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Neuroscience of Psychopathy & Morality:
An Ale Meta-analysis of Psychopath's Moral Reasoning

By

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Abstract

Psychopathy is a disorder characterized by antisocial and affective traits. Psychopaths present various behavioral problems and moral violations, rendering psychopathy to be defined as a disorder of moral insanity. In addition to behavioral and cognitive research providing evidence of these behavioral issues, neuroscientific research has found abnormal brain activity in psychopaths during moral reasoning tasks, specifically in brain areas that are have been implicated in moral cognition in normal population, such as the amygdala, posterior cingulate, hippocampus, and the basal ganglia. In this study, I aim to gather the results of all fMRI research that have studied brain activity during moral reasoning tasks in psychopath, and run a meta-analysis to see how psychopathy impairs brain activity during moral reasoning. Using the software GingerALE, devised by brainmap.com, I ran the results of 16 studies that have met the criteria to be included in this meta-analysis. The main meta-analysis did not provide any likelihood of activation results. This is the case due to the small number of studies included in the meta-analysis paired with the different methodology and tasks used in each study. In the future, as more fMRI research is completed in this area—moral reasoning in psychopaths—it is expected that a meta-analysis would show conclusive results.

Introduction

What is Psychopathy?

Psychopathy is a personality disorder defined by a cluster of affective and interpersonal (personality) traits, lifestyle and behavioral characteristics (social deviant behaviors) (see Table 1; Hare, 1999, 2003; Viding, McCrory, & Seara-Cardoso, 2014). The interpersonal traits are comprised of narcissism and grandiose sense of self, manipulative behavior, superficial charm, and pathological lying (Clark, 2014). The affective traits consists of irresponsibility, shallow emotions, and lack of empathy, remorse, or guilt. Psychopathy is further marked by behavioral and lifestyle facets, which comprise parasitic lifestyle, impulsive behavior, stimulation seeking, unrealistic life goals, as well as early behavioral problems, juvenile delinquency, and criminally versatility (Hare, 2003; Hare, Neumann, & Mokros, 2018). Given that the psychopathic characteristics and traits are self-indulgent, the construct of psychopathy describe a person who is an intraspecies predator, who mastered at using charm and manipulation, without remorse, to get what they want, usually living a parasitic lifestyle that can be detrimental for both the psychopath and those around them (Hare, 1996).

Despite the belief that psychopathy entails violence and criminal behavior, many researchers argue that while psychopathy consists of a variety of unethical behaviors, these are not necessarily criminal, thought they are often of an immoral nature (Clark, 2014). In fact, while 15 to 35 percent of the inmate population meet the requirements for psychopathy (Kiehl & Hoffman, 2011), only a small fraction of psychopaths are imprisoned for committing violent crimes; suggesting that the greater percentage of psychopaths are non-violent, and not necessarily criminals or partaking in antisocial behaviors (Berg et al., 2013; Kiehl, 2010). It is based on this evidence that some have proposed that psychopathy is not necessarily linked to

antisociality. Rather, it has been suggested that the findings from research with psychopaths in forensic settings do not generalize to all expressions of psychopathy (Porter, Woodwoth, & Black, 2018). As proposed by Cleckley and many modern researchers, the majority of psychopaths are found in many different types of occupations, have no contact with the criminal justice system, and are not involved in any criminal behavior or activity (Cleckley, 1976; Benning, Venables, & Hall, 2018). These people, although meeting the requirement for psychopathy, are nonetheless successful in not engaging in antisocial behaviors, while some are even successful in attaining prosperous careers in business, hospitals, and even universities (Benning, Venables, & Hall, 2018). It is important to note that despite the success of not engaging in criminality, they are still at risk of being impaired in social interactions, having impairment in emotions, remorse and empathy (Benning, Venables, & Hall, 2018).

Nonetheless, other researchers suggest that antisocial behavior is an essential component of psychopathy, arguing that the suggestion that psychopaths can lead successful lives is a contradiction in terms, since psychopathy, by definition, is a disorder that necessarily entails antisocial behaviors, along with impairment in impulse control and other domains that increases the chances of criminality and antisociality (Kiehl & Lushing, 2014). Matt DeLisi (2009), for instance, have argued that psychopathy is indeed the unified theory of crime. That is, antisocial behavior is not only an outcome of psychopathy, but is also intrinsic to the definition of psychopathy since the core traits of the disorder matches unequivocally the concept of antisociality and criminal behavior (i.e., which can be understood as a short-sighted, self-centered, inconsiderate and impulsive action that is defiant and mean) (DeLisi, 2018). Furthermore, it is also argued that psychopaths may manifest antisocial behavior in more ways than externalized, or overt, violence (i.e., fighting, physical assault, etc.). For instance, antisocial

behavior can also be expressed through threats, emotional abuse, and dominance, all of which can be considered implicit, or hidden, antisocial behaviors (Gray & Snowden, 2016; Porter, Woodworth, & Black, 2018). Because these antisocial acts often occur behind closed door, and they often cause shame to the victims, these are often never reported (Verona & Vitale, 2018).

Furthermore, psychopathy is known as a disorder of amorality (Blair, Jones, Clark, & Smith, 1995). It is known that psychopaths have difficulty in distinguishing conventional and moral wrongs (Blair, 1995, 1997, 2008; Smetana, 2005; Turiel, 1998, 2005). For instance, psychopaths do not see a difference between not thanking someone who did a person a favour (an example of a conventional wrong) and a person who punches another person for no reason (an example of a moral wrong). As will be discussed in the next section, psychopaths have deficits in inhibitory control, which when coupled with deficits in distinguishing types of moral wrongs often leads to immoral behaviors (Blair, Mitchell, & Blair, 2005; Nichols, 2002). However, more recent findings suggest that psychopaths do understand moral distinctions, and the rightfulness and wrongness of actions; the problem is that they simply do not care (Cima, Tonnaer, & Hauser, 2010). The amorality of psychopathy, a central part of this disorder, is the focus of many theories of psychopathy, a topic which is the focus of the next section.

Theories of Psychopathy

Several prominent theories of psychopathy have been proposed to explain psychopaths' antisocial behaviors and their deficient moral development and amorality, most of which have been invigorated by neuroscientific evidence. Among them are: David Lykken's low-fear hypothesis (Lykken, 1995); Newman's response modulation perspective (Newman, 1998); and Blair's violence inhibition mechanism (VIM) (Blair, 1994). In addition, two prominent neuropsychological models of psychopathy have been proposed and deserve to be highlighted

here: The Integrated Emotions Systems (IES) model by Blair et al. (2005), and Kiehl's (2006) Paralimbic System model. I shall discuss each in order.

Lykken's low-fear hypothesis

As discussed in the previous section, David Lykken (1957) classified psychopaths between primary and secondary using experimental evidence to show that individuals in the two groups differed in their anxiety levels and capacity to experience fear. He argued that secondary psychopathy is less affected and influenced by genetic factors, being rather influenced by social forces, which given the "right" environmental factors could lead to the development of psychopathy due to poor socialization (Iacono, 2018). Primary psychopathy, classified as "real psychopathy" for Lykken, was marked by fearlessness and difficulty in socializing, due to the troubled temperament of the individual. According to his "low-fear-quotient" theory, people have a "fear quotient", which is ingrained in our biology, thus being an "innate tendency to fear certain stimuli" (Lykken, 1995, p. 118). With experience, people are conditioned to fear certain stimuli and situations that have been paired with, or experience along with, inherently fearful stimuli, which might comprise of pain and punishment.

