MORAL JUDGMENT AND THE BRAIN: THE ROLE OF THE FRONTAL LOBES AND THE MODERATING INFLUENCE OF MORTALITY SALIENCE AND TYPE OF MORAL DILEMMA ON MORAL JUDGMENT

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Dedication

This project is dedicated to my friends and family who have supported and inspired me along the way

To my wife, Zeinab Chamsine Jaber,

a strong and inspiring woman. Thank you for being a constant source of support and encouragement during the challenges of graduate school and life.

I am truly thankful for having you in my life.

To my family,

who have always loved me unconditionally and whose good examples have taught me to work hard for

the things that I aspire to achieve.

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Chapter 1

Introduction

Moral reasoning and judgment studies have been on the rise for the last 20 years as part and parcel of the field of moral psychology. The reasons behind the renewed interest in the study of moral reasoning and judgment have to do with the advances in brain translational imaging techniques and methods. Moral psychology for the most of the 20th century remained in the shadows of moral and political philosophy (Flanagan, 1991) Aside from the work of Piaget and Kohlberg, moral psychology remained constrained by the assumptions and methodological techniques of moral philosophy (Greene, 2013; Haidt, 2012; Flanagan, 1991). According to Sinnott-Armstrong (2008) cognitive psychology and psychology in general remained for the most of the 20th century convinced that "empirical science is irrelevant to moral philosophy and to common moral beliefs" (p. i).

One of the reasons behind the hesitation of psychology to embrace morality as a topic of empirical study has to do with the ambiguity of the concept of morality itself, as morality has a different meaning to different branches of philosophy and science. Graham et al (2011) aptly described the conceptual confusion in defining morality and its domains by stating "how can we measure moral concerns when people disagree about what "morality" means?" (p.366)

The advent of neuroscience and brain translational imaging technologies (MRI, fMRI, PET, SPECT) ushered in a new era whereby the relationship between moral judgment and reasoning and specific brain structures can now be systemically studied. Several theories have appeared in the published literature as a result of the investigation of the role that the

brain plays in moral reasoning and judgment. One of the theories that have gained particular prominence is dual process theory (Greene, 2008). The dual process theory of morality is built on the dual processing theory of cognition which proposes that cognitive and perceptual processes engage two different brain systems and areas: the intuitive/heuristic system that is usually quick and receptive to emotional evaluation versus the more cognitive and reflective system that is receptive to reasoning and rational thinking (Kahneman, 2011).

Greene (2008) proposed that two distinct brain areas lead to two different types of moral judgment and at the same time have a moderating influence on moral judgment. Utilizing moral dilemmas, dual process theory suggests that there are two primary types of moral judgment: the utilitarian type of moral judgment that is associated with the reflective/rational system of brain versus the deontological type of moral judgment that is associated with the intuitive/heuristic system. Study after study has shown a robust correlation between brain areas associated with emotional evaluation such as the ventromedial prefrontal cortex (VMPFC) and deontological moral judgments**,** and between brain areas associated with planning and deliberation such as the dorsolateral prefrontal cortex (DLPFC) and utilitarian moral judgments (Greene, 2013). Greene's dual process theory of moral judgment has relied on philosophical assumptions about the meaning attributed to moral judgments made by different individuals responding to specific moral dilemmas that have not yet been tested empirically. The present dissertation is an attempt to explore the answers given to moral dilemmas and the reasons and meaning behind such answers, thus allowing for a more thorough understanding of the association between the VMPFC and deontological judgments and the DLPFC and utilitarian judgments.

Furthermore, no studies thus far have attempted to investigate the relationship between moral reasoning and types of moral judgments and the electric signature of brain activity as measured by quantitative electroencephalography (QEEG). QEEG, which is the comprehensive measurement of electrical activity throughout the entire cerebrum in real time (Demos, 2005), has the advantage of measuring temporal changes in an individual's brain while engaged in any number of cognitive tasks. Thus, as individuals solve or respond to different dilemmas and tasks, QEEG allows for the measurement of the electrical changes in the brain while they occur temporally (Evan & Abarbanel, 1999; Demos, 2005) giving the investigator the ability to observe how different stimuli and tasks engage different brain regions and yield different electrical signals. The high temporality of QEEG provides it with as distinct advantage over other brain imaging technologies that usually have high resolutions but lack the temporality of QEEG (Rocha et al, 2013).

Moreover, research has shown that inducing specific emotional reactions has both direct and indirect influence on the type of moral judgments (Greene, 2000; Haidt, 2007; Pyszczynski et al, 2003). Specifically, research utilizing terror management theory (TMT), which posits that reminders of one's own mortality induces emotional anxiety that is followed by specific defensive reactions aimed at strengthening one's connection to his/her cultural worldview (Pyszczynski et al, 2012), has shown that reminding people of their own mortality leads to harsher moral judgments that are more deontological in nature. However, no research has directly investigated the relationship between induced anxiety via mortality salience and its influence on moral judgment making.

The present study primarily utilizes the dual processes theory of moral judgment as a theoretical framework. The relationship between specific types of moral judgment,

solicitation of emotional states, and the brain electrical activity were investigated in this study. Specifically, this study investigated a) the relationship between type of moral dilemma and type of moral judgment, b) emotional arousal induced by mortality priming and type of moral judgment, and c) changes in electrical activity in the DLPFC and VMPFC associated with anxiety and type of moral dilemma and type of moral judgment.

Chapter 2

Literature Review

Moral Philosophy: An Overview

Origins

Morality has generated many paradoxes and conflicts since antiquity. It is around 600 BCE when Western philosophers began their earnest attempts at defining the essence of our moral obligations. One reason behind such paradoxes and conflicts is the fact that morality is a subject that is built on "systemizing, defending, and recommending concepts of right and wrong behavior" (Fieser, 2007, p.10). As Perry (1954) aptly wrote "morality is something which goes on in the world….Nothing is more familiar; nothing is more obscure in its meaning" (p.1).

Thus, morality is a thorny concept because of its relation to the justification of our behaviors according to criteria. The conflict becomes evident when one attempts to define the criteria, where they come from, and how to apply them to one's conduct.

Rachels (2007) defines morality as a systematic elucidation of rules about how one ought to live and in what manner one needs to live his/her life. For Rachels, morality should not be based on personal preferences and tastes. Instead, reason and impartiality should guide moral judgments. Thus, "morality is, first and foremost, a matter of consulting reason." (p. 11). Reason in Rachel's definition should be based on facts that exist regardless of our wishes, and the purpose of reason in moral judgment is to apply facts as they exist to different cases.

Rachels' definition of morality as a matter of utilizing reason to decide between courses of action represents only one conceptualization of morality throughout the ages. The idea of reason as an arbiter of moral truth has always been in direct tension with the idea that morality should be judged solely on the consequence and utility of our moral decisions that takes into consideration the happiness of the people affected by certain moral decisions (Rachels, 2007). The interplay and opposition of these different conceptualizations of morality reflects on a more general plane the tension between moral absolutism and moral relativism (Johnson, 1993). Moral absolutism is the idea that there exists universal moral truths that are absolute and that when applied appropriately should help us decide which actions are right and which are wrong. Moral relativism on the other hand asserts that universally true laws do not exist, and that what is right and what is wrong is always dependent on specific cultural, situational, and historical standards.

The debate between moral absolutism and moral relativism extends the story of morality back in time to the early Greek philosophers.

Philosophical Foundations and Theories of Morality

Early Greek Philosophical Conceptions

The beginning was with Plato and Protagoras, who each on his own left a mark on later philosophical conceptualizations of morality, Plato being the philosophical patriarch of moral realism and Protagoras the champion of moral skepticism (Fieser, 2000).

Protagoras (490-410 BCE) is famous for saying "man is the measure of all things". Thus, moral truths from this perspective do not exist above and beyond human beings, who are not only the measure of all things but "of things that are, that they are, and of things that

are not that they are not " (Fieser, p.5, 2000). This concept of people being the measure of all things was refined and elaborated upon for centuries. Thus, a 21st century philosopher would according to Fieser define moral skepticism as the "view that moral principles have no objective foundation independent of human society" (p.4). From this viewpoint, cultures with their specific laws, traditions, and historical progress reflect at any point of time certain ways of deciding what is morally right and what is wrong, and ways enforcing and reinforcing the practices, conventions, and traditions that support the moral rules existing at the time.

Thus, cultural relativism "challenges our belief in the objectivity and universality of moral truth…in effect saying there is no such thing as universal truth in ethics, there are only various cultural codes, and nothing more" (Rachels, 2007 p.18). According to Rachels, the following claims are usually associated with moral relativism or moral skepticism: (1) cultures and societies develop their own moral and ethical systems and codes, (2) within every society and culture what is right and wrong is determined by the society's moral code, (3) there is no way to decide in an objective manner which society's code is better than another's, (4) no special status should be given to one's own societal moral code**,** (5), we should show tolerance, acceptance, and understanding, not arrogance when judging other people's conduct.

On the other hand, Plato's (428-348 BCE) moral stance is an extension of his theory of the forms. According to the theory of the forms, "the universe is divided into two realms. First there is a visible world of appearances, which contain physical objects…. Second, there is an intelligible world of forms, which contains universal abstract objects" (Fieser, p.7, 2000). From this perspective, moral truth and values belong to the realm and world of forms (Morgan, 1992) and we can only understand and rediscover theses moral truths by rationally

recollecting what we were once were acquainted with but had to forget due to living in the world of appearances (Fieser, 2000; Morgan, 1992). To sum the key points of Plato's moral theory, one can say that (1) moral values belong to the spiritual unchanging world of forms, (2) if one wants to find moral truth he/she has to search in the world of forms and not appearances, (3) for people to act and become moral they need to partake in the moral forms, and (4) the way to gain moral knowledge is to rationally recollect the moral forms with which we were once acquainted.

The ideas of Plato led to a more polished and developed notion of what is known as moral realism. Samuel Clarke (1675-1729), a 16th century British philosopher argued that instead of a metaphysical world of forms that correspond to moral truths, moral values are eternal, intuitive and unchanging much like mathematical truths. Thus, moral realism from a more modern perspective becomes the position "that moral principles have an objective or real foundation, and are not subjectively based on human convention and traditions advocated by a particular culture"(Fieser, p.4, 2000).

Although Protagoras and Plato's contributions to moral philosophy were far-reaching and consequential, nonetheless Aristotle had a different view of morality that did not subscribe to Plato's moral realism or to Protagoras' moral skepticism.

Aristotle (384-322 BCE) developed an understanding of morality based on his virtue theory. A virtue can be defined as "a trait of character manifested in habitual action" (Rachels, 2007 p.175). These habits of action are generally considered to be good things to acquire and develop. Some of these virtues are benevolence, civility, fairness, patience, and courage.

