sport, neutral, mutilation, threat). Startle probes were delivered in half pictures of each valence category. Rated valence and arousal for each picture were collected through the Self-Assessment Manikin. Low empathy women rated fear stimuli as more pleasant, and erotic, mutilation and fear stimuli as less arousing, compared to high empathy women, indicating a reduced perceived activation in these participants. No group differences were found in affective modulation of startle reflex and ERPs responses (P300, Slow Positive Wave). Low empathy measured by a questionnaire sensitive to cognitive aspects of empathy and high emotional detachment seemed to have an influence only on subjective evaluation of emotional stimuli, but not on implicit psychophysiological measures.

The main aim of the second study was to investigate empathy from a different perspective, by selecting participants in the implicit physiological domain rather than for the cognitive one: thus the association among general startle reflex amplitude (registered in a resting paradigm), affective modulation of the startle reflex, emotional cortical responses, subjective evaluation of emotional stimuli, empathy and emotional detachment was investigated. Women with low and high general startle reactivity watched emotional IAPS pictures (erotic, sport, neutral, mutilation, threat) while startle reflex and EEG signals were recorded. Acoustic startle probes were delivered in half pictures of each emotional category. Valence and arousal ratings were collected through the Self-Assessment Manikin. Women with low general startle reactivity (low responders) did not differ from women with high general startle reactivity (high responders) in their perceived ratings of valence and arousal, but they achieved lower empathy scores on questionnaire. While high responders showed an affective modulation of the startle response, with an inhibition of the reflex during erotic pictures, low responders manifested a flattened response, with no affective modulation of the

reflex. Low responders also exhibited a reduced cortical positivity (P200), and a later enhanced positivity (Slow Positive Wave) in response to erotic stimuli.

A low baseline reactivity (startle reflex) was related to lower empathy levels, reduced affective modulation of the startle reflex, and altered cortical responses to emotional stimuli (ERPs).

The third study examined emotional decision-making capabilities through the Iowa Gambling Task in women with high psychopathic traits and a control group. Behavioral and psychophysiological responses were recorded during the task. Participants with high psychopathic traits, similarly to the control group, showed greater confidence in their choices after picking from the advantageous deck, but nevertheless picked a higher number of cards from the disadvantageous decks. These findings are in line with literature about psychopathic men (Van Honk et al., 2002; Mahmut et al., 2008) and revealed perseverative tendencies, greater sensitivity to reward, and reduced sensitivity to punishment, in women with high psychopathic traits. Furthermore, women with high psychopathic traits showed a general reduced amplitude of the Feedback-Related Negativity, in response negative outcomes, indexing an insensitivity to punishment, and greater Slow Negative Complex amplitudes in response to gain feedback, indexing enhanced responsivity to reward and gratification.

The fourth study was primarily meant to investigate associations between triarchic domains of psychopathy (boldness, meanness, and disinhibition; Patrick et al., 2009), assessed with the Triarchic Psychopathy Measure (TriPM; Patrick, 2010), and narcissism, measured by the Narcissistic Personality Inventory (NPI; Raskin & Terry, 1988). Two different factorial solutions were considered for NPI's scoring: Raskin's 7-factor solution (Authority, Entitlement, Exhibitionism, Exploitativeness, Self-Sufficiency, Superiority, Vanity; Raskin & Terry, 1988), and Kubarych's 2-factor

solution (Power, Exhibitionism; Kubarych et al., 2004). Boldness correlated with all Raskin's subscales, meanness was associated with scoring on authority, exploitativeness, entitlement, and self-sufficiency, and disinhibition was related to scoring on exhibitionism and exploitativeness. Also entitlement and exploitativeness were expressed differently in males and females, in line with findings from literature (Tschanz et al., 1998; Ryan et al., 2008). Entitlement was predicted by both boldness and meanness in men, and only by meanness in women, whereas exploitativeness was predicted by boldness in men, and both boldness and meanness in women. Kubarych's power factor was predicted by both boldness and meanness, whereas exhibitionism was predicted by both boldness and disinhibition. Several narcissistic domains revealed associations with specific configurations of psychopathic traits and the Narcissistic Personality Inventory was able to capture both the grandiose and the vulnerable aspects of narcissism.

6.2 Limitations of the research

The present finding should be interpreted in light of several possible methodological issues.