According to the low-fear hypothesis, people at risk of developing psychopathy have a low fear quotient—that is, they do not respond to "normal" fear stimuli. Hence, because punishment of "wrong" or antisocial behavior is necessary for the process of socialization. Once one is punished, they associate the punishment with the behavior, and when they feel compelled to act in a similar ay, the fear of punishment constraints their antisocial behavior. However, those with low few quotient do not respond to punishment, and hence, are harder to socialize. It is important to note that, while primary psychopathy is influenced by biological factors, the low-fear-quotient theory acknowledges the importance of the social environment; as Lykken himself

affirms, if parents are successful in teaching proper socialization skills to a child, even if the child is predisposed to develop psychopathy, they will be able to channel their psychopathic traits in more virtuous ways. As his famous quote says, “the hero and the psychopath may be twigs on the same genetic branch” (p118). Biologically, Lynkken’s low-fear-quotient theory highlights the psychopath’s amygdala as the part of the brain implicated in this disorder (Clark et al., 2019).

Newman’s Response Modulation Hypothesis

Another important theory of psychopathy, proposed by Joseph Newman, is the Response Modulation Hypothesis (RMH). According to the RMH, modulation is a rapid and automatic shift of attention from a dominant response set to the evaluation of the current action, which gives initiation to self-regulation (Newman & Wallace, 1993). In other words, response modulation is the automatic direction of attention to stimuli and information that is secondary to the initial goal-directed behavior (Wallace, Vitale, & Newman, 1999). For example, a person who, with each press of a button, wins a dollar, will go through a response modulation if after two or three trials of pressing the button they start losing a dollar. After assessing the secondary information (i.e., they are now losing money), they will reassess their initial behavior (i.e., pressing the button), following the initiation of self-regulation (i.e., stopping to press the button).

However, according to Newman’s hypothesis, the fundamental deficiency in psychopathy is that psychopaths fail to accommodate to information that is not part to their initial dominant response, rendering the psychopath’s RMH disinhibited—that is, the psychopath’s response modulation is obstructed, not allowing the psychopath to notice important information pertinent to the behavior at hand. This disinhibition of the RMH in psychopathy occurs due to a failure to reflect on the maladaptive nature of a behavior (Patterson & Newman, 1993). As such,

psychopaths are unable to reflect on secondary information to their behavior, and as such, are unable to accommodate and change given any feedback. Their attention is narrowly focused on the dominant response (i.e., their initial behavior), thus acting in a disinhibited manner. The disinhibition of the RMH renders the psychopath unable to acknowledge any causal association between the consequences of their behavior and the behavior itself (Hamilton & Newman, 2018). Biologically, the RMH emphasizes the prefrontal brain area as the part of the brain implicated in psychopathy (Clark et al., 2019).

Blair's violence inhibition mechanism

The violence inhibition mechanism (VIM) is a cognitive account, based on normal and abnormal moral development. Blair (1994) proposed that psychopaths have a deficient VIM. This mechanism is responsible for raising a withdrawal behavior, as a response to non-verbal distress cues. These cues are, for instance, the sound of a person crying or in pain, or a person's facial expression of pain or fear. For people with a normal functioning VIM, it would be aversive to experience these non-verbal cues. The VIM stimulates the person who experiences these cues to stop hurting the distressed person and is known as an empathy instrument (Maibom, 2014). Using this mechanism, Blair explains that an impairment in emotional learning, caused by abnormalities in the amygdala and the vmPFC, might be the cause of psychopathy in the first place (Blair, 1994). He asserts that the lack of the VIM leads to psychopathic behaviors that is driven by a lack of empathy for the victim (Blair, Mitchell, & Blair, 2005). Therefore, according to Blair's theory, the neuro structure of the psychopath's brain (i.e., the amygdala and the vmPFC) is faulty, leading to a lack of empathy. Given this deficiency in empathy, the VIM becomes defective, which then explains why psychopaths are capacitated of hurting others without feeling guilt, and are unable to make moral judgments. While evidence exists to

invigorate his theory in regards to psychopaths' capacity in hurting other people and not feeling guilt, recent evidence does suggest that psychopaths are able to understand right from wrong, but they do not act in accordance with this understanding (Cima, Tonnaer, & Hauser, 2010). Nonetheless, Blair's VIM is still a very influential and important theory in the field (Blair et al., 2016; Fede et al., 2016).

Blair and colleagues' Integrated Emotions Systems

In addition to these models of psychopathy, Blair and colleagues (2005) proposed the Integrated Emotions Systems (IES) model, which is one of the first cognitive neuroscience theories (Blair, 2005). According to this model, psychopathy's underlying trait are its deficits in processing emotional and affective stimuli (Blair et al., 2005). Thus, the IES model focus on dysfunctions of the amygdala, which causes impairments in the cognition and processing of aversive stimuli and interpersonal cues that either expresses, or are associated with, feelings of fear and distress (Blair, 2005). As such, emotional cues of distress in others are not properly processed or acknowledged. This results in the failure of psychopathic individuals to inhibit their behavior, leading to the culmination of antisocial and immoral actions (Blair et al., 2005; Patrick, 2014). Psychopathic individuals are not able to acknowledge distress cues, and are unable to connect their behavior with negative outcomes, and the reason for this is the impairments within the psychopath's amygdala (Blair et al., 2005). This model allows for the integration of Blair's other theory of psychopathy, the VIM, which has already been discussed in this section (Blair et al., 2005). Just like the VIM, the IES is a theory about behavior inhibition. But in addition, the IES spells out the neurobiological underpinnings of the VIM. That is, it focuses on unpacking the deficits in activity within the amygdala of psychopaths. As such, while the VIM explains psychopathy in the cognitive level (i.e., the inability to acknowledge distress cues in others to

inhibit behavior), the IES explains the brain abnormalities that give rise, or contributes, to what happens in the cognitive level.

Kiehl's paralimbic theory of psychopathy

Another neuropsychological perspective is the Paralimbic Theory of Psychopathy. While a large body of research regarding psychopathy and its potential neural correlates have been seemingly fixated on deficiencies within regions in the limbic system, such as the amygdala and hippocampus, a model proposed by Kiehl (2006), the Paralimbic Theory of Psychopathy, moves away from this prevalent association between emotion regulating brain regions and psychopathy. In fact, the very theoretical foundation of the Paralimbic Theory of Psychopathy is that individuals with higher psychopathic levels display neurocognitive issues as a result of longstanding dysfunction in other brain regions non-fear/emotion related. As Kiehl (2006) explains, the paralimbic cortex, being connected to the limbic system, ensures a gradual transition between brains regions within the primary limbic system, such as the septal region, substantia innominate, and the amygdaloid complex (including both the nuclear and cortical layers). Much of the paralimbic system is composed by the anterior superior temporal gyrus, rostral and caudal anterior cingulate, posterior cingulate, orbital frontal cortex, insula, and parahippocampal regions (Kiehl, 2006). As such, it is within these very regions, complex and intricate by nature, that psychopaths display dysfunctional connectivity when performing language, attention and affective processing tasks, as well as moral reasoning tasks (Fede et al., 2016).

The Study of Morality

One aspect that is common across theories of psychopathy is that their deficiencies, specifically brain abnormality believed to be implicated in psychopathy, greatly affects

psychopaths' moral behavior and moral decision-making. In fact, as will be discussed in this section, many of the brain areas implied in moral cognition and decision-making with healthy participants overlap with the same brain regions that are abnormal in the psychopathic brain. Understanding this overlap, and how these regions are affected in psychopathy may present the opportunity to better understand psychopathy as a disorder and the behavioral issues psychopaths usually present. Before unpacking this point, it is imperative to discuss morality, both as a theory and its operationalization within psychology and neuroscience.