Aristotle considers moral virtues to be but habits that one can acquire to help in regulating our desires. Moral virtues according to Aristotle usually represent the mean course between two opposite extremes, and the way to acquire moral virtues is through practice and habituation. For instance, courage/bravery is a desired virtue, but according to Aristotle if "someone avoids and is afraid of everything, standing firm against nothing, he becomes cowardly; if he is afraid of nothing at all and goes to face everything, he becomes rash." (Nicomachean Ethics, Bk,II, Ch.3, p.179)

The western philosophical history is an elaboration and extension of the ancient Greeks. According to Casebeer (2003), the works of these early Greek philosophers were precursors to the three most dominant moral philosophical theories in the West: utilitarianism, deontology, and moral virtue theory.

Utilitarianism

Hume (1711-1776) was one of the first philopshers to propose the concept of utility as a general criterion of deciding whether an action is moral or not ,but the concept was elaborated and refined by Jeremy Bentham (1748-1832) and John Stuart Mill (1806-1873). Utilitarianism is defined as, "the moral theory that an action is morally right if it serves the greatest good for the greatest number of people" (Fieser, 2007,p.2000). Hume argued that what is usually deemed moral is the action that brings immediate pleasurable consequences for oneself or others (Frankena & Granrose, 1974). Hume added that these actions that bring pleasure become useful only when they become rules that are followed. Hume's emphasis on rules was the foundational core of what was dubbed as rule utilitarianism.

Unlike Hume, Bentham, who is considered to be the father of classical utilitarianism, deemphasized the importance of rules, suggesting that the only thing that matters is the pleasing or displeasing consequences of actions. Bentham defines utility as the "property in any object, whereby it tends to produce benefit, advantage, pleasure, good, or happiness or to prevent the happening of mischief, pain, evil, or unhappiness" (Bentham, 1776, p.131). For Bentham, utility can be measured for the party or parties involved, thus sometimes the individual's happiness is the measure and other times it is the whole community's happiness overall that defines the utility of an action. Bentham's brand of utility was called "act utilitarianism" which focuses on calculating the balance of good over evil when deciding whether an action is morally right for an individual to do in a specific context. (Frankena & Granrose, 1974).

John Stuart Mill, who was a follower and student of Bentham, was more elegant and capable in presenting a more defined form of utilitarianism. Mill, like his mentor, stressed the importance of pleasure as a primary criterion of morality and distinguished between higher/intellectual pleasures and lower sensual pleasures (Fieser, 2000). However, like Hume, Mill considered rules of conduct to be more important than individual actions. Bloom (1968) summarized Mill's work and presented a more modern view of rule-utilitarianism, which stated "an act is right if and only if it conforms to learnable sets of rules, the adoption of which by everyone would maximize intrinsic value" (p.160). The intrinsic value is nothing more than pleasure, but Mill distinguished between quantity and quality of happiness. As Riley (2010) explained, Mill believed that some higher pleasures such as enjoying the arts are more intrinsically valued than mere lower pleasures. The higher kinds of pleasures are usually

"associated with the moral sentiment of justice, namely, a feeling of 'security' for vital personal concerns that everyone has and that ought to be recognized as equal rights, is qualitatively superior to any competing kinds of pleasures regardless of quantity" (p.67).

While utilitarianism focuses on consequences of actions, especially on the happiness of agents, as a criterion of the morality of action, other schools were mainly concerned not with rules, but with what they considered to be the rights of individuals regardless of overall utility, and these schools were called philosophical deontology.

Deontology

Casebeer (2003) states that deontologists consider our duty to act in accordance with the dictates of pure reason as the "categorical imperative". Deontologists give a prominent position for duties that we as creatures owe each other in not violating each other's rights. The father of deontology is considered to be the German philosopher Immanuel Kant. Kant, in accordance with his belief in the special place that humans occupy in the scheme of creation maintained that all humans have a life that has an "intrinsic value" which is above and beyond anything else (Rachels, 2007). Kant believed that all of our morality could be deduced from the principle of the categorical imperative. According to White (2004) "certain actions are prescribed (or forbidden) as matters of duty, regardless of the consequences of the action (or inaction). These duties are based on the categorical imperative, a "rule that is used to judge maxims, or plans of actions" (p. 92).

Kant defined the categorical imperative in three different laws: the first law is *the formula of autonomy or of universal law*, which states that an individual "acts only according to that maxim whereby [he/she] can at the same time will that it should become a universal

law" (Kant, 1785, p. 421). Stated differently Kant wants people to consider the question "what if everyone did that?" The second law is the *formula of respect for the dignity of persons*, which asserts that one "acts in such a way that you treat humanity, whether in your own person or in the person of another, always at the same time as an end and never simply as a means" (Kant, 1785, p. 429). The third law is the *formula of legislation for a moral community*, which teaches to "act as if your maxims were to serve at the same time as a universal law (for all rational beings)" (Kant, 1785, p. 438). Ross (1954) stated that Kant attempted to find common characteristics to which moral laws must subscribe. These characteristics, which can be found with the help of pure reason, can then be applied as criteria for judging any action's correctness. (Kant's deontology differs in many regards from what Greene calls deontological. For Green deontological response are intuitive, emotional, and fast, while deemphasized the role of motives and emotions and focused heavily on rational deliberation that is slow and methodical).

John Rawls (1971) attempted to find a modern abstraction of the philosophical works of the renaissance. He states that the principles of justice constitute the main component of the original contract of agreement bringing people into unity. He adds that these principles "are the principles that free and rational persons concerned to further their own interests would accept in an initial position of equality as defining the fundamental terms of their association" (p. 53). Thus, for Rawls, the rationality of human beings that is part and parcel of their biology will conceivably lead them to regard equal liberty and justice as first principles. What Kant hailed as pure reason was, in a sense, pure rationality that needed to be divorced from any emotional effects and partiality of human character traits (Churchland, 2011).

Virtue Theory

The dissatisfaction with deontological and utilitarian explanations of morality led to the revitalization of virtue as a possible corner stone of an agent's moral character. According to Holland (2011), virtues are "character traits, or dispositions of character, such as courage and benevolence, acquired during upbringing; one ought to develop and practice the exercise of the virtues and inculcate them in children" (p.192). Thus, an agent's action can only be evaluated by judging whether a virtuous person could endorse such action. Virtue ethics highlights the importance of an agent's character, motives, and a desire to act in accordance with one's virtues in building a moral character (Schwartz, 2009) as opposed to an impersonal conceptualization of morality that emphasizes rules and categorical imperative for moral behaviors and actions.

Philippa Foot and Elizabeth Anscombe are among the few philosophers whose work propelled the revival of Aristotelian virtue ethics (Schwartz, 2009). Anscombe (1958) in her famous paper "Modern Moral Philosophy" expressed a growing dissatisfaction with utilitarianism and deontology. Her work focused on the importance of human nature, human action, the characteristics and types of virtue, human flourishing, and bridging the gap between the philosophy of ethics and real life situations.

Thus, virtue ethics with its focus on "early development of good, habits, the capacity to reason sensibly about specific social issues…..developing good institutions to provide a harmonious structure to the social lives of individuals" (Churchland, 2011, p.164) provides a bridge between the philosophy of morality and ethics, the psychology of moral development, social aspects of moral education and building institutions to serve the public, and the neuroscience of moral decision making.

Psychological Theories of Moral Development

Questions about how we form moral decisions and moral judgments spurred a big interest in the psychological study of morality. According to May et al (2010), moral psychology is the interdisciplinary study of the mental life, moral thoughts, feelings, reasoning, and motivations of moral agents, and the study of the mental processes and structures guiding our moral actions and behaviors. For a long period of time, moral philosophers had an aversion for any attempts at naturalizing moral philosophy (Sinnott-Armstrong, 2008). The resistance to naturalizing moral philosophy and at utilizing the experimental sciences to understand moral decision-making goes back to G.E. Moore's (1903) attack on what he dubbed the "naturalistic fallacy". Moore stated that idea of associating certain morally perceived properties such as good, valuable, or right with natural properties such as happiness or love is fallacious in the sense that saying for instance "happiness is good" would always lead to one questioning whether or not happiness is really good (Churchland, 2011). The fallacy-that you can't derive an "ought" from an "is" was first proposed by Hume (1738); lies in the attempt to analyze and define "goodness" or "right" which would lead to logical confusion (Tanner, 2006). Moore's influence remained very strong in the philosophical circles until the 1990's when many philosophers and psychologists began to appreciate the value that cognitive psychology, neuroscience, and evolutionary psychology has for understanding morality.

However, even though most of the 20th century favored a separation and a lack of dialogue between the works of moral philosophy and that the other fields, there was a strong and persistent effort by the Swiss developmental psychologist Jean Piaget, and later by his student Lawrence Kohlberg to study the development of moral reasoning based on Piaget's

developmental stages. This opened the way for a host of new terms such as moral cognition, moral reasoning and moral judgment that became the corner stone of studying moral psychology and development.

Stages Theories of Moral Development

Piaget

Piaget is considered to have led the way in initiating the modern study of moral psychology (Lapsley, 1996). For most of the 20th century, moral psychology was defined by the work of Piaget and Kohlberg.

According to Carpendale (2000) "both Piaget and Kohlberg argued that moral development is not simply a process of 'stamping in' cultural expectations. Instead of being passed on from previous generations, the aspect of morality that goes beyond mere conformity to traditional rules must be constructed by individuals" (p.182). The emphasis on how morals are constructed by individuals through the unfolding of developmental stages became a central theme of moral studies and research.

Piaget studied moral development by focusing on how children acquire specific rules and how these rules reflect underlying cognitive structures that unfold in an ontogenetic sequence of stages (Feldman & Benjamin, 2004). Piaget argued that children discover rules governing interaction between them and others through a process of trial and error learning, which would eventually lead to self-constructed understanding of morality (Haidt, 2012). Thus, Piaget would study how children played a game of marbles and how they negotiated the rules of the game.

According to Piaget (1997), rules are the cornerstone of morality and studying how these rules are acquired is sufficient to understand morality. Thus, "playing games, having

arguments, and working things out together will help [children] learn about fairness far more effectively than any sermon from adults" (Haidt, 2012, p. 7). For Piaget, children's experience with playing, taking turns, and sharing will unfold and morph in tandem with the unfolding of the cognitive-developmental stages culminating in the development of the idea of justice (Piaget, 1997, Haidt, 2012, Flanagan, 1991).