The first two studies were carried out exclusively on students from Psychology classes, and this might limit the generalizability of results to general population. Our studies investigated empathy and emotional regulation, and psychology students, due to their future career, might be differently motivated, from students attending other Schools, in making a good impression and present themselves as highly empathic and sensitive. Role of a psychologist is to evaluate and understand feelings and mental states of others, in order to properly treat a patient. Some psychology students might wrongly perceive themselves as highly empathic and questionnaires scores might have been

biased by this belief and social desirability. Also, psychology students might know better than others personality questionnaires, and therefore manipulate their answers.

Another limit of the four studies is the fact that participants were all young students, ranging approximately between 19 and 26 years. Psychopathic traits, empathy, and psychophysiological reaction might manifest differently in older adults. For example, elderly adults show reduced startle magnitude and more habituation than younger adults in startle paradigms (Ludewig et al., 2003).

Furthermore, the first, second, and third studies employed relatively small (although standard) sample sizes. Therefore, they need to be extended and replicated in order to better understand the associations between questionnaires, behavioral data and subjective evaluations, and psychophysiological measures.

The first three studies were focused exclusively on female samples, due to a dearth of knowledge about psychopathic traits and emotional detachment in women. Comparisons with results on psychopathic men from literature are limited by the fact that paradigms used to investigate affective modulation of psychophysiological and behavioral responses are not exactly the same. Therefore, it might have been useful to test for gender differences also recruiting male participants and presenting them the same paradigms.

Also, having a direct comparison between "successful" and "unsuccessful" psychopaths could help to better understand continuities and discontinuities in the manifestation of the disorder. The four studies here presented focused exclusively on healthy "successful" participants, and a real direct comparison of results between these two categories is very difficult and problematic.

6.3 Directions for future research

In future research it might be interesting to analyze emotional regulation and decision-making in healthy men from community, in order to directly compare genders within the community of successful psychopaths. Also, in order to better understand analogies and differences in the comparison of "successful" and "unsuccessful" psychopathy, it might be useful to replicate these paradigms in criminal "unsuccessful" psychopaths.

Furthermore, in the fourth study, the relationship between triarchic conceptualization of psychopathy and narcissism was investigated. Associations between traditional conceptualization of psychopathy (mainly characterized by emotional detachment and antisocial behavior) and several personality disorders are reported in literature. For example, Paulhus and Williams (2002) found a correlation between self-report measures of psychopathy and Machiavellianism. Similarly, Lee and Ashton (2005) found strong associations between primary psychopathy and machiavellianism. Some of the criteria used to diagnose psychopathy are similar to those used to define antisocial personality disorder. Also, most studies revealed correlations between psychopathy and antisocial/histrionic personality disorders (e.g., Hamburger, Lilienfeld, & Hogben, 1996; Lilienfeld, Van Valkenburg, Larntz, & Akiskal, 1986). It might be interesting to examine association and common underlying structures between the recent triarchic conceptualization of psychopathy and Machiavellianism, histrionic personality disorder, and antisocial personality disorder.

The knowledge of psychophysiological mechanisms and behavioral patterns associated with emotional regulation in adults with low empathy and high psychopathic traits can be helpful in the development of new personality questionnaires and assessment strategies. Also, psychophysiological correlates could be used in therapeutic

settings, to better design a psychotherapeutic intervention and evaluate treatment outcomes. Physiological measure could also be employed in forensic contexts, and be a valid help in the diagnosis of psychopathy. Psychopaths typically lie during interview and manipulate questionnaires answers. Hence psychophysiological data, being less subject to voluntary control, could be a more reliable tool in the examination of psychopathic traits.

Furthermore, the use of psychophysiological paradigms may help to increase efficiency in the recruitment and selection of specific candidates for jobs within an organization. "Successful" psychopaths often display a superficial charm, are charismatic, dominant, self-confident, dynamic and proactive. Therefore, they might appear as ideal leaders in some particular kinds of organizations and easily reach power positions. But they also act without conscience or morality, and are devoted to personal profit at the expense of others. They are impulsive, irresponsible, and do not learn from mistakes. Their selfish and exploitative behavior can have, on the long-term, bad consequences for the company. Psychopaths are particularly able at manipulating answers in self-report questionnaires and at putting themselves in a good light during job interviews. Therefore, implementing psychophysiological targeted paradigms such as those used/developed in the present thesis could well integrate verbal colloquia and subjective reports during job interview, which can be easily biased by voluntarily distortions, and this would help reducing damages to firms and corporations.