Morality is one of the cornerstones of human society, guiding life, actions, and decisions at the individual level, and being the base for law-making and social conventions at the social level. Morality as a set of standards, designates "right" or "wrong" behavioral attitudes (Haidt & Kesebir, 2010), thus providing a paradigm from which we can make judgements about good or bad, morally right or wrong, allowing for cooperation within society (Ayala, 2010). However, "morality" can mean a lot of things, thus being an umbrella term that conveys a diversity of judgements about many behaviors, which range from social interactions to social customs to more serious, and even criminal, behaviors (Skitka & Conway, 2019). Since Ancient Greece, the role and nature of morality has been debated, and while many were—and still are—the theories and philosophical views of what morality is and what counts as moral (see for instance: Ayala, 2010; Copp, 2006; Skitka & Conway, 2019; & Sinnott-Armstrong & Wheatly, 2014), the role of morality in a society is usually agreed upon. Most definitions congregate on the fact that morality usually comprises justice, rights, fairness, and norms about social interactions (Killen & Rutland, 2011); taking morality to be synonymous with ethics, for research purposes (Ayala, 2020). According to Graham and Valdesolo (2018), while people differ in their moral definitions and moral identity (i.e., what they consider right or wrong), these differences can predict prosocial

behaviors, since morality "guards against motivated justification of apathy or immoral behavior" (p.8).

Although theories may share this similarity proposed by Graham and Valdesolo (2018), theories of morality are diverse as theories in any other discipline. Haidt and Kesebir (2010), for instance, proposed a theory that is focused on morality's functionality rather than the content of morality. For them, morality encompasses psychological mechanisms important for a moral life, such as virtues and norms, values, and practices, which together balance people's decisions to control selfish behavior while increasing cooperation (Haidt & Kesebir, 2010). On the other hand, another important theory of morality, based on the hypothesis that humans are innately equipped with a predisposition to moral dispositions, suggests that morality is natural, arising from either imagined or perceived aversion of causing harm to other people. Such perspective gives much importance to social emotions, such as guilt, shame, or empathy, as being necessity for moral behavior. In philosophy, these are often called "emotivism" or "sentimentalist" theory of morality (Maibom, 2002). Emotivism suggests that emotional processing is necessary and the source of moral understanding. These theories are often opposed by "rationalist" theories of morality, which stresses the importance of reasoning in the moral judgment process, sometimes even downplaying the role of emotions for moral reasoning and understanding (Deigh, 1995; Matthews, 2014). Another theory of morality, based on evolutionary theory and social environmental influences, suggests that across time, humans saw it is evolutionary beneficial to act morally to one another, since it improves cooperation, which in turn improves chances of survival (Baumard et al., 2013). Neurobiological theories have also been proposed, and gained much attention in the last two decades. In general however, these theories generally propose that

moral cognition is organized through distinct and interconnected brain regions, which will be discussed in the next section (Moll et al., 2005).

In addition to definitions and theories of morality, another important point of discussion in the study of ethics is the functionality of morality. While many are the theories of morality and the attempts to define what morality is, many scholars have suggested that understanding the functions of morality is more important than coming up with a definition or theory. Many have suggested that the function of morality is to enhance social cohesion (Kitcher, 2005), by guiding people to function collectively, while protecting the rights and interests of members of one's community (Prinz, 2007). Others have argued that the function of morality is to contribute to one's own satisfaction, while allowing for the bonding and social coexistence with other people who, despite differences, can rely on each other for mutual benefits (Joyce, 2006). Despite the variation in definitions and views of morality, or of the functions of morality, most researchers agree that morality is a guiding set of principles of which different people can rely upon to live in harmony with one another (Decety & Cowell, 2014), and from which actions are judged to be right or wrong (Ayala, 2020). I shall expose some of the most prominent theories of morality in this section.

Dual Process Theory

Created by Greene and colleagues (2001; 2004), the dual process theory (DPT) proposes that cognitive and affective processes work together to produce moral judgements. The DPT originally was devised in order to introduce to psychology a model that combines aspects of both rationalism and emotivism. According to this theory, when faced with a moral dilemma, people automatically experience a negative reaction to the thought of doing something which will cause harmful outcomes to others (Greene et al., 2004). As such, given that the right environment is

provided—that is, given people have time to think, the resources to make choices, and the motivation to act—people will decide upon the best course of action that will lead to a better outcome (Skitka & Kesibir, 2010). This view is based on both utilitarian and deontological views of morality (Skitka & Kesibir, 2010). Utilitarian views are often rational and calculated moral decisions made on the basis of outcomes and consequences of actions, such as is moral to act in a way that brings about the most happiness, or causes the greatest positive outcome, or saves the greatest amount of people. Deontological judgements are decisions made based on moral duties and obligations, not necessarily taking into account the outcomes and consequences of actions, such as do not kill another human independently of whom they are and the situation or circumstances—that is, even if the person is a terrorist about to commit an atrocity. Furthermore, Greene and colleagues (2004) makes a distinction between "personal" and "impersonal" moral judgements. Personal moral judgments are those that are driven by social-emotional reactions, thus being primordially emotionally driven, while impersonal judgments are those that are driven by cognitive processes, where the person is aware and mentally processing the outcomes and righteousness or wrongness of the situation (Greene et al., 2004).

Social Intuitionist Model

Proposed by Haidt (2001), the social intuitionist model argues that moral judgements do not stem from conscious reasoning about morality, but rather it originate from intuition. That is, moral judgements are simply made aware within our consciousness without anyone having to be conscious about each step of the process that leads to the moral judgement (i.e., weighing evidence, thinking of outcomes, inferring a conclusion). Moral intuitions are innate cognitive adaptations that have been learned through the evolutionary process, being a quick and automatic response to challenging and ambiguous situations (Haidt, 2001). These intuitions provoke a

feeling of good or bad, like or dislike towards a situation. Once we are made aware of the intuition, or feeling it causes, we may then reason to offer a post hoc explanation of why the intuition makes sense and is "moral" (Skitka & Conway, 2019). However, in this view, emotions are believed to trigger moral intuitions (Wheatley & Haidt, 2005). As such, people often may not have the conscious understanding of why they make a distinct moral judgement (i.e., why they think stealing is wrong, or why obeying elders is right), because such judgment is made based solely on feeling and intuition (Haidt, 2001). Even though the theory posits that moral intuitions are innate, the theory emphasizes the cultural and social influences on morality. This is the case since the process of socialization within a culture and social setting both matures and shapes the endogenous intuitions (Haidt, 2001).

Moral Foundations Theory (MFT)

A prominent theory of morality, the Moral Foundations Theory (MFT) proposes that five different moral domains makes up what we call "morality", namely Harm, Fairness, Loyalty, Authority, and Purity (Graham et al., 2013). These domains describe, very broadly, what people across cultures consider as moral (Graham et al., 2013). Each of these domains developed during the stages of evolution as a response to adaptive needs (Graham et al. 2011; Graham, Haidt, & Nosek, 2009). Each of the five moral domains has a counterpart. For example, the counterpart of harm is care, cheating is the counterpart of fairness, betrayal is to loyalty, and subversion and degradation are the counterparts to authority and sanctity, respectively (Haidt & Graham, 2007).