Kohlberg

Kohlberg constructed a theory of moral development consisting of three levels each with two distinct phases: Level I – pre-moral or pre-conventional (4 – 10 years), level II – conventional moral (10 – 13 years), and level III – of post-conventional moral (after 13 years) (Gibbs et al, 2007). All of Kohlberg's moral dilemmas centered on issues of fairness and justice and was designed to solicit children's reaction to issues related to problems in fairness and justice. Kohlberg divided Level I into two stages: the heteronomous morality stage and the individualistic, instrumental morality stage. The heteronomous morality stage is characterized by the egocentric point and moral realism and the norms are concrete rules of what is right and wrong that are defined regardless of the psychological perspective of self and others**,** while the individualistic, instrumental morality stage is characterized by the appearance of psychological standards that mediates and balances the psychological needs of self and other through concrete interactions (Lapsely, 1996). Kohlberg's Level-II consists of two stages: the interpersonal normative morality stage that is characterized by the integration of the sentiments of gratitude and loyalty into the process of reciprocity, and the social system morality stage that is characterized by the appreciation of the perspectives of the generalized member of society. (Lapsely, 1996) Level III of Kohlberg's theory culminates in

the principle of the universality of morality and the moral point of view that takes equality and fairness as the guiding principles of ethical reasoning. (Lapsely, 1996)

Though Kohlberg's theory has had tremendous influence in psychology, his work been criticized on the basis that his views rest on assumptions which are limiting and restrictive to the domain of moral development. (Haidt, 2001; Flanagan, 1991). For instance, the assumption that the function of morality is mainly to resolve interpersonal conflicts which center on issues of fairness and justice and that cognitive moral reasoning is the main tool for handling and resolving such interpersonal conflicts places an almost naïve emphasis on the rationality of human beings to resolve moral conflicts with impartiality and adherence to platonic and Kantian views of the prominence of justice and fairness in human life and conflicts (e.g., Churchland, 2011; Flanagan, 1997; Haidt, 2012; Greene, 2013; Johnson, 1993). Kohlberg's emphasis on rationality and the importance of fairness and justice in interpersonal conflicts meant considering moral reasoning as the most important factor in moral behavior and actions (Maschette, 1977). Galotti et al (1989) defined *moral reasoning* as "conscious mental activity that consists of transforming given information about people in order to reach a moral judgment", and moral cognitions refer to "any host of cognitive acts that helps us decide on how we should act and under what conditions" (p.35).

However, as Maschette (1977) asked, to what extent does such reasoning reflect "real life", and how representative of real moral dilemmas are the hypothetical moral dilemmas Kohlberg used in his research? For, instance to what degree do moral reasoning and decision-making studies represent what happens in real life responses to moral dilemmas and quandaries (Cortese, 1984)? This raises a question about the ecological validity of moral

judgment research and about the extent to which conditions studied and stimulated in the context of the lab can reflect real life situations (Kazdin, 2003).

Moreover, it seemed that Kohlberg neglected the power of affect, motivations, and moral action and behaviors to influence moral reasoning. As many researchers suggested, "factors additional to moral judgment are necessary for principled moral reasoning to be translated into 'moral action.' The 'factors' are situational, motivational and emotional, and 'ego strength' effects" (Maschette, 1977, p.125).

Furthermore, one of the criticisms directed at Kohlberg's theory of moral development was his neglect of gender differences. The role of gender and gender difference in the development of moral character and moral behaviors has been a very contentious issue in the field of psychology in general and in the field of developmental psychology in particular (Walker et al, 1987). Flanagan (1991) explained that there is some indication that there exists differences in the socialization process between males and females in Western cultures, and thus it is possible that such difference could lead to qualitative and quantitative differences between males and females when it comes to the moral domain. However, as Whiting and Edwards (1988) argued, such differences in the socialization process between males and females is a cultural fact and by no means supports the universality of moral development.

Gilligan (1982) asserted the theories of moral development have tended to focus on issues of justice and fairness as constituting morality's core domain while overlooking issues of care and relatedness. As Gilligan stated "the moral imperative that emerges repeatedly in interviews with women is an injunction to care, a responsibility to discern and alleviate the "real and recognizable trouble" of this world" (p.100) while the moral imperative for men is

"an injunction to respect the right of others and thus to protect from interference the rights to life and self-fulfillment" (p.100).

However, the research supporting Gilligan's assertion of a different moral injunction for women appears to have certain methodological weaknesses. In particular, Gilligan seemed to have based her assertion of a different moral injunction for women on limited data collected mainly from small samples of college female students who were discussing controversial topics such as abortion or were drawn from elite colleges and universities (Colby & Damon, 1995).

Nonetheless, there appears to be some evidence that women do tend to judge moral dilemmas and moral contentious issues by emphasizing certain domains that men might tend to ignore, such as care, harm avoidance, dependency, and so forth (Santos-Ruiz et al, 2012).

The role of culture in moral development is yet another contentious issue that has troubled the field of developmental moral psychology since its inception (Turiel, 2008). However, work by Shweder, Mahaparta, and Miller, (1987) has reestablished the role of culture as an important part of research in the field of moral development.

One aspect of cultural differences that pertains to the issue of morality is the difference between "individualistic" and "collectivist" cultures (Turiel, 2008). According to several researchers (e.g. Markus & Kitayama, 1991; Turiel, 2008) where a culture falls on the dimension or orientation of collectivism versus individualism will affect "how persons are defined, how they interact with each other, how society is defined, and how the goals of person and the group are established and met" (Turiel, 2008, p.484).

In individualistic cultures, "the highest value is accorded to the person as detached from others and as independent of the social order" (Turiel, 2008, p.385). Thus, in

individualistic cultures the values of self-sufficiency, self-reliance, independence, and weariness of authority and obedience take central stage and affect how social and moral development unfold. Alternatively, collectivist cultures place higher value on duty to the group and to one's family, respect for authority, social harmony, and interdependence (Oyserman, Coon, & Kemmelmeier, 2002).

Haidt's (2004) research into the domains of moral judgment led him to study whether there is any difference in the way Americans from Philadelphia, Upper class educated people from Brazil, and working class Brazilians judged moral and conventional violations. Moral violations consisted of dilemmas that centered on violations of sexual mores such as incest, while conventional violations centered on violations of social etiquettes. He found that while American subjects and educated subjects from Brazil treated moral and conventional violations differently, the working class Brazilians tended to find no difference between moral violations and conventional violations. Haidt's study highlighted the fact that the moral domain is different across class, cultures, and nations, and that it is by no means limited only to fairness and justice paramount to western cultures.

Psychodynamic Theories of Morality

For many thinkers psychoanalysis represents the missing link between moral reasoning and the constellation of conflicting desires, motives, wishes, and affects (Lear, 2003). For instance, Edward et al (1995) argue that psychological conceptions of morality focus on moral reasons and values at the expense of understanding how unconscious motives and desires interact and conflict with moral reasons and ethical values.

Freud's introduction in 1919 of the superego established the psychoanalytic study of the development of morality. The superego was introduced by Freud as part of his structural

theory, which stipulated the existence of three mental structures: the id, the ego, and the superego. The superego represented for Freud the part of oneself that supervises things from a moral perspective and it is usually formed around the resolution of the Oedipal complex (McWilliams, 1994). In essence, the sense of right and wrong is the product of internalizing and identifying with one's parents' prohibitions and values (Freud, 1923; McWilliams, 1994).

Lang (2008) argues that the precursor of the superego is the feeling of guilt associated with incestuous and murderous desires and wishes that the child harbors toward his /her parents. The transformation from simple and less complex forms of internalized guilt and shame into more complex, nuanced, and multifaceted states arises out the constant exchange between inner and outer aspects of reality (Lear, 2003). Thus, from a psychoanalytic perspective, the introjections of the parents' prohibition and values will pass from one generation to the next thus forming the backbone of the moral standards and value of an individual's particular society.

According to Fabricius (2004), psychoanalysis can provide theoretical support for moral autonomy due to its emphasis on the idea of internalized guilt. The ability to experience guilt is considered by most psychoanalytic theorists to be the source of the motivational energy behind our moral actions. Thus, from a psychoanalytic perceptive, knowing what is right or wrong coupled with the ability to cognitively and rationally negotiate moral behavior is not enough by itself to cause an individual to choose the morally right behavior or action. What is needed is an inner sense of autonomy and the ability to experience guilt for an individual to act morally. Psychoanalysis "shows that allowing "bad feelings" in one's thinking helps to refrain from "bad deeds" and to find socially acceptable

forms of regulation instead. Aggression, rage, and envy are functional for the individual and for the community and society." (Fabricius, p.310)

Contemporary Psychological Theories of Morality

The Social Intuitive Theory

The dissatisfaction with traditional moral psychological theories reflects the misgivings about what Graham et al (2011) call the narrowness of the moral domain. The moral domain was defined for the most part by an implicit/explicit assumption that interpersonal conflicts centered on fairness and justice were of paramount importance to the study of moral reasoning and development. Haidt (2001) argues that research in non-Western countries has shown that concern about fairness and justice is only one aspect of a multitude of other concerns that non-Westerners considered to be aspect of morality.

The original model (see Figure 1) of moral judgment espoused by the rationalist and stage wise theories places rational deliberation and reasoning in a causal chain leading to moral

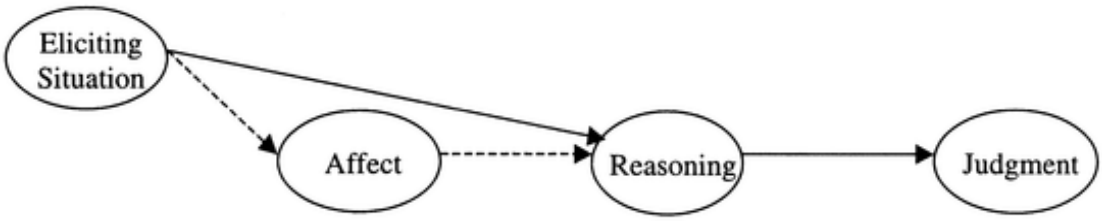


Figure 1. The Original Model of Moral Judgment. The figure shows that first a soliciting moral situation will induce an affective reaction and will influence reasoning leading to moral judgments. In this model, reasoning takes a central and a priori role in shaping our moral judgments. Reproduced from Haidt, 2001.

judgments (Haidt, 2001). Specifically, these theories of moral judgment give reasoning a priori influence on shaping the moral judgment, while still accounting for the effects of emotion and of the soliciting situation. The a priori influence of reasoning on moral judgment has been misguided and wrong according to Haidt (2001). In his influential paper *The Emotional Dog and Its Rational Tail,* Haidt (2001) proposed an alternative model for moral judgment (see Figure 2) whereby moral reasoning does not play a causal and a priori role in moral judgment.

Haidt (2001) believes that Kohlberg's focus on fairness and equality does not fully represent the totality of the moral domain. There have been multiple attempts at understanding the reasons behind the restriction of the moral domain in the West. One of the reasons behind the move from a view of morality as a full spectrum of moral concerns to a narrow concern with justice and fairness is the move away from virtue ethics to quandary ethics (Appiah, 2008; Pincoffs, 1986). Kohlberg and his followers popularized the use of ethical quandaries and dilemmas in studying the domains of moral judgment. Quandary ethics is "the study of how people should resolve quandaries, particularly those that pit the rights or welfare of one person against those of another" (p.367). However, such ethical quandaries were limiting because of their over-dependence on highlighting only issues of justice and fairness.

According to Graham et al (2011) research on people in India (Shweder, Mahapatra, & Miller, 1987), people of lower social class in Brazil and the United States (Haidt et al., 1993), and conservatives in the United States (Graham, Haidt, & Nosek, 2009; Haidt & Hersh, 2001; Jensen, 1998) has revealed moral considerations beyond the individual-based concerns of harm and fairness, involving concerns about spiritual purity and degradation

(even for acts that involve no harm), concerns about proper hierarchical role fulfillment, and moral expectations of loyalty to the local or national group.