6.4 Conclusions

The present thesis provides some hints for better understanding the relationship between specific personality traits, psychophysiological responses, and behavioral pattern. More precisely, it revealed how different levels of empathy and emotional

detachment can influence the subjective evaluation of emotional stimuli and perceived bodily states. It also revealed how a generally low physiological reactivity (startle reflex) can be an index of low empathy and reduced elaboration of emotional stimuli. Furthermore, these findings add to current literature on emotional decision-making showing how high psychopathic traits can impair performances on decision-making tasks and lead to perseverative behavior and altered reward/punishment sensitivity. The present work also provides a better understanding of the common mechanisms underlying psychopathy and narcissistic traits.

Most studies have been carried on criminal male psychopaths. This thesis contributes to literature on psychopathic construct showing how also "successful" females with psychopathic traits manifest with emotional dysregulation and decision-making impairment. Observing emotional abnormalities in healthy women from community also foster the idea of psychopathy as a dimensional and continuous construct, rather than a configuration of discrete categories.

Appendix 1

Triarchic Psychopathy Measure (TriPM)

Patrick, 2010

This questionnaire contains statements that different people might use to describe themselves. Each statement is followed by four options:

1=”true”

2=”somewhat true”

3=”somewhat false”

4=”false”

For each statement, mark an "X" next to the option that describes you best. There are no right or wrong answers; just choose the option that best describes you.

1) I’m optimistic more often than not.	1	2	3	4
2) How other people feel is important to me.	1	2	3	4
3) I often act on immediate needs.	1	2	3	4
4) I have no strong desire to parachute out of an airplane.	1	2	3	4
5) I’ve often missed things I promised to attend.	1	2	3	4
6) I would enjoy being in a high-speed chase.	1	2	3	4
7) I am well-equipped to deal with stress.	1	2	3	4
8) I don’t mind if someone I dislike gets hurt.	1	2	3	4
9) My impulsive decisions have caused problems with loved ones.	1	2	3	4
10) I get scared easily.	1	2	3	4
11) I sympathize with others’ problems.	1	2	3	4
12) I have missed work without bothering to call in.	1	2	3	4
13) I’m a born leader.	1	2	3	4
14) I enjoy a good physical fight.	1	2	3	4
15) I jump into things without thinking.	1	2	3	4
16) I have a hard time making things turn out the way I want.	1	2	3	4
17) I return insults.	1	2	3	4
18) I’ve gotten in trouble because I missed too much school.	1	2	3	4
19) I have a knack for influencing people.	1	2	3	4
20) It doesn’t bother me to see someone else in pain.	1	2	3	4
21) I have good control over myself.	1	2	3	4
22) I function well in new situations, even when unprepared.	1	2	3	4
23) I enjoy pushing people around sometimes.	1	2	3	4
24) I have taken money from someone’s purse or wallet without asking.	1	2	3	4
25) I don’t think of myself as talented.	1	2	3	4

26) I taunt people just to stir things up.	1	2	3	4
27) People often abuse my trust.	1	2	3	4
28) I'm afraid of far fewer things than most people.	1	2	3	4
29) I don't see any point in worrying if what I do hurts someone else.	1	2	3	4
30) I keep appointments I make.	1	2	3	4
31) I often get bored quickly and lose interest.	1	2	3	4
32) I can get over things that would traumatize others.	1	2	3	4
33) I am sensitive to the feelings of others.	1	2	3	4
34) I have conned people to get money from them.	1	2	3	4
35) It worries me to go into an unfamiliar situation without knowing all the details.	1	2	3	4
36) I don't have much sympathy for people.	1	2	3	4
37) I get in trouble for not considering the consequences of my actions.	1	2	3	4
38) I can convince people to do what I want.	1	2	3	4
39) For me, honesty really is the best policy.	1	2	3	4
40) I've injured people to see them in pain.	1	2	3	4
41) I don't like to take the lead in groups.	1	2	3	4
42) I sometimes insult people on purpose to get a reaction from them.	1	2	3	4
43) I have taken items from a store without paying for them.	1	2	3	4
44) It's easy to embarrass me.	1	2	3	4
45) Things are more fun if a little danger is involved.	1	2	3	4
46) I have a hard time waiting patiently for things I want.	1	2	3	4
47) I stay away from physical danger as much as I can.	1	2	3	4
48) I don't care much if what I do hurts others.	1	2	3	4
49) I have lost a friend because of irresponsible things I've done.	1	2	3	4
50) I don't stack up well against most others.	1	2	3	4
51) Others have told me they are concerned about my lack of self-control.	1	2	3	4
52) It's easy for me to relate to other people's emotions.	1	2	3	4
53) I have robbed someone.	1	2	3	4
54) N I never worry about making a fool of myself with others.	1	2	3	4
55) It doesn't bother me when people around me are hurting.	1	2	3	4
56) I have had problems at work because I was irresponsible.	1	2	3	4
57) I'm not very good at influencing people.	1	2	3	4
58) I have stolen something out of a vehicle.	1	2	3	4