In addition to counterparts, each domain has a specific and distinct function (Graham et al, 2013). For example, the harm domain makes people condemn unnecessary violence towards victims, while also protesting and condemning the suffering of others, thus caring for those in need. Purity is concerned with actions that may cause violations to perceptions about the sanctity

of body or soul (for instance, not disrespecting religious traditions and laws). Authority helps to navigate social spaces, respecting hierarchies and social positions (i.e., respect for elders or for parents, for a judge or a teacher).

Dyadic Model of Morality

Designed to be an alternative to the MFT, the dyadic model of morality (DMM) proposes that morality is a function of the perception or awareness that in any interaction there are always two distinct minds: the intending mind, which belongs to a moral agent (i.e., someone who acts towards another), and the experiencing mind, which belongs to the moral patient (i.e., the one who the moral agent acts towards) (Gray et al., 2012). The focus of the mind of the moral agent is on knowledge and intention, while the focus of the patient's mind is on emotions (Schein & Gray, 2018). People then judge acts as moral or immoral based on this interaction, which serves as a prototype. For example, an act will be immoral if the moral agent acted with the knowledge or intention that his act would cause the patient to suffer a harm (Gray, Costello, Loughnan, & Hodson, 2012). Based on this prototype, a person can assign blame and assess the wrongness of an action (Gray et al., 2012). Furthermore, proponents of this theory believe that all morality can be condensed to interactions where intentions and causing suffering are at play (Skitka & Conway, 2019). As such, these theorists believe that the essence of morality is harm itself (Gray et al., 2012). Thus, they oppose pluralist theories, such as the MFT, which posits that morality consists of a variety of properties (i.e., purity, harm, authority, etc.) (Skitka & Conway, 2019).

Moral Motives Theory

Proposed as an alternative view to the MFT, the Moral Motives Theory is a theory that lays out different manners in which morality is experienced in social interactions. It posits that motivations are essentially approach or avoidance oriented (Janoff-Bulman & Carnes, 2013).

Motivations that are driven by avoidance, known as proscriptive morality, are based on protection of harms and inform what people should avoid doing. On the other hand, approach motivations, known as prescriptive morality, informs what people should do in order to provide the well-being of others and preserve the common good (Skitka & Conway, 2019). Moral motivation operates, according to the theory, in three levels: the self-regulation level, the interpersonal regulation level, and the social/ collective regulation level (Janoff-Bulman & Carnes, 2013). Each of these levels is supposed to lay out how morality is often manifested in social life. At times, morality serves to self-regulate our behavior to restrain from behaving in inappropriate ways that will be rude or immoral. At other times, morality guides us on how to interact with other individuals, thus informing us to avoid lying or causing trouble (Janoff-Bulman & Carnes, 2013). Finally, at other times, morality guides people through interactions in a broader social level, informing how to act in ways that advances social welfare, promoting social justice (Skitka & Conway, 2019). MMT differs from other theories in that it proposes morality is not just about avoiding what is immoral or bad, but that morality is also focused on people's motivation to do good and what is seen as moral (Skitka & Conway, 2019).

Review of Literature: Neuroscience of Psychopathy & Morality

In addition to the many theories of morality, recent work on neuroscience has further illuminated the nature and workings of moral reasoning. Neuroscientific research on morality found that moral cognition and decision-making is associated with activation of the amygdala, the medial prefrontal cortex, the anterior cingulate cortex, the ventromedial prefrontal cortex (vmPFC), the posterior cingulate (PCC)—which is also involved in theory of mind and integration of emotions during morals decision making—as well as the insula and the posterior and superior temporal sulcus (Eres, Louis, & Molenberghs, 2017; Greene, Sommerville,

Nystrom, Darley, & Cohen, 2001). As already mentioned in passing before, the brain areas related to morality contains most of the same brain areas that are deficient in the psychopathic brain. This is one of the reasons why researchers call psychopathy an emotional and amoral disorder (Blair, 2005).

Research involving psychopaths reveals that individuals with psychopathy show difficulty in distinguishing moral wrongs from conventional wrongs (Nichols 2002), albeit the fact that psychopaths have been found to have the ability to differentiate between right and wrong (Aharoni, Sinnott-Armstrong, & Kiehl, 2012; Tonnaer & Hauser, 2010; Harenski et al., 2010). Nonetheless, psychopaths present abnormal emotional responses and aberrant moral behaviors during moral tasks (Blair et al., 1995; Harenski, Harenski, Shane & Kiehl, 2014; Yirmiya et al., 1992). For instance, if presented with images of people in pain, psychopaths have abnormal activity in brain regions associated with emotional apprehension, when compared to non-psychopathic groups, and they fail to appreciate the emotional pain in others (Decety, Chen, Harenski, & Kiehl, 2013; Marsh et al., 2013). These abnormal responses to emotional reactions and manifestations of pain from others have a negative effect on the psychopath's ability to process and understand value (Baskin-Sommers, Stuppy-Sullivan, & Buckholtz, 2016; Hosking et al., 2017).

With the growing contributions and overlapping work between neuroscience and psychology, modern research on psychopathy is highly influenced by neuroscience. Indeed, neuroscientists discovered that the amygdala and the ventromedial prefrontal cortex (vmPFC), two brain areas that are densely interconnected, are dysfunctional in the psychopathic brain, especially during moral judgment tasks (Greene & Haidt, 2002; Kiehl et al., 2004; Koenigs et al., 2011; Viding, McCrory, & Seara, 2014), which is thought to have an effect on difficulties with

moral decision making and empathy responses (Harenski et al., 2014; Marsh et al., 2014). Psychopathic individuals have been shown to have a diminished activity in the amygdala during emotional recognition and moral judgment tasks (Marsh & Cardinale, 2014), as well as surface deformations of the amygdala and reduction of amygdala volume (Boccardi et al., 2011; Yang et al., 2009). Other researchers found indications that, in addition to dysfunctional activity in the amygdala and vcPFC, there is decreased grey matter in these two brain parts of psychopaths (Ermer et al., 2012). Other findings suggest that there are fewer neurons and increased white matter in the frontal lobes of psychopaths (Yang et al., 2005).

Given findings that suggests that psychopaths share neurological traits, it is becoming easier to diagnose the disorder using functional magnetic resonance imaging (fMRI) (Kiehl & Hoffman, 2011). Also, fMRI data suggests that amongst the abnormalities in the brains of psychopaths, there is decreased neural activity in the paralimbic regions of the brain—more specifically, the anterior cingulate cortex (ACC), posterior cingulate cortex (PCC), insula, temporal lobe, and the parahippocampal gyrus are associated with abnormalities in psychopathy—as has been discussed previously in the exposition of Kiehl's (2006) paralimbic theory of psychopathy, which posits that psychopathy is marked by a dysfunction in the connectivity of the paralimbic region of the brain, a region that is responsible for, amongst other functions, moral reasoning. Notably, the neuropsychological research has suggested that psychopathy can be determined by abnormality in the development of the brain (Gao, Glenn, Schug, Yang, & Raine, 2009). Such findings imply that the development of the disorder has biological and chemical influences. To summarize, when making moral judgments, psychopaths have been shown to have different brain activation patterns than healthy, non-psychopathic populations (Glenn, Raine, & Schug, 2009; Harenski et al., 2010). In general, it has been found

that, during tasks of moral cognition, psychopaths present reduced brain activation in the ventromedial prefrontal context (vmPFC), the amygdala, and the posterior cingulate (PCC).