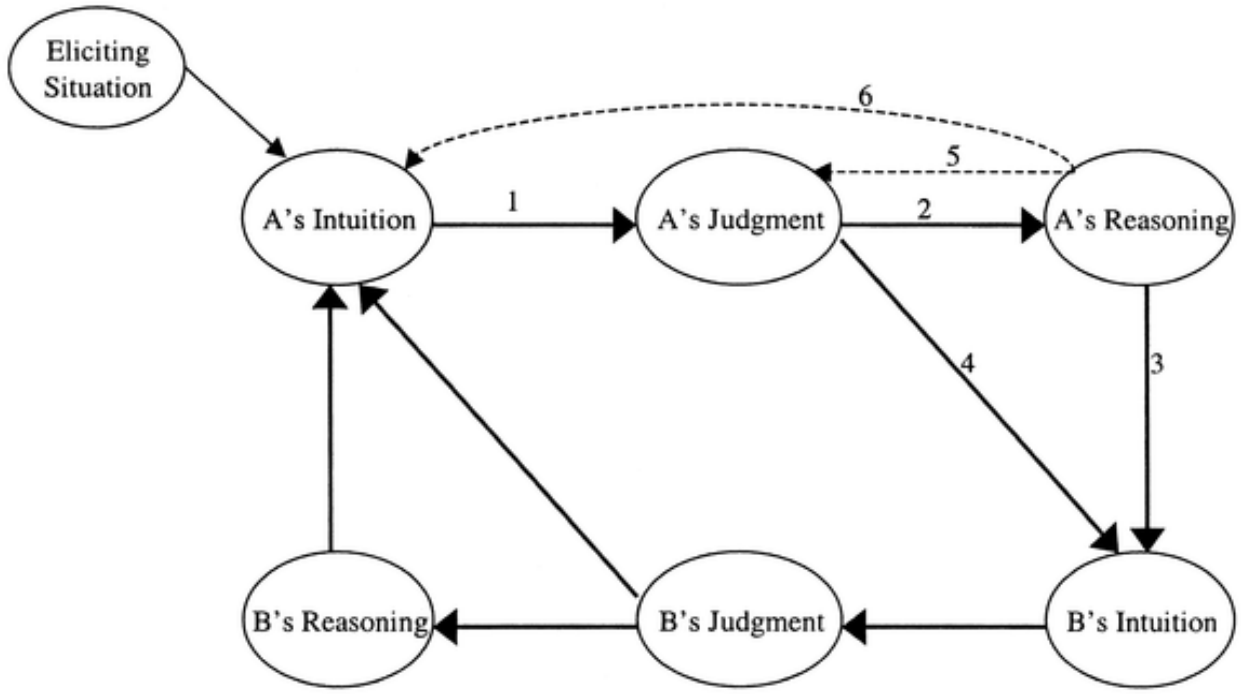


Figure 2. The Social Intuitionist Model. The model suggests that intuitions play a central role in shaping one's moral judgments. The reasoning link in the model appears to be a post hoc activity rationalizing our already intuitive judgments. Reproduced from Haidt, 2001.

In response, Haidt and Kesebir (2010) proposed what they considered to be a more comprehensive definition of morality and the moral domain. Moral systems are now defined as a composite symphony of intertwining set of values, virtues, habits, identities, technologies, institutions that are all regulated by a set of psychological mechanisms with evolutionary roots. Based on this wider definition of moral systems, Haidt and Graham (2007) proposed a moral foundation theory (MFT) that was built on 5 dimensions: Harm/Care, Fairness/Reciprocity, Ingroup/Loyalty, Authority/Respect, and Purity/Sanctity.

MFT is an outgrowth of the social intuitionist approach to morality as opposed to the rationalist approach to the moral domain (Haidt, 2001). According to the social intuitionist model "there are moral truths and that when people grasp these truths they do so not by a process of ratiocination and reflection but rather by a process more akin to perception, in which one 'just sees without argument that they are and must be true" (Harrison, 1967, p. 72). The social intuitionist theory considers moral reasoning to be a post hoc activity involved in justifying what our intuitions have already decided for us. In other words, people engage in moral reasoning and justification in order to find supportive arguments for their already established judgments. Nisbett and Wilson (1977), Kuhn (1991), Kunda (1990), and Perkins, Farady, and Bushey (1991) found that people on a daily basis engage in reasoning processes that are mainly aimed at supporting their already established assumptions. Motivated reasoning has been a hotly debated concept among psychologists mainly due to the challenge it imposes on traditional views of reasoning.

Graham and Haidt (2009) developed a Moral Foundations Questionnaire (MFQ) that is based on the Moral Foundation Theory. The final version of the MFQ was called MFQ30. The MFQ30 consists of 32 items administered in two parts. Graham et al (2011) reported that

the measure has demonstrated adequate psychometric properties including demonstrating satisfactory goodness-of-fit to a five factor structure.

Zhong et al (2010) showed support for the Purity/Sanctity domain. They found that having subjects clean their hands with an antiseptic wipe, or visualizing themselves in a clean or a dirty state prior to making judgments on moral issues such as pornography, profane language, adultery made them make harsher moral judgments. Cameron et al (2013) found that priming subjects with disgust prior to making moral evaluation while telling them to consciously ignore that influence still resulted in subjects making harsher moral judgments but only did so in individuals who were not skilled in differentiating between their emotions. These studies support the expansion of the moral domain to include evaluations and behaviors that go beyond the fairness and justice domain.

Rottman et al (2014) studied American adults who were recruited via an online crowdsourcing website and were generally liberal and non-relegious. They looked at whether perceived harm played a role in morally condemning suicide or whether harm was a post-hoc reasoning masking a more intuitive emotional moral condemnation of suicide. Their results showed that suicide was seen as morally wrong not because of any associated harm but because it reflected a "tainting of the soul", giving less credibility to theories that place a high premium on perceived harm as a sole dynamic in moral judgment and reasoning.

Baril and Wright (2012) studied moral attitudes and cognitions by administering to three groups Rest's neo-Kohlbergian stages of moral development, Defining Issues Test (DIT), and Graham and Haidt's MFQ. Their results indicated an overlap between stage2/3 (personal interests) of the DIT and the In-group foundation in the MFQ and stage4 (maintaining norms) of the DIT and the authority foundation of the MFQ. The overlap

between MFQ and the DIT implies that the social intuitionist theory claim of ingenuity in broadening the moral domain is not totally supported. While the social intuitionist theory has been important for elevating the importance of intuitions and emotions in moral judgment, it nonetheless does not wholly supplant the role of rational deliberation and reasoning. The inclusion of both intuitions/emotions and reasoning/rational deliberation in moral judgment in contemporary psychological theories of morality will be discussed in the next section.

Dual Processing Theory of Morality

While the social intuitionist model of moral judgment opened the way to understanding the role of emotions and intuitions in moral judgment, it seemed to do so by a total relegation of reason to a mere post-hoc activity activated only to justify already established intuitions and emotions regarding specific moral dilemmas and tasks. The Dual Process Theory (DPT) proposed and advanced by Greene et al (2001) appears to account for both the emotional and rational process involved in moral judgment.

The dual process theory of moral judgment is based on the dual process theory of perception proposed by Kahneman (1991) as the dichotomy of fast thinking vs. slow thinking. According to Kahneman, fast thinking comprises of two distinct variants of intuitive thought: the first one is the heuristic fast thinking and the second one is the automatic/ implicit fast thinking, which is based on the unconscious activities of memory and perception. Furthermore, Kahneman described the accurate intuitions of experts as "better explained by the effects of prolonged practice than by heuristics" (p.11). For Kahneman, skill and heuristics become complementary sources for decision-making and judgments.

Theories of dual processing in the brain have been proposed by many researchers and disciplines (Epstein, 1994; Evans, 2003; Evans & Over, 1996; Sloman, 1996; Stanovich &

West, 2000). De Neys (2006) argues that most dual process theories have in common the following: first they all assume that a

> "first system (often called the heuristic system) will tend to solve a problem by relying on prior knowledge and beliefs, whereas a second system (often called the analytic system) allows reasoning according to logical standards. The heuristic default system is assumed to operate rapidly and automatically, whereas the operations of the analytic system are believed to be slow and heavily demanding of people's computational resources." (p.428)

Cognitive science has extensively studied how people acquire and learn new information and how such information becomes inscribed in neural networks that operate mainly out of normal conscious awareness. According to Anderson (2000), as individuals practice certain skills repeatedly, such skill becomes more and more free of conscious cognitive involvement. Thus, the amount of conscious attention to details involving the task at hand becomes more automatic and fast, giving experienced people more time and energy to create more connections and solutions to arising problems. This adaptability in skill acquisition involves three stages identified by Fitts (1964) and Anderson (1982). The first stage, named the *cognitive* stage, involves direct instructions and supervision to the learner from an experienced instructor or professional. At this stage one usually relies on existing knowledge and skills in problem solving. The second stage named the *associative* stage involves less and less instruction and a transition from explicit and declarative representation of the skill in question to an implicit and procedural representation. Thus, the second stage of skill acquisition enables individuals to move from the requirements of verbally reviewing their steps to a more fluid and error free performance. Lastly, after enough training skills

enter the third stage named the *autonomous* stage. At this stage the skill become more rapid and automated and the degree of cognitive and conscious attentional involvement gradually diminishes.

De Neys (2006) studied the effects of executive burden and working memory span on analytic thinking versus heuristic thinking. He gave subjects two different types of tasks; one had them do the task while attempting to keep a dot pattern in their working memory and one with the task only. The results indicated that on conflict items, individuals' who were asked to keep a dot pattern in their working memory demonstrated compromised reasoning performance compared to individuals who were asked to solve non-conflict problems that their heuristic systems seemed apt at solving.

According to Conway and Gowronski (2013) the dual process theory of morality assumes that emotional reactions are the first ones to be elicited when one is confronted with moral decision making, and that cognitive processes that usually override emotional reactions, need longer time to counter our reflexive emotional reactions and allow for a reconciliation between the emotional and the cognitive processes. Their research found that "deontological inclinations are related to emotional reactions to harmful actions, whereas utilitarian inclinations are based on cognitive deliberation about costs and benefits" (p.221). Not surprisingly, it was found that people who give more deontological judgments were high on personality factors such as empathic concern, perspective taking, and faith in intuition, while people high in utilitarian judgments were high in the factor of the need for cognitive deliberation and evaluation (Conway & Gowronski, 2013). Greene et al (2008) have shown that utilitarian judgments were disrupted when one's cognitive resources were under increased cognitive loads. Other support for the importance of cognitive deliberation in

producing more utilitarian judgments can be found in Suter and Hetwig's (2011) work on showing the effect of time pressure in decreasing the likelihood of utilitarian judgments. The study indicated that when making utilitarian judgments cognitive resources were needed to overrule the intuitive/emotional judgments, but when subjects were given less time to think, their judgments tended to be more deontological, reflecting a decreased effect of cognitive deliberation on the intuitive/emotional reactions.