Appendix 2

Narcissistic Personality Inventory (NPI)

Raskin & Terry, 1988

In each of the following pairs of attitudes, choose the one that you most agree. Only mark one answer for each attitude pair (a or b) and please do not skip any items.

1. a. I have a natural talent for influencing people.
   b. I am not good at influencing people.
2. a. Modesty doesn't become me.
   b. I am essentially a modest person.
3. a. I would do almost anything on a dare.
   b. I tend to be a mostly cautious person.
4. a. When people compliment me, I sometimes get embarrassed.
   b. I know that I am good because everybody keeps telling me so.
5. a. The thought of ruling the world frightens me.
   b. If I ruled the world it would be a much better place.
6. a. I can usually talk my way out of anything.
   b. I try to accept the consequences of my behaviour.
7. a. I prefer to blend into the crowd.
   b. I like to be the center of attention.
8. a. I will be a success.
   b. I am not concerned about success.
9. a. I am not better or worse than most people.
   b. I think I am a special person.
10. a. I am not sure if I would make a good leader.
    b. I see myself as a good leader.
11. a. I am assertive.
    b. I wish I were more assertive.
12. a. I like to have authority over other people.
    b. I don't mind following orders.
13. a. I find it easy to manipulate people.
    b. I don't like it when I find myself manipulating people.
14. a. I insist upon getting the respect that is due me.
    b. I usually get the respect I deserve.
15. a. I don't particularly like to show off my body.
    b. I like to display my body.
16. a. I can read people like a book.
    b. People are sometimes hard to understand.
17. a. If I feel competent I am willing to take responsibility for making decisions.
    b. I like to take responsibility for making decisions.

18. a. A. I just want to be reasonably happy.
    b. I want to amount to something in the eyes of the world.
19. a. My body is nothing special.
    b. I like to look at my body.
20. a. I try not to show off.
    b. I am apt to show off in get the chance.
21. a. I always know what I am doing.
    b. Sometimes I'm not sure what I'm doing.
22. a. I sometimes depend on people to get things done.
    b. I rarely depend on anyone else to get things done.
23. a. Sometimes I tell good stories.
    b. Everybody likes to hear my stories.
24. a. I expect a great deal from other people.
    b. I like to do things for other people.
25. a. I will never be satisfied until I get all that I deserve.
    b. I take my satisfactions as they come.
26. a. Compliments embarrass me.
    b. I like to be complimented.
27. a. I have a strong will to power.
    b. Power for its own sake doesn't interest me.
28. a. I don't care about new fads and fashions.
    b. I like to start new fads and fashions.
29. a. I like to look at myself in the mirror.
    b. I am not particularly interested in looking in the mirror.
30. a. I really like to be the center of attention.
    b. It makes me uncomfortable to be the center of attention.
31. a. I can live my life in any way I want to.
    b. People can't always live their lives in terms of what they want.
32. a. Being an authority doesn't mean much to me.
    b. People always seem to recognize my authority.
33. a. I would prefer to be a leader.
    b. It makes little difference to me if I am the leader or not.
34. a. I am going to be a great person.
    b. I hope I'm going to be successful.
35. a. People sometimes believe what I tell them.
    b. I can make anybody believe anything I want them to.
36. a. I am a born leader.
    b. Leadership is a quality that that takes a long time to develop.
37. a. I wish somebody would someday write my biography.
    b. I don't like people to pry into my life.
38. a. I get upset when people don't notice how I look when I go out in public.
    b. I don't mind blending into the crowd.
39. a. I am more capable than other people.
    b. There is a lot I can learn from other people.
40. a. I am much like everyone else.
    b. I am an extraordinary person.

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