Finally, further studies have suggested that the impulsive behavior of psychopaths is associated with abnormal dopamine transmission. For instance, Buckholtz and colleagues (2010) found that raised anticipation-related activity within the nucleous accumbes was predicted by the high scores of impulsive-antisocial on self-report psychopathic trait inventory. In a recent paper, Hosking and colleagues (2017) revealed that maladaptive decision making in psychopaths is caused by dysregulation in the cortico-striatal circuit. Other areas related to impulsive or sensation-seeking behavior in psychopaths have also been traced to heightened activity in the striatum, including the putamen, caudate, and the nucleus accumbens (Korponay et al., 2016).

Present Study & Hypothesis

The present thesis aims to investigate the neuroscience of psychopaths' moral reasoning through a meta-analysis of studies conducted since the year 2000 through February of 2021, covering almost 21 years of research. To date, three meta-analysis have been conducted to look at patterns of neural engagement during moral cognition tasks (Fede & Kiehl, 2020), and of psychopath's abnormal brain function (Deming & Koenigs, 2020; Poeppl et al., 2019). The former meta-analysis found that the left amygdala, medial prefrontal cortex, bilateral temporoparietal junction, and posterior cingulate are common areas of the brain that show activation in healthy adults during moral reasoning tasks. The latter two meta-analysis found that psychopathy is associated with hyperactivity in the medial default mode network regions, including the amygdala, a surprising finding since the amygdala is supposed to be underactive in psychopathy (Deming & Koenings, 2020); while Poeppl and colleagues (2019) found that psychopathy is associated with aberrant brain activity in the prefrontal, limbic, and insular

regions, suggesting that such aberrant activity is directly related to the psychopathology of psychopathy. Together, these findings suggest that the same brain regions that are active in healthy adults, are the same regions that show aberrant activity in psychopaths.

However, no meta-analysis have been conducted looking only at the likelihood of brain activation of psychopaths during moral reasoning tasks alone. Hence, the current meta-analysis's focus is on brain activation of psychopaths solely during moral reasoning tasks. In addition, two of the three meta-analysis identified have used multilevel kernel density analysis instead of an activation likelihood estimation (ALE meta-analysis), the method used in this meta-analysis. Here, I use an ALE meta-analysis to look for the likelihood of activation in brain regions of psychopaths during moral reasoning tasks. In conducting this study, I have followed a two-step process. First, I conducted a meta-analysis looking at the likelihood of activation across studies that, in addition to a moral reasoning task, also had an emotional component paired with the moral task (e.g., looking at how remorse can affect moral decisions) (see Table 2). Since psychopaths show abnormalities in areas of the brain related to both emotions and morality, and since emotions are important to morality, this first analysis was to be used as a comparison, in order to see if any major differences surfaced as an effect of emotional cognition paired with moral reasoning.

This first analysis also included results for the comparison between groups (e.g., psychopaths > non-psychopaths) and the groupwise results during moral and emotional tasks (e.g., viewing > identifying moral behavior, harmful < helpful behaviors, etc.), as reported in each study. Secondly, in the main meta-analysis, I focused the ALE analysis on studies or experiments that strictly used a moral reasoning task only, with no emotional or additional component to the moral task (see Table 3). In this second step, the analysis was only centered at

the contrast of activation or deactivation for psychopaths compared with non-psychopaths, both for activation (e.g., psychopaths > non-psychopaths) and for deactivation (e.g., non-psychopaths > non-psychopaths).

The goal of the current work is to examine how psychopathy affects the brain activation during moral reasoning tasks. Understanding the neurobiological correlates of psychopathy related to morality can have important implications for diagnosing and treating this disorder, especially as it relates to moral and pro-social behavior. It has been suggested that the identification of neural correlates of psychopathy can inform the development of biomarkers vulnerability and detection of the disorder (Deming & Koenigs, 2020). In this vein, understanding the brain regions of psychopaths that are implicated in moral reasoning can lead to the creation of anatomical targets, that, in accordance with theories of psychopathy—specifically the Blair's (2005) VIM—would function abnormally, but that we know are important for pro social/ moral behavior. Hence, armed with this neurobiological understanding could help to develop clinical interventions targeted at anatomical areas to improving pro-social and moral behaviors for psychopaths. This is something that can only be done through neurobiological work, which would not be possible with studying in the behavioral or cognitive levels alone.

In accordance with the literature of psychopathy and moral decision making, I hypothesize that, for psychopaths, there will be a higher estimate likelihood of activation in the dorsolateral prefrontal cortex (dlPFC) across the identified studies. In addition, I also predict that the meta-analysis will show that psychopaths present a decreased likelihood of activation in the amygdala, in the vmPFC, and the dmPFC during moral decision making tasks, in accordance with Blair's VIM (Blair, 2005) and Kiehl's paralimbic system model of psychopathy (Kiehl, 2006).

Methodology & Results

Selection Criteria & Participants

This meta-analysis included 1370 participants across 16 studies and 68 experiments (Table 1). I conducted a literature search on Google Scholar, PsycINFO, and PubMed from the year 2000 to February 2021, using the following terms: "psychopathy", "morality", and "fMRI" (["psychopathy" OR "morality" OR "fMRI"]) on each platform. Studies were included only if they contained an experiment that tested moral reasoning or judgment in psychopathic populations through some form of moral task (e.g., looking and identifying moral-laden images, or make an ambiguous moral decision after reading a moral short-story). For the second analysis, studies were excluded if they tested other types of experiments that were not strictly of a moral nature (i.e., studies that tested the effects of Theory of Mind or emotional reactions in psychopaths, such as fear or regret, in moral choices; see Table 3). Studies were also excluded if they tested moral tasks in populations that, while may have overlaps with psychopathy, are not necessarily psychopathic (e.g., Fede et al., 2016, who looked at moral decision making in substance users).

Studies were included if they (1) reported fMRI coordinates in Montreal Neurological Institute (MNI) or Talairach template space; (2) sampled participants who were 18 years old or older; (3) compared participants' brain activity during moral reasoning or decision making with some validated measure of psychopathy (e.g., PCL-R; PPI, etc.). After identifying qualified studies (*N*=16; see Table 2), I extracted the fMRI coordinates in accordance with the manual from Research Imaging Center at the University of Texas, San Antonio (http://brainmap.org). Final results for activation analysis are based on 6 studies, 51 foci from 15 experiments within

these studies, and 443 subjects, while the final results for deactivation analysis is based on 8 studies, 53 foci from 16 experiments, and 672 subjects (Table 3).

Procedure

The activation likelihood estimation model (ALE) is a novel model used to determine locations in the brain where, given a specific paradigm used, is capable of attaining above chance flow of activation in a specific coordinate or coordinates within such brain regions. The software package GingerALE was used to conduct this analysis. According to Eichkhoff and colleagues (2012), given this approach set by ALE, its primary purpose is to disprove the null hypothesis that concentration of activation in the brain, also known as foci, is uniform and equal through the entire brain. In fact, this model attempts to provide evidence that brain activation occurs in specific regions of the brain in respect to specific experiment paradigms while using Gaussian probability distribution (Eickhoff et al., 2009). As a manner of disproving such null hypothesis, the ALE examines defined grey matter voxels, whereby one "modelled activation" (MA) map is computed by merging all the activation foci's probability distributions reported in a given experiment. The MA maps then contain for each voxel the probability of an activation being located at exactly that position.