The utilitarian versus deontological dichotomy in moral judgment has also been represented as a dichotomy of 'personal" vs. "impersonal" moral judgments and actions (e.g. Killgore, Killgore, Day, Li, Kamimori, & Balkin, 2007; Koenigs et al., 2007; Valdesolo & DeSteno, 2006). Personal moral actions refer to any actions that ''could reasonably be expected to lead to serious bodily harm, to a particular person or a member or members of a particular group of people . . . where this harm is not the result of deflecting an existing threat onto a different party" (Greene et al., 2001, p. 2107), while impersonal moral actions are moral action that does not meet the criteria of the personal one.

The distinction between personal moral reasoning and impersonal moral reasoning was shown to correlate to differences in whether people rely more on visual cognitive style in solving moral conflict or more on verbal cognitive style of resolving conflict (Amit &Greene, 2012). Using a matched working memory test, one verbal and one visual, to identify individuals with visual cognitive styles versus verbal cognitive styles, Amit and Greene found that people with a visual cognitive style gave more deontological solutions to moral dilemmas compared to people with a more verbal cognitive style. Their results indicate that the ability to visualize harm affected individuals' ability to use rational processes associated with utilitarian moral judgments and thus made it harder on them to accept the utilitarian

solution that requires in most cases the justification of forsaking an individuals' rights to life in order to save the lives of a group of individuals (Ciaramelli, Muccioli, Ladavas, & di Pellegrino, 2007; Cushman, Young, & Hauser, 2006; Greene, Morelli, Lowenberg, Nystrom, & Cohen, 2008; Greene, Nystrom, Engell, Darley, & Cohen, 2004; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Koenigs et al., 2007; Mendez, Anderson & Shapira, 2005). Moreover, visualizing cognitive moral dilemmas and scenarios might highlight certain emotionally salient features and allow such visual and highly emotional features to sway moral judgment into a more deontological approach.

The distinction between heuristic/emotional and manual/cognitive cost-benefit oriented processes in moral judgment put forth by dual process theory opens the door to investigating how emotional and cognitive factors could play roles in moral reasoning and judgment. In most situations, the deliberative/reasoning component of moral reasoning/judgment does not conflict with the emotional/intuitive aspect of moral reasoning/judgment. However, under certain circumstances, the conflict will be very salient and apparent, and that is what the present study attempts to show by employing moral dilemmas that exaggerate the conflict and thus may have a demonstrable influence on how dilemmas are manifested in differential brain processes.

In one of its modern iterations (Greene, 2004), the moral dilemmas (see Figure 3) are as follows: "Suppose a runaway trolley is about to run over and kill five people. Suppose further that you can hit a switch that will divert the trolley onto a different set of tracks where it will kill only one person instead of five. Is it okay to hit the switch?" or " what if the only way to save the five people were to push a large person (larger than yourself) in front of the trolley, killing him but saving the others? Would that be okay?"

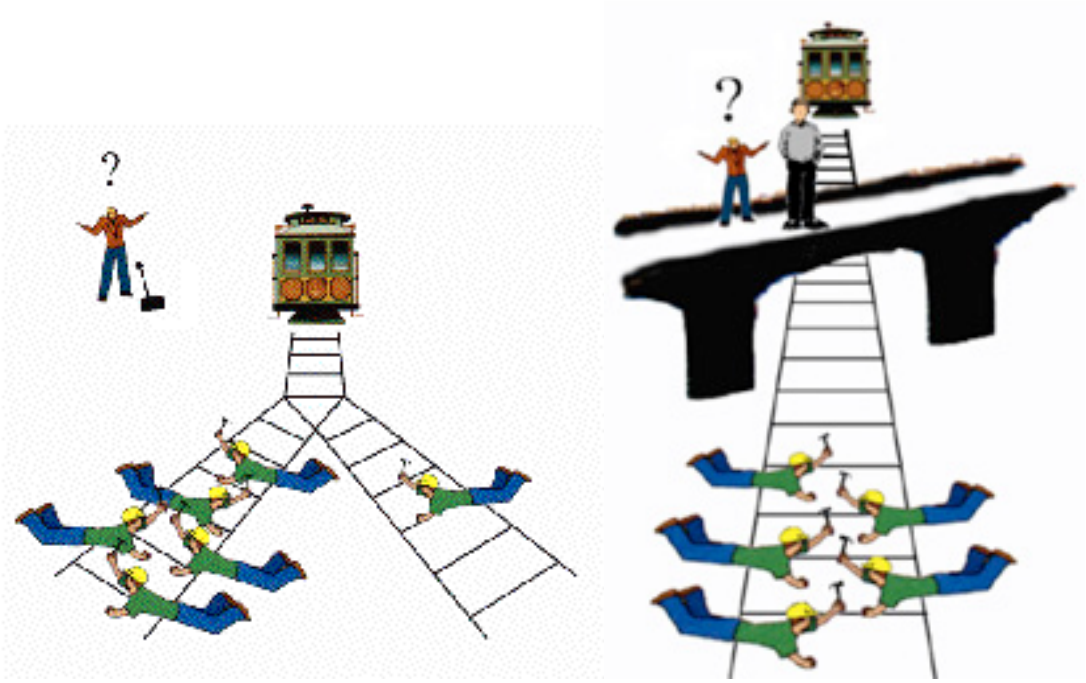


Figure 3 Moral Dilemmas A & B.. On the left is “The switch moral dilemma” where a person has to decide whether to switch and change the track to save five people but to kill one person on the alternative track. On the right is “the push moral dilemma” where a person has to decide whether to push a bystander into the track of an incoming train to save people 5 persons. Reproduced from Greene (2012).

The dual processing theory of moral judgment was developed by utilizing moral dilemmas typically used in quandry studies: the "switch" dilemma and the "push" dilemma. Phillipa Foot (1967) was the first one to develop such moral dilemmas by creating hypothetical dilemmas that are geared toward highlighting the tension between deontological vs. utilitarian and personal vs. impersonal dilemmas. Greene and colleagues distinguished between 'personal' and 'impersonal' moral violations and judgments. "A moral violation is personal if it is: (i) likely to cause serious bodily harm, (ii) to a particular person, (iii) in such a way that the harm does not result from the deflection of an existing threat onto a different party. A moral violation is impersonal if it fails to meet these criteria" (Greene & Haidt, 2002, p.519). According to Greene (2013) the negative reactions people feel at the prospect of pushing one person to save five individuals, but not at the prospect of hitting a switch that will end killing one person, comes from the gut reaction aversion to such acts (pushing someone). Moreover, the distinctions between personal and impersonal dilemmas have to do with the difference between means and side effects. In the impersonal type of dilemmas, the death that results from redirecting the path of the train is accidental; it is a side effect of the intended action of saving five individuals. However, the death that results from pushing the one person in the personal dilemma is not a side effect, it is the means through which one achieves the goal of saving five people. Thus, according to Greene (2013) humans have automatic settings that incline them to be sensitive to the distinction between means and side effects.

For instance, Greene seems to have a priori philosophical assumptions about the meaning he assigns to "yes" and "no" responses in both dilemmas. The subjects in Greene's original study were not asked about what affected their decision to say "yes" or "no". The

present study attempts to address this issue by not only analyzing the "yes" or "no" answers to the moral dilemmas, but by also offering subjects the chance to elaborate on their answers by choosing between different reasons corresponding to deontological and utilitarian conceptualizations. Thus, in Greene's conceptualization deontological judgments are equivalent to personal dilemmas and utilitarian judgments are equivalent to impersonal ones.

EEG and QEEG: An Overview

EEG stands for electroencephalograph, which is basically a "graphical representation of neuronal activities in the cerebrum" (Demos, 2005, p.17). According to Teplan (2002), "the electroencephalogram (EEG) is defined as electrical activity of an alternating type recorded from the scalp surface after being picked up by metal electrodes and conductive media" (p.1). The fact that the voltage arriving at the scalp is very tiny is offset by the amplification of the EEG by a factor of 10,000-50,000 (Luck, 2005).

The graphical representation denotes the difference in voltage between two different scalp locations corresponding to cerebral areas plotted over time. As ions flux in and out of neurons they create dipoles that deflect electrons at the measuring electrodes. One of the advantages of using EEG is its ability to record complex patterns of neural and electrical activity within milliseconds after administering a stimulus (Taplan, 2002). Thus, the EEG's high temporal sensitivity/resolution allows the researcher to observe in real time the changes in a brain's electrical patterns in response to changes in stimuli or environment. MRI and other translational imaging technologies only measure metabolic activity in the brain and not direct neuronal activities, thus giving the EEG an edge over them.

EEG recordings are subject to a lot of noise due to the nature of the EEG signal and tend to contain a lot of artifact that is not associated with actual neuronal activity. The nature

of the EEG signal subjects it to the many sources of electric signals in a lab, such as signals from electric wires and computer screens (Luck, 2005). To counter the noise from electric sources most EEG software applies filters that select a threshold to measure at or below, while ignoring anything higher than the threshold. In addition to electrical noise, a researcher has to pay attention from artifacts coming from any kind of movement including muscle tension, eye blinking, and jaw clinching that could create spikes in the EEG signal. To counter these types of artifacts, a researcher has to make sure to inspect the EEG output while recording and direct the subject toward more relaxing and immobile placement (Luck, 2005; Thatcher, 1998).

According to Bickford (1987), the research and clinical indications for using EEG are diverse and range from, (1) monitor alertness, coma and brain death; (2) location of areas of damage following head injury, stroke, tumor, etc.; (3) test afferent pathways (by evoked potentials); (4) monitor cognitive engagement (alpha rhythm); (5) produce biofeedback situations; (6) control anesthesia depth ("servo anesthes"); (7) investigate epilepsy and locate seizure origin; (8) test epilepsy drug effects; (9) assist in experimental cortical excision of epileptic focus; (10) monitor human and animal brain development; (11) test drugs for convulsive effects; and (12) investigate sleep disorder and physiology.