Results

Across all studies analyzed, looking at both the comparison between groups (e.g., Psychopaths > non-psychopaths) and the groupwise results during moral and emotional tasks (e.g., viewing > identifying moral behavior, harmful < helpful behaviors, etc.) GingerALE reported that no clusters were found for deactivation results. Conversely, three significant clusters were found for activation results: Cluster one found a higher likelihood of activity in the dorsomedial prefrontal cortex (dmPFC: x= -4, y= 50, z= 32, *z-value* = 7.670), cluster two found

activity in the region of the Subcallosal Gyrus (temporal pole: x= 30, y= 6, z= -18, *z-value* = 5.957), and cluster three found activation on the hippocampus (x= 30, y= -38, z= -2, *z-value* = 6.704) (see Table 4). For the second analysis, focusing only on moral tasks not paired with additional stimuli, and centered at the contrast of activation or deactivation for psychopaths compared with non-psychopaths (e.g., psychopaths > non-psychopaths), GingerALE was not able to find any significant clusters, both for activation (e.g., psychopaths > non-psychopaths) nor for deactivation (e.g., non-psychopaths > non-psychopaths).

The current study investigated the neural correlates of moral processing of psychopaths using an ALE meta-analysis method to see what the field has found across all fMRI studies that have been conducted in the last 21 years in regards to how psychopathy affects brain activity during moral tasks. Our results could not provide evidence for nor against the hypothesis that activation would be centered around dlPFC, and deactivation would be centered around the amygdala, the dmPFC, and the vmPFC, in accordance with both Blair's (2005) VIM and Kiehl's (2006) paralimbic system model. Nonetheless, when all studies and contrasts of interest were added together, GingerALE found three clusters of activation in three areas that would not be expected to be active in non-psychopaths during moral tasks: the dmPFC, the subcallosal gyrus (temporal lobe), and the hippocampus.

Discussion

Using the findings from 16 studies, the first step of this meta-analysis identified several significant clusters of neural activity in psychopaths and non-psychopaths during moral reasoning, that may or may not have involved secondary stimuli, such as emotional recognition or theory of mind. The first cluster found was in the left dorsomedial prefrontal cortex (dmPFC), a region significantly associated with social cognition that includes morality, empathy, and

theory of mind. For instance, it is activated during moral reasoning when one is analyzing the intention or mental state of others (Yoder & Decety, 2014). Activation in this area is likely due to the influence of non-psychopathic individuals in the studies, since the literature provides many evidence of abnormal activation in this region in psychopaths (Greene et al., 2001; Moll et al., 2001); although some studies (see Decety et al., 2015) reported that psychopaths did show activation of this are during identification of emotional expressions in morally-laden pictures, but—in accordance with the literature—not during the analysis of morally-laden scenarios (i.e., harmful vs. helpful scenarios). Similar findings have been identified in other studies included in this meta-analysis (e.g. Gleen, Raine, & Schug, 2009). This indicates dysfunction of complex social processes that are important for moral behavior, and the credence that the activation of this area in the meta-analysis is driven by non-psychopathic, or low-psychopathic, individuals. Interestingly, Glenn and colleagues (2009) found that there is a high activation of the dorsolateral prefrontal cortex (dlPFC) in psychopaths during moral decision-making, suggesting that psychopaths are able to reach moral decisions relatively similar to less psychopathic individuals, but using other brain regions that are not often implied in morality.

The second cluster of activation was around the region of the right subcallosal gyrus (temporal pole) driven by the influence of non-psychopathic individuals. In non-forensic populations, activation in this region has been positively correlated with emotional cognition and moral decision-making (Decety et al., 2012). Studies have suggested that, similar to the dlPFC, activation in this area is corelated with theory of mind that is required for moral decision-making (Saxe et al., 2004). Studies included in this meta-analysis have reported deactivation of this are in psychopathic individuals during viewing morally-laden behaviors, but active during identifying emotional states (Decety et al., 2012).

The third cluster of activation was in the hippocampus. Activity in the hippocampus is related to fear conditioning and plays an important role during emotional reaction and processing of emotions of facial expressions and social emotions (Fusar-Poli et al., 2009; Immordino-Yang and Singh, 2013; Tsetsenis et al., 2007). While being another area that shows deficiency in psychopaths, some of the studies used in this study found that the hippocampus was active in psychopaths when they analyzed emotional consequences of harmful actions (Decety et al., 2012). However, the explanation for this increase was, just like for the other areas, that the psychopathic brain was compensation for low activity in other areas. This provides further evidence showing that this activation cluster was driven by the influence of non-psychopaths and the compensatory brain activity in psychopaths in tasks where other brain areas, which should be functioning in certain moral or emotional tasks, are indeed abnormal.

In all, activation of these three areas is considered normal and expected for non-forensic samples (i.e., healthy adults). For psychopaths, the studies that reported activation of these areas, for either moral or emotional tasks, explained this activation as compensatory neural activity in psychopathic brain (e.g., Decety et al., 2016; Fede et a;., 2016; Marsh & Cardinale, 2014; Yoder et al., 2021). Hence, it is safe to assume that the clusters found to be active in the first step of this study is being driven by both the compensatory activation in psychopaths, and the normal activation in the non-psychopath controls included in the current study.

Having found these three regions of interest, I proceeded to the second step of the study, narrowing the analysis to brain activation and deactivation of psychopaths during moral tasks only. In this second meta-analysis of functional neuroimaging studies of moral reasoning in psychopaths, no significant clusters were found for either activation or deactivation of psychopaths during moral tasks with the contrasts of interest: “psychopaths > non-psychopaths”

and “high-psychopaths > low-psychopaths”, which are contrasts that show the areas that are more active in psychopaths, or those higher in psychopathic scores, than non-psychopaths or those low in psychopathic scores during moral reasoning tasks. Hence, I was not able to find evidence for my hypothesis, neither could I provide evidence to disprove it.

The reason for not finding any significant clusters can be varied. First, and most importantly, there have been only 14 studies identified for the last 21 years that have looked at the neuroscience of moral reasoning in psychopaths. In addition, not all studies showed significant activation in psychopaths during the moral tasks used in the experiment, which is the case of Seara-Cardoso and colleagues (2016), Zijlmans and colleagues (2018) and Fede and colleagues (2016). In addition to these studies, three studies only showed significant deactivation results, and no significant activation for psychopaths or those high in psychopathy, which is the case for Caldwell and colleagues (2015), Osumi and colleagues (2012) and Glenn, Raine and Schug (2009). Hence, the final analysis was only able to analyze results for 7 studies (see Table 3). While surprising, this is not entirely shocking, since very few studies have been identified using moral tasks and used for this analysis. For comparison, other meta-analysis in overlapping areas have used more than 200 studies (Deming & Koenigs, 2020). Analyzing seven meta-analysis studies may simply not be enough to reveal reliable significant results (Cheung & Vijayakumar, 2016).

In addition to the low number of studies, the population and the measures of psychopathy changes significantly across studies. Studies whose population were incarcerated or violent individuals used the Psychopathy Checklist Revised (PCL-R) which, albeit being the gold standard measure of psychopathy, was designed to be used for forensic populations (e.g., incarcerated individuals). However, studies that used non-incarcerated individuals (e.g.,

university students) often used the Psychopathy Personality Inventory (PPI), which was designed to assess psychopathy for nonincarcerated samples, and for this purpose the criminological traits that are part of the PCL-R are not included in these measures (Poythress et al., 2010). Despite the amount of evidence showing that these measures (PCL-R and PPI) may be correlated with one another (Copestake, Gray, & Snowden, 2011; Malterer et al., 2010), a high-score on the PPI does not necessarily imply a high score in the PCL-R, since many of the items in the PCL-R are measuring violent and criminal activity, whereas the PPI focuses on non-violent non-criminal aspects of psychopathy (e.g., while a person scoring higher on the PPI may never have committed criminal activities and been incarcerated, their scores on the PCL-R may be lower, given that they would score a 0 for the violent and delinquency). Also, other experiments used yet different measures, such as the Youth Psychopathy Inventory – Short Version (YPI-SV; see Zijlmans et al., 2018) and the Self-Report Psychopathy Scale Short-Form (SRP-SF; see Seara-Cardoso et al., 2016).

In addition to wide variation of psychopathy measures used across studies, different moral tasks and techniques were also used across studies. For instance, while Decety and colleagues (2015) used pictures with morally laden behaviors and violations, Harenski and colleagues (2014) used moral written scenarios, where participants would have to reason through the scenario and reach a decision with moral implications. A divergence in techniques, population characteristics and psychopathy measures, coupled with a low number of studies may have contributed to the overall noise in clusters found by the GingerALE platform. In the future, as more fMRI studies in the area of morality within a psychopathic population increases, we may get significant clusters and a better analysis of the effect of psychopathy in brain activation/deactivation during moral reasoning. Future studies should also explore the impact of

streamlining methodology and measures. It would, however, be interesting to do so across different types of population to improve the validity and effect that different manifestations of psychopathy (more violent psychopaths vs. less violent psychopaths) have on moral reasoning.

While it is true that these factors discussed in the last paragraphs are most likely the reasons for this study yielding no results, another possibility that must be discussed is that this is indeed a true null finding. That is, that there is no overlapping likelihood of activation across studies, and that this would be true even if the studies used the same methods in similar populations. Given the small number of studies available for a meta-analysis (N=16), this is indeed very possible, and that each study found activation and deactivation in different regions, thus not allowing for GingerALE software to find any significant likelihood of activation. This does not, however, imply that no overlapping likelihood of activation exists in the brain of psychopaths and that no brain areas would be implicated in psychopathy in regards to moral reasoning. Rather, it is expected with a high degree of certainty—especially when taken into consideration that other meta-analysis have found likelihood of activation in psychopaths' brain—that with more studies conducted in this area, a future meta-analysis would find significant areas of activation across studies; thus showing the likely brain regions that are activated and deactivated in psychopaths during moral reasoning tasks.

In sum, we did not find any significant clusters of activation likelihood in the main meta-analysis which looked at results of activation and deactivation of psychopaths on moral reasoning tasks alone. Possible reasons may be due to the small number of studies that met the criteria of the present study. Hence, the current study could neither provide evidence for the hypothesis, nor evidence that would have disconfirm it. The three clusters of activation likelihood for the analysis of all 16 studies is explained by the fact that the activation of non-

psychopathic controls were included in the analysis, providing much more data for the GingerALE software to analyze.

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Table 1. The 20 Items of the Psychopathy Checklist-Revised (R.D. Hare, 2003)

	Item	Factor
1	Glibness/ Superficial Charm	Factor 1/ Interpersonal
2	Grandiose Sense of Self Worth	Factor 1/ Interpersonal
3	Need for Stimulation	Factor 2/ Lifestyle
4	Pathological Lying	Factor 1/ Interpersonal
5	Conning/ Manipulative	Factor 1/ Interpersonal
6	Lack of Remorse or Guilt	Factor 1/ Affective
7	Shallow Affect	Factor 1/ Affective
8	Callous/ Lack of Empathy	Factor 1/ Affective
9	Parasitic Lifestyle	Factor 2/ Lifestyle
10	Poor Behavioral Control	Factor 2/ Antisocial
11	Promiscuous Sexual Behavior	N/A
12	Early Behavioral Problems	Factor 2/ Antisocial
13	Lack of Realistic Goals	Factor 2/ Lifestyle
14	Impulsivity	Factor 2/ Lifestyle
15	Irresponsibility	Factor 2/ Lifestyle
16	Failure to Accept Responsibility	Factor 1/ Affective

17	Many Marital Relationships	N/A
18	Juvenile Delinquency	Factor 2/ Antisocial
19	Revocation of Release	Factor 2/ Antisocial
20	Criminal Versatility	Factor 2/ Antisocial

Table 2. List of All Studies

Study	*N*	Psychopathy Measure	Task
Caldwell et al., 2015	87	PCL-R	Moral Judgment
Decety et al., 2015	155	PCL-R	Emotional Recognition
Fede et al., 2016	245	PCL-R	Moral Judgment
Glenn et al., 2009a	17	PCL-R	Moral Judgment
Glenn et al., 2009b	9	PCL-R	Moral Judgment
Harenski et al., 2014a	157	PCL-R	Moral Judgment
Harenski et al., 2014b	32	PCL-R	Moral/Emotional Judgment
Jochem, 2011	12	PCL-R	Moral Judgement
Marsh & Cardinale, 2014	33	PPI-R	Moral/Emotional Judgment
Marsh et al., 2011	42	PCL-YV	Moral/Emotional Judgment
Osumi et al., 2012	20	PSPS	Aggression/ Fair & Unfair
Pujol et al., 2012	44	PCL-R	Moral/Emotional Judgment
Seara-Cardoso et al., 2016	32	SRP-SF	Moral/Emotional Judgment
Yoder et al., 2015	115	PCL-R	Moral/Emotional Judgment
Yoder et al., 2021	88	PCL-R	Moral/Emotional Judgment
Zijlmans et al., 2018	122	YPI-SV	Moral Judgment

Total	1210	N/A	N/A

Table 3. List of Studies Included in Main Meta-Analysis

Study	*N*	Psychopathy Measure	Task	Neural Activity
Decety et al., 2015	155	PCL-R	Emotional Recognition	Activation
Glenn et al., 2009b	9	PCL-R	Moral Judgment	Activation
Harenski et al., 2014b	32	PCL-R	Moral/Emotional Judgment	Activation
Pujol et al., 2012	44	PCL-R	Moral/Emotional Judgment	Activation
Yoder et al., 2015	115	PCL-R	Moral/Emotional Judgment	Activation
Yoder et al., 2021	88	PCL-R	Moral/Emotional Judgment	Activation
TotalActivation	443			
Caldwell et al., 2015	87	PCL-R	Moral Judgment	Deactivation
Decety et al., 2015	155	PCL-R	Emotional Recognition	Deactivation
Glenn et al., 2009a	17	PCL-R	Moral Judgment	Deactivation
Harenski et al., 2014a	157	PCL-R	Moral Judgment	Deactivation
Marsh & Cardinale, 2014	33	PPI-R	Moral/Emotional Judgment	Deactivation
Osumi et al., 2012	20	PSPS	Aggression/ Fair & Unfair	Deactivation

Yoder et al., 2015	115	PCL-R	Moral/Emotional Judgment	Deactivation
Yoder et al., 2021	88	PCL-R	Moral/Emotional Judgment	Deactivation
Total Deactivation	672			

Table 4. ALE Results for Overall Meta-Analysis

Cluster	X	Y	Z	Z-Value	ALE	Label
1	-4	50	32	7.6703	0.04	Dorsomedial Prefrontal Cortex
2	30	6	-18	5.9569	0.03	Subcallosal Gyrus
3	30	-38	-2	6.7041	0.03	Hippocampus

Figure 1. Cluster 1 (Reported on Table 4) (x=-4, y=50, z=32)