Quantitative electroencephalography, (QEEG) refers to the "mathematical processing of digitally recorded EEG in order to highlight specific waveform components, transform the EEG into a format or domain that elucidates relevant information, or associate numerical results with the EEG data for subsequent review or comparison" (Nuwer, 1997, p. 278). Thatcher and Lubar (2008) state that QEEG is usually used for the purposes of research, diagnosis, and implementation and guidance of treatment. Furthermore, QEEG is the analysis

of EEG output that allows for comparing a person to a normative database and usually it is a very helpful way of standardizing where measurements of brain activity occur. QEEG is usually obtained by utilizing the 10-20 International System of Electrode Placement (ISEP) developed by Jasper (1958).The numbers '10' and '20' refer to the distances between adjacent electrodes that are either 10% or 20% of the total front- back or right-left distance of the skull. According to Trans Cranial Technologies Manual (2012), "four anatomical landmarks are used for the essential positioning of the electrodes: first, the nasion which is the point between the forehead and the nose; second, the inion which is the lowest point of the skull from the back of the head and is normally indicated by a prominent bump; the pre auricular points anterior to the ear." (p.1)

The 10-20 ISEP allows for the placement of the electrodes by associating meaningful letters and numbers to brain positions (see Figure 4). By convention, odd numbers refer to areas on the left side of the brain and even numbers refer to areas on the right side of the brain. The letters provided by the 10-20 ISEP refers to anatomical cortical areas of the brain. F stands for frontal lobes, Fp for frontal poles, T for temporal lobes, O for occipital lobes, P for parietal lobes, C for central and sensorimotor cortex, A refers the earlobe reference placed on both earlobes, and Z for the centerline that separates left and right hemisphere (Demos, 2005) Anatomical directions for placement of the ISEP are very helpful in relating the sensor positions with numerous anatomical brain areas. For instance, dorsal means toward the top of the head, lateral mean to the left or right of the midline, ventral toward the bottom of the head, and medial midline of the brain.

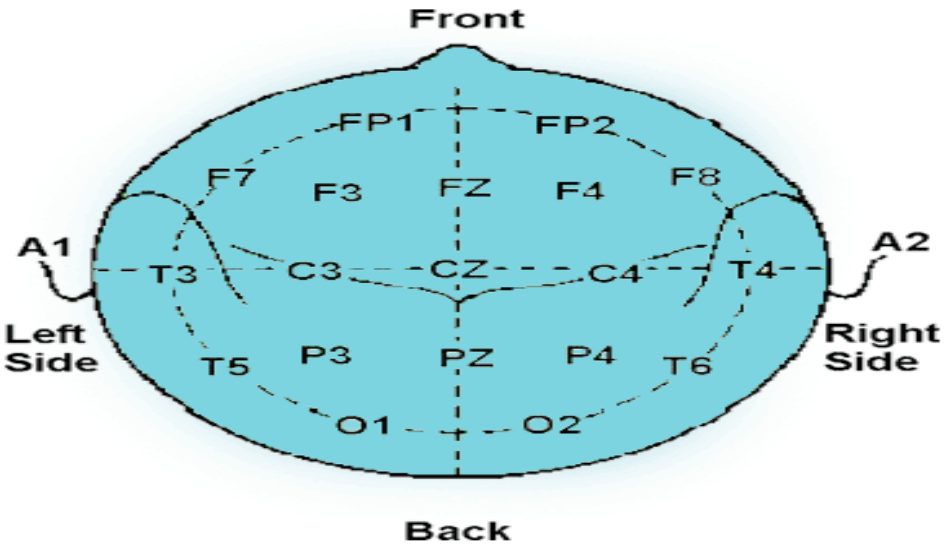


Figure 4. Graphical Presentation of the 10-20 ISEP.

Thus, the electrode placement is directed and guided by corresponding the electrodes with specific brain areas which are thought to be associated with specific functions and symptoms (Demos, 2005). The frontal lobe which is associated with memory, attention, social awareness, character, motivation and planning, corresponds to sensors, Fz, F3, F4, F7, and F8 and the frontal poles to the Fp1 and Fp2. The parietal lobe, which has been dubbed as the association cortex and is usually related to the key functions such as math, naming objects, complex grammar, and spatial awareness, correspond to the Pz, P3, and P4 sensors. The temporal lobe is usually associated with the functions of verbal memories, word recognition, reading, language, and emotions on the left side and with the function of facial recognition, social cues, and object recognition on the right side. The temporal lobe is associated with the T3, T4, T5, and T6 sensors and the right hemispheric temporal region is important due to its proximity to the amygdala (emotion) and hippocampus (memory). The occipital lobe is usually associated with the function of the visual field, locating objects in the

environment, color and movement recognition, reading, and writing corresponds to the Oz, O1, & O2 sensors. The sensory and motor (sensorimotor) cortex corresponds to the C3, C4, & Cz sensors. The Fz, Cz, and Pz correspond to the Z that divides that two hemispheres and is related to the cingulate gyrus. (Damos, 2005, Panksepp, 1998, Foster & Harrison, 2002, Damasio, 1994).

The computerized analysis of QEEG yields information on frequency distribution, voltage (amplitude), locus of studied phenomena, waveform, absolute power, relative power, and inter-hemispheric symmetries (Cantor, 1999). Of particular importance to the present study is absolute power. Raw QEEG data are usually measured in amplitudes (microvolts/hertz) and then transformed via specific normative database software into power (squared microvolts). The software will convert the raw data using a Fast Fourier Transformation (FFT). Thus, the transformation will yield absolute power values for each band frequency in a specific electrode site and a total absolute power value for all band frequencies on each specific electrode.

The QEEG's non-invasiveness and safety makes it a very important tool in investigating the brain processes of cognition, perception, memory, emotions, and language in both adults and children (Evan & Abarbanel, 1999, Demos, 2005, & Teplen, 2002). Research has shown that QEEG has high reliability, specificity, and sensitivity (Arruda et al. 1996; Burgess &Gruzelier 1993; Corsi- Cabrera et al. 1997; Fein et al. 1984; Gasser et al. 1985; Harmony et al. 1993).

Hammond (2009) states that, "QEEG provides reliable, non-invasive, objective, culture-free and relatively low cost evaluation of brain functioning, permitting

individualization of treatment and added liability protection" (p.31). Hammond reviewed recent literature on neuro-feedback and found a trend in relying more and more on QEEG assessment protocols that collect data from 19 electrode sites on the scalp simultaneously. Data collected from the 19 electrode sites are then "examined, artifacts carefully removed, and then extensive statistical comparisons are made to normative databases to obtain scientifically objective data on brain function. These data may include such measures as magnitude, absolute and relative power, power ratios, coherence, phase lag, comodulation, and analysis with sophisticated discriminant functions" (p.32).

EEG rhythms can be divided into distinct frequency bands which themselves are associatd with different states of arousal and cognitive engagement: Delta (1-4 Hz) is usually characteristic of sleep, repair, and complex problem solving, Theta (4-8Hz) is usually characteristic of creativity, insight, and deep states of meditation, Alpha (8-12 Hz) is usually characteristic of alertness, peacefulness, readiness, and meditation, Beta (13-21Hz) is usually characteristic of thinking, focusing, and sustained attention, and finally Gamma (38-42 Hz) is usually characteristic of cognitive processing and learning (Demos, 2005). Frequencies of 20-32 Hz are named High Beta and usually indicate intensity, hyperalertness, and anxiety. The alpha range/rhythm is considered to be the brain's relaxed and idle state and thus provides a natural and adequate reference/baseline for comparing how emotional and cognitive tasks/stimuli arouse different brain areas and regions (Panksepp, 1998).

QEEG is usually recorded first in an eyes-open and/or eyes closed condition to obtain measurements of resting brain state activity. Eyes-open or eyes-closed conditions involve subjects being alert, sitting quietly, and not moving; and are usually used to develop

normative references (Thatcher, 1999). Active task recordings of QEEG refers to recordings of brain activity while a subject is involved in a cognitive or perceptual task. According to Thatcher (1999) "many EEG or EP (evoked potentials) have reported reproducible changes in brain dynamics that are task dependent." (p.32) Eyes-open or eyes closed usually lead to uniform recordings of EEG due to the simplicity of the minimal cognitive task the subject involved in, while active task recordings of EEG are "dependent on the intensity of the stimuli, the background noise of the room, the distance between the subject and the stimuli, the subject's understanding of the task instruction, and the subject's motivation" (p.32).

Terror Management Theory

Terror Management Theory (TMT) proposes the simple idea that reminders of one's mortality and finitude trigger a host of cognitive and emotional defenses aimed at managing the anxiety aroused by the thoughts of one's demise (Tremoliere et al, 2012, Greeneberg at al, 1986). Building on Darwin's theory of evolution and Becker's existential/anthropological studies "TMT thus posits that humankind manages the potential terror (hence the term *terror management*) resulting from awareness of the inevitability of death by maintaining faith in a cultural worldview and procuring self- esteem by living up to the standards of value prescribed by that worldview" (Landaue et al, 2007, p.478). Thus, when people are confronted with implicit or explicit reminders of their own mortality, they tend to place high premium on the values, morals, and life style of their own culture.

Greeneberg et al (1990) showed that reminders of death affected perceptions and evaluations of in-group versus out-group subjects. They showed that when Christian college students were asked to give evaluations of certain subjects (Christian or Jewish) after being

reminded of their own mortality they tended to form more positive evaluations of in-group subjects versus out-group subjects compared with subjects who were not reminded of their own mortality.

TMT posits two stages in dealing with reminders of one's own mortality. First, individuals explicitly try to block any access to thoughts of their own mortality. Second, individuals engage in active identification with one's own cultural worldview and group (Greeneberg et al, 1999). According to Solomon et al (2015) death reaction involves two types of defensive reactions: proximal defenses and distal defenses. Proximal defenses are activated immediately after reminders of imitations of mortality and include deliberate suppression of the thoughts of death by distracting oneself, suppressing or rationalizing away the awareness of one's mortality. The distal defense stage is activated after thoughts of death and mortality have been repressed and pushed to the farther side of conscious awareness. Distal defenses act to "muffle mortal terror because they support the belief that we will end endure in some literal or symbolic form beyond our death." (Solomon et al, p.171).

The support for the dual process activation of defenses to reminders of one's own death comes from studies done by Greeneberg, Solomon, and Pyszczynski (2003). A study done by Simon et al (1997) showed that people who were given certain cognitive manipulation tasks aimed at decreasing their access to their cognitive resources showed more awareness of, and easier accessibility to, death-related thoughts than people who were not deprived of such access. Thus, the cognitive effort needed to suppress awareness and access of death thoughts is jeopardized due to being involved in other cognitive tasks, thus indicating that suppression of death awareness require the utilization cognitive resources that

are limited in nature. Moreover, Gailliot et al (2006) has shown that people who were given reminders of their own mortality and then later asked to do the Stroop task showed impaired performance suggesting that engagement in active suppression of death-related thoughts consumed cognitive resources needed to keep up with the demands of the Stroop task.

Gailliot et al (2006) relate the ability to minimize access to thoughts of death and anxiety related to reminders of death to self-regulation. The ability to exert cognitive manipulation and attention to suppress death-related thoughts after exposure to reminders of death is bolstered by self-regulation. According to Muraven and Baumeister (2000), self-regulation is a trait shaped by genetic and by environmental factors. Thus, low capacity for self-regulation would increase vulnerability to disturbing thoughts and feelings about death and coping with thoughts of death will demand and consume an individual's limited resources for self-regulation (Muraven & Baumeister, 2000).

The present study focuses on the effects of mortality reminders as defined and constructed by the terror management theory (Greeneberg et al, 1986) on the outcome of moral reasoning and judgment and on how the interaction between mortality reminders and moral reasoning/judgment have a demonstrable influence on brain activation.

Neural Substrates of Moral Judgment and Reasoning

Dorsolateral Prefrontal Cortex (DLPFC) and Ventromedial Prefrontal Cortex (VMPFC) Anatomy and Functions

The DLPFC and the VMPFC are anatomically parts of the frontal lobes and cortex and, in particular the prefrontal part of the frontal lobes. The frontal lobes in the human brain constitute of all the tissues in front of the central sulcus (Kolb & Wishaw, 2003). The frontal lobes constitute about 20% of the neocortex and are functionally divided into three different

regions: motor, prefrontal, and premotor.

The prefrontal cortex is the cerebral cortex that covers the front parts of the frontal lobe. The prefrontal cortex is further divided into three distinct regions in the primates' brain: the dorsolateral prefrontal cortex, the ventral prefrontal cortex (and sometimes referred to as the orbital frontal cortex), and the medial frontal cortex (Gazzaniga, 2002; Kolb & Wishaw, 2003).

The prefrontal cortex is associated with higher order aspects of motor planning, execution of behavior, and integrating information over time (Gazzaniga, 2002). As Goldman-Rakic, (1992) states, "the cardinal function of prefrontal cortex is the regulation of behavior by internalized (symbolic) cues. Fundamental to this capacity is the ability of an organism to access and hold information in mind and then to use that information to guide responses in the absence of external cues" (p.34).

The DLPFC is a region of the prefrontal cortex that is considered to act as a conductor of the reasoning process in the brain (Greene, 2013). Damage to the DLPFC usually results in perseveration, distractibility, disinhibition, diminished planning/initiative, difficulties in recency memory, temporal ordering difficulties, difficulties in long-term recall, verbal fluency/recall, self-ordered working memory tasks, certain types of associative learning, impaired egocentric spatial processes, "utilization" behavior problems, lack of hygiene, and release of primitive reflexes (Greene, 2013; Gazzaniga, 2002; Damasio, 1994).

The VMPFC is a region of the prefrontal cortex involved in emotional processing, understating emotional cues, and emotional responding. (Greene, 2013) There is growing fMRI evidence that the medial prefrontal cortex is activated and recruited during belief-based

moral judgment (Young, 2007;Young & Saxe, 2008) and there is evidence that the VMPFC may "be necessary for attributing intentions to moral agents, and process this information along with outcome information during moral judgment" (Young et al, 2013, p.2).

The present study attempts to look at how the DLPFC and the VMPFC in the frontal lobe of the brain respond to personal versus impersonal moral dilemma and to induced state of anxiety (through reminders of mortality) as measured by electrical activity picked up by electrodes/sensors placed on areas associated with the DLPFC and the VMPFC.

Personal Versus Impersonal Moral Dilemmas, DLPFC, and VMPFC

Personal moral dilemmas have been found to increase activation in areas of the brain involved in emotional processing such as the medial frontal gyrus, the amygdala, and the ventral medial prefrontal cortex (VMPFC), while impersonal moral dilemmas have been found to increase activation in areas of the brain associated with cognitive processes such as dorsa-lateral prefrontal cortex (DLPFC) (Greene et al, 2001).

Greene et al (2001) investigated the neural correlates of moral judgment using fMRI. They found that areas such as medial frontal gyrus, posterior cingulate gyrus, and bilateral angular gyrus were more involved in reactions to moral dilemmas that evoke strong emotional reactions (which Greene et al called "personal moral dilemmas"), while areas associated with working memory such as the parietal lobes and right middle frontal gyrus were less active during the presentation of personal moral dilemmas. More specifically, based on numerous studies of brain lesions (Damasio, 1997), Greene proposed that the ventromedial prefrontal cortex is involved in automatic emotional responses, and that the dorsolateral prefrontal cortex is responsible for controlled cognitive processes. Ciaramelli et

al (2011) found that "VMPFC is necessary for integrating outcome and belief information during moral reasoning. During moral judgment, VMPFC may mediate intentions, understanding, and overriding of prepotent responses to salient outcomes" (p.962).

Moretto et al's (2009) research with patients with damage in the ventromedial prefrontal cortex (VMPFC) has shown that in addition to such patients demonstrating greater levels of approval of personal moral violations compared to a control group, these patients' skin conductance response (SCR) was almost absent when they approved or considered personal moral violations. The conclusion is in agreement with studies measuring the SCR of patients with VMPFC damage who viewed disturbing images and who showed muted SCR responses compared to a control group that did not have damage in the VMPFC (Damasio et al, 1991). Furthermore, Bechara et al (1994) investigated the effects of the damage in the VMPFC on the sensitivity to future consequences. They studied the phenomenon by using a version of the "gambling experiments". In their version, the subjects were asked to play a game of cards where on each trial they were supposed to choose a card from four possible decks labeled A, B, C, D. Subjects were only told that some cards will earn some money and some will earn them money plus require them to pay a penalty which was sometimes very costly. Unknown to the subjects, decks A and B usually yielded the most money but they exacted very high penalties, while decks C and D yielded less money but less penalties overall. After some trials, normal subjects with no VMPFC damage will usually start picking more cards from decks C and D, while subjects with VMPFC damage picked more cards from decks A and B as the game progressed. The surprising finding in this study is that every time normal subjects were posed to pick from decks A and B, their SCR registered right

before they did that, while subjects with damage to their VMPFC showed no SCR before choosing from decks A and B.

Ciaramelli et al (2007) studied the effect of damage in the VMPFC on moral judgments of subjects. They tested 7 patients VMPFC lesions and 12 healthy individuals on personal moral dilemmas, impersonal moral dilemmas, and non-moral dilemmas. They found that compared to healthy subjects, patients with VMPFC lesions were more likely to endorse moral personal violations as acceptable. However, they found that both group responded in a similar manner to the impersonal and non-moral violations. Thus, indicating the importance of an intact VMPFC in opposing personal moral violations.

Wei Xue et al (2013) utilized graph theory-based network analysis of event-related potentials during moral decision making. Their results indicated that the personal dilemmas generated more significant (paired t-test, $p < 0.05$) nodal activity at the F2, F4, & Fp2 electrodes than the impersonal ones, while the reverse was true for the F3 electrode. The results indicate that the personal task might be more emotionally salient, thus probably requiring the input of the right hemisphere to process emotional information (Schwartz, Davidson, & Maer, 1975). By contrast the impersonal task showed more long distance connections in the frontal regions indicating " higher functional integration (Supekar, Musen, & Menon, 2009) contributing to conflict processing (Forbes & Grafman, 2010) because of inflicting direct harm to a person, compared with the impersonal condition" (p.27).

Purpose of the Present Study

The purpose of the present study is manifold. First, it sought to examine the relationship of type of moral dilemma (personal/push vs. impersonal/switch) to the type of moral judgment (deontological vs. utilitarian). Specifically, this study attempted to determine

whether Greene's (2004) assumptions regarding personal dilemmas leading to a high number of deontological judgments and impersonal dilemmas cause a higher number of utilitarian judgments could be empirically supported. Second, this study aimed to investigate the relationship between type of moral judgment (deontological vs. utilitarian) and brain/cortical activation with attention given to the VMPFC and the DLPFC in the prefrontal regions. FMRI research has shown a correlation between different brain areas and different types of moral judgment, such as an increased activation in the dorsolateral prefrontal cortex when making utilitarian judgments and increased activity in the ventromedial prefrontal cortex when making deontological judgments. However, no research has explicitly studied the relationship between the total absolute power in the DLPFC and VMPFC and types of moral judgment. Third, the present study aimed to examine the extent to which cognitive load, defined in terms of defending against negative affect associated with heightened mortality salience and disruptive emotions, influence moral judgments. The electrode and sensor positions that this study investigated were: Fp1, Fp2, Fpz, F7, F3, F4, and F8. Roughly speaking, the Fp1, Fp2, will correspond to the dorsolateral prefrontal cortex and the F3, F4, and Fz will correspond to the ventromedial prefrontal cortex. It was expected that deontological judgments would show higher absolute total power (spike is electrical activity) in sites F3, F4, and Fz corresponding to the VMPFC in comparison with DLPFC, while utilitarian judgments will show higher absolute total power in sites Fp1 and Fp2 corresponding to the DLPFC.

Statement of Hypotheses

For this study, four hypotheses were tested:

Hypothesis 1. Type of moral dilemma would be associated with different types of moral judgments. Specifically personal dilemmas (e.g., push dilemma) would produce significantly higher deontological judgments while impersonal dilemmas (e.g., switch dilemma) would produce significantly higher utilitarian judgments.

Hypothesis 2. Different types of moral judgments would be associated with elevated activity in total power in specific areas of the frontal lobes. Specifically, DLPFC would show higher power level for utilitarian judgments and the VMPFC would show higher power level for deontological judgments.

Hypothesis 3. Disruptive affect caused by priming of mortality salience would influence type of moral judgment with significant reductions in utilitarian judgments and significant increase in deontological judgments for both personal and impersonal moral dilemmas.

Hypothesis 4: In the priming condition, mortality salience would be associated with higher absolute power in both the VMPFC and the DLPFC relative to baseline regardless of types of moral dilemmas (personal or impersonal). However, deontological judgments would be associated with higher absolute power in the VMPFC compared to the DLPFC.

Significance of the Study

The present study has important practical and theoretical implications. First, from a practical perspective, knowing how emotional arousal associated with mortality reminders has a significant effect on the type moral judgments one arrives at will help shed light on the situational contexts of making moral decisions and judgments. From the legal domain to the educational domain, we are always involved in making decisions that have wide ranging

implications for the growth, development, and sometimes lives of individuals. Thus, understanding the intertwined relationship between emotional arousal, situational contexts, and type of moral judgments may help clarify how one's moral decisions and judgments are not always the result of adherence to certain rules or guidelines, but in most cases subject to emotional influences.

There is evidence that mortality salience has an influence on the judgments made by municipal judges regarding legal transgressions (Rosenblatt, Greeneberg, Solomon, Pyszczynski, & Lyon, 1989). In the study, 22 municipal judges were recruited and were told that the study's main purpose was to examine the relationship between personality traits, attitudes, and bond decisions. The surprising finding was that judges presented with reminders of their own mortality tended to set higher bonds (average =$455) compared to the control group of judges whose average bond was $50. Although this is only one study, it seems that death reminders may have a strong influence on the judgment of a group of people who are supposed to be impartial in their application of the law. Tremoliere et al (2012) summed the implications of the finding that moral judgment is affected by mortality salience by stating that, "irrespective of the precise processing specification underlying the effect of mortality salience, our findings have worrying implications for public debate (and private judgments) about controversial moral issues" (p.383). Thus, individuals under the influence of mortality salience are less likely to devote their full cognitive attention to fully ponder and understand the nuances of the life and death moral debates and issues.

The present study also opens the door for further investigation of the relationship between the brain's electrical activities, studies in translational neuroimaging, and moral judgment. Specifically, the present study aims to shed light on the dual processing theory

proposed by Greene et al (2001) with its assumption of two distinct brain regions associated with different types of moral judgments and the extent to which negative affect influences how moral judgments are made. The present study's investigation of Greene's dual processing theory may have theoretical implications for the science of moral judgment by opening the door for the discussion of the philosophical and psychological assumptions behind the dual processing theory and the theoretical assumptions of the meanings assigned to types of moral judgments in response to different types of moral dilemmas.

Chapter 3

Method

Participants

The present study used a total sample of 20 adult participants recruited via the participant research pool at the University of Detroit Mercy and/or through referrals made from colleagues of the author. The sample was comprised of 11 women and 9 men with a mean age of 31.05 years (SD= 6.55, ranging from 20 to 42 years of age). In terms of ethnicity, 11 participants self-identified as Middle Eastern, five as Caucasian, one as Asian, and three as mixed ethnicity. With respect to religious affiliation, 15 participants reported being actively affiliated with a faith system. Information on the specific faith systems to which these participants were affiliated was also gathered, where 5 reported no religious affiliation, 7 reported Christian affiliation, and 8 reported Muslim affiliation. In regard to employment, 11 participants reported holding a full-time job, and five a part-time job. Four participants were unemployed. As all participants were actively matriculating students at time of their involvement in this study, information on their declared majors was obtained. The most common major was psychology (n= 8), followed by business (n= 5). The remaining participants reported a range of majors including nursing (n= 1), teaching (n=1), biology (n= 1), graphic design (n= 1), and dental hygiene (n= 1). Two participants reported not having a major. Lastly, five participants reported taking some form of medication at time of their involvement in the study.

Measures, Materials, and Equipment

Background Survey. A paper-and-pencil self-report survey with questions about various demographic characteristics, such as age, sex, gender, and ethnicity, religious

affiliation, and household income was used. A copy of the survey can be found in Appendix A.

Moral dilemmas. The "push" and "switch" versions of the runaway trolley dilemma were used. In both versions, a scenario is described where the participant is witness to a trolley which threatens to kill a group of people unless some form of action is taken. In the "push" dilemma, participants are told that there is a large person next to them on a bridge and are asked whether or not it is acceptable to push the person in front of the oncoming trolley, sacrificing the person's life in order to stop the trolley and save the lives of a group of people further down the trolley tracks. In the "switch" dilemma, participants are told that there is a switch beside them which could be pulled in order to change the track the trolley travels on. Participants are informed that if no action is taken, the trolley will continue down the track and kill a group of people. However, if they pull the switch, then the trolley will be diverted down a different track where it will kill only one person. Participants are asked whether or not it would be acceptable to pull the switch.

Both moral dilemmas were presented with standardized text providing the scenarios and information described above along with corresponding visual images in a manner consistent with research done by Greene (2004). Appendix B contains the dilemmas as used in the present study.

Moral reasoning. In responding to the moral dilemmas, participants were only required to provide a yes or no response as to whether or not they consider some form of action morally acceptable. In order to get more specific information relating to the reasons for participant responses, after the initial response, participants were asked to use an 11-point response scale ranging from 0 to 10 to indicate why they made the decision they did. The

zero-end of the scale had a descriptive anchor that was designed to reflect deontological reasoning (i.e., "Life of an individual is sacred and has value regardless of the total happiness of others"). At the other end of the response scale, a descriptive anchor was used to reflect utilitarian reasoning (i.e., "The sum happiness of five people overrides that of one person"). Responses at the extreme of the scale were interpreted as reflecting the influence of only one form of moral reasoning while responses falling in the mid-range values of the scale were interpreted as suggesting both deontological and utilitarian reasoning processes were used to arrive at the moral judgment made in each dilemma.

Priming Stimuli. Two different primes were used, one which was designed to heighten mortality salience and another which was intended to serve as a non-affect inducing neutral prime condition. For mortality salience, participants were prompted to reflect on the feelings and thoughts that arise when considering their own death and to imagine what will happen to them as they physically die and ultimately reach death. The neutral prime involved asking participants to reflect upon the feelings and thoughts that arise as they imagine sitting in a park and to give consideration to what might happen both during and subsequent to spending time sitting at a bench in a park.

Debriefing statement. At the end of their participation, participants in the experimental group were provided with a debriefing statement about their involvement in the study and about their exposure to mortality reminders.

EEG Apparatus and Materials. Brain activity was measured and recorded using the Discovery 20 EEG amplifier and associated software developed by BrainMaster Technologies Inc. As per the manufacturer (http://www.brainmaster.com/content-

sub/discovery-20/), this device "provides 24-bit conversion with an internal sampling rate of 1024 samples/second and 256 sps [sampling rate per second] data rate to" a computer. Its bandwidth permits accurate recording of all common spectral frequencies (i.e., delta, theta, alpha, beta, high beta). The sensor system used is called Electro-cap. This is a cap made of stretchable hypoallergenic material which was placed on the head of participants. Embedded in the cap are a total of 19 pure tin electrodes which are distributed so that when the cap is adorned, they are placed on the scalp in a manner consistent with the 10/20 International placement system. To facilitate electrical conductivity and reduce impedance levels, a product called electrogel was injected into each electrode site using a sterile blunted needle and syringe. As the present study was specifically interested in capturing frontal lobe activity, only electrodes placed over the frontal lobes were prepared and used (i.e., F3, F4, Fz, Fp1, and Fp2).

Study Design and Procedure

This study used a mixed factorial within-between cross-over experimental design wherein all participants were initially quasi-randomly assigned to a group were they were first presented with the push or switch moral dilemma and then, after the introduction of a prime, were given the other dilemma (e.g., push group did switch dilemma; switch group did push dilemma). All participants received both moral dilemma conditions. In the case of the prime, there were two prime conditions- mortality salience and neutral conditions. Participants were quasi-randomly assigned to a prime condition. The dependent/outcome variables were type of moral judgment, moral reasoning, and brain activity operationalized in terms of absolute power across all spectral frequencies measured. Figure 5 provides a visual depiction of the study design.

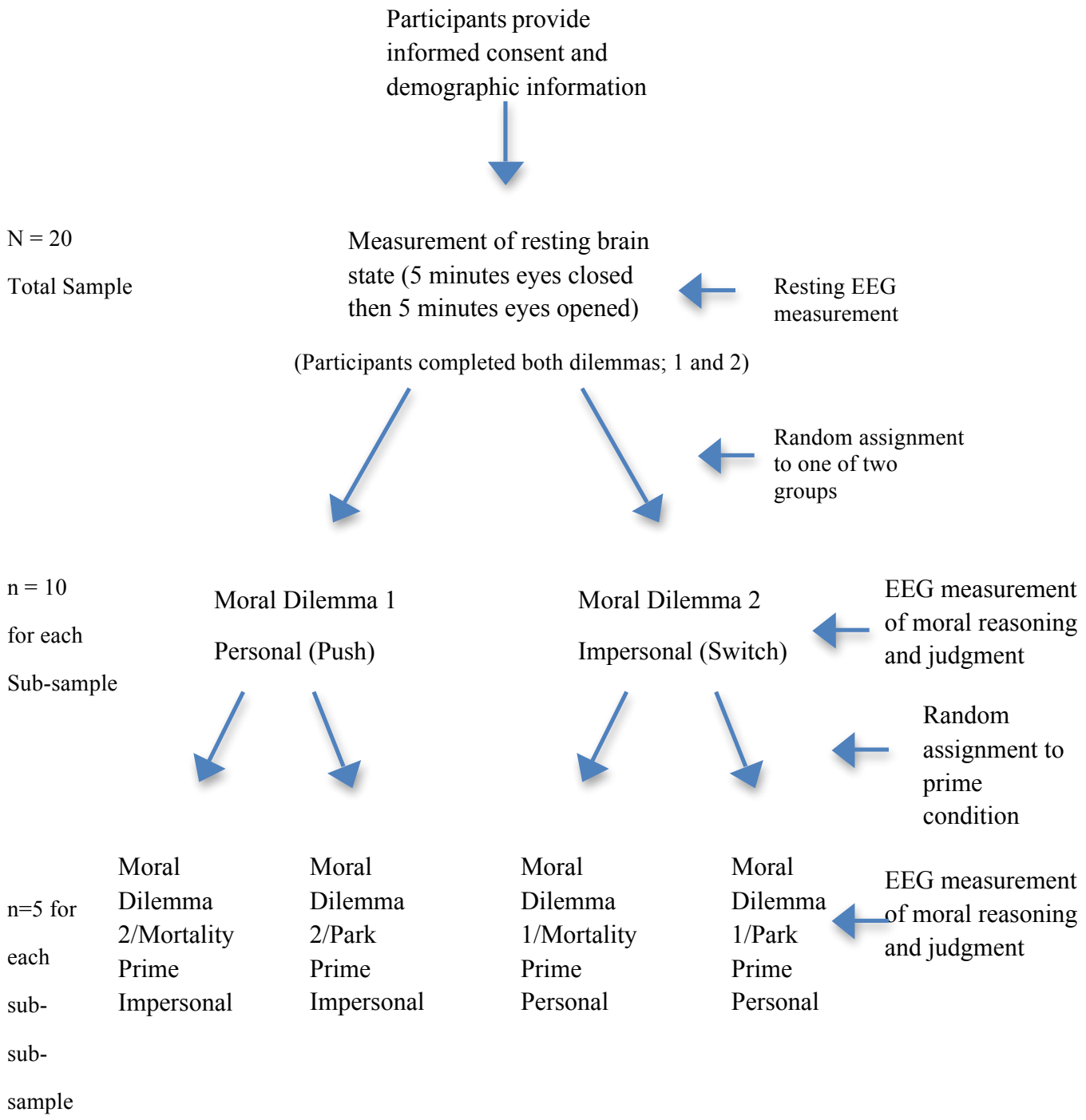


Figure 5. Visual Depiction of Research Design Used

Participants who were interested in volunteering for the study set up an appointment with the author. All appointments were held at a location on the University of Detroit Mercy McNichols campus where the EEG and computer equipment could be accessed. As well, for all appointments, the author was accompanied by an assistant who was there to help with the experimental protocol when needed.

Upon arriving for their scheduled appointment, participants were provided with a brief description of the purpose and method of the study and the consent form was reviewed. After answering any questions, participants then completed and signed the informed consent form and the background survey. Next, participants were fitted with the electrocap and then instructed to face a computer screen on which a PowerPoint slide presentation was shown. The initial slides simply instructed participants to sit in a relaxed state, first with eyes closed for five minutes, then with eyes opened for another five minutes, so that resting brain activity could be measured. For the eyes open condition, participants were instructed to look at a dot that appeared on the center of the computer screen. During this time, EEG output was checked for evidence of problems with impedance or excessive artifact. If there was evidence of problems, the experimenter made adjustments accordingly (e.g., if participant was moving, then asking him to remain still). Thereafter, all participants were presented with the first dilemma (either push or switch) which they read off a PowerPoint slide. Half of all participants got the switch dilemma first while the remaining participants got the push dilemma first. Afterwards, participants were presented with the prime condition (i.e., mortality salience versus neutral), followed by the administration of the second trolley dilemma. For both dilemmas, participants were given sufficient