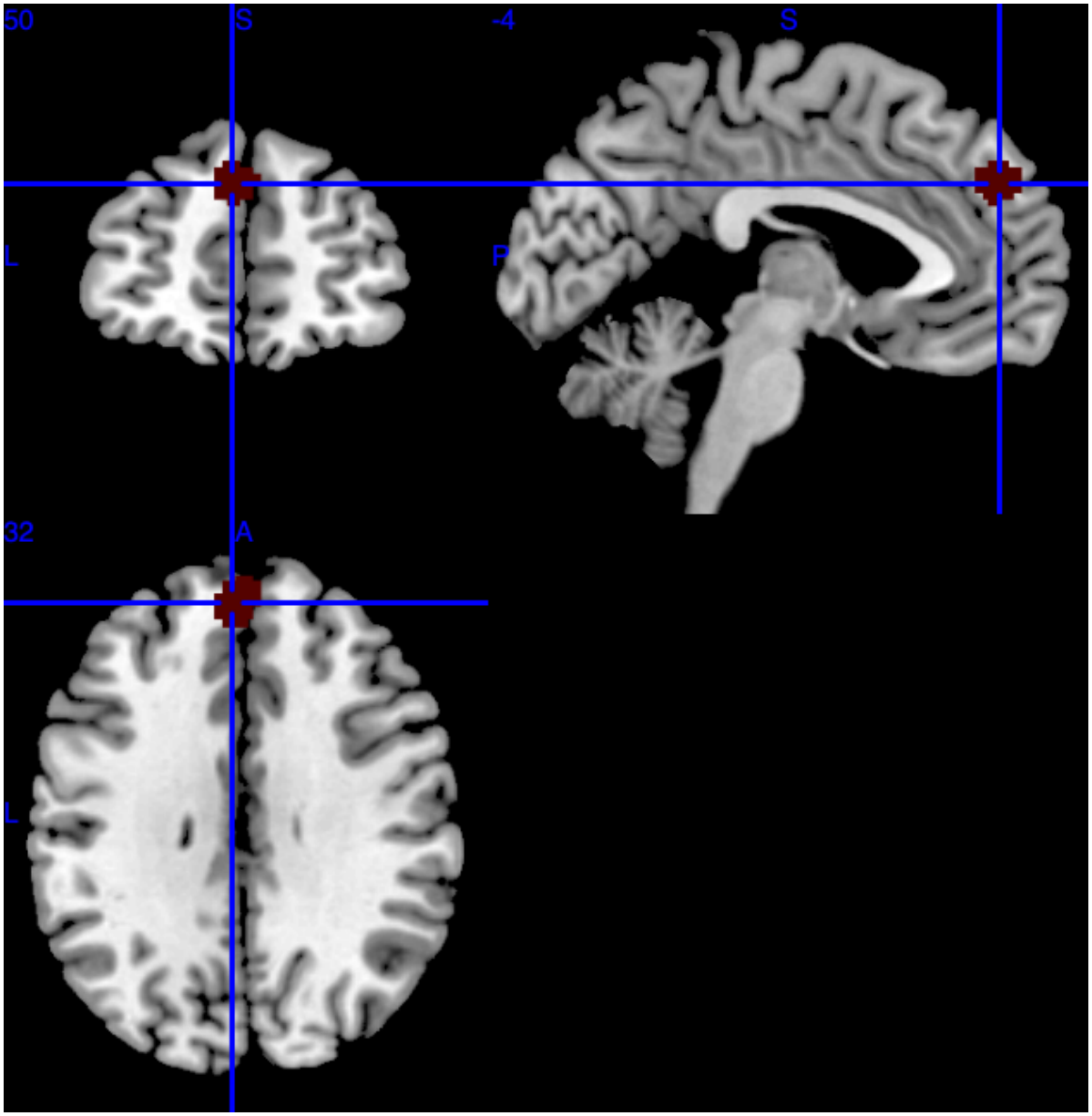

Figure 2. Cluster 2 (Reported on Table 4) (x=30, y=6, z=-18)

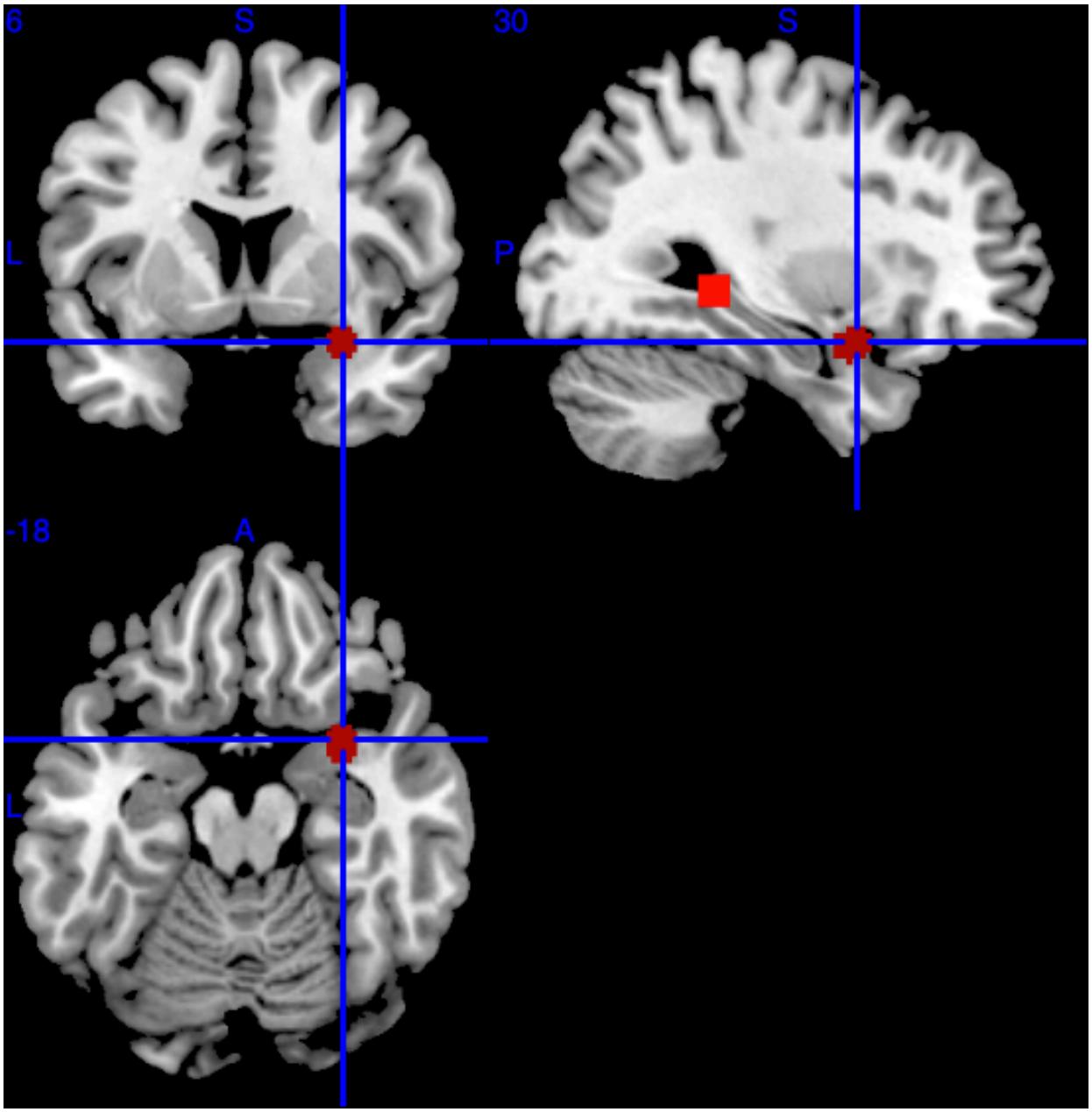

Figure 3. Cluster 1 (Reported on Table 4) (x=30, y=-38, z=-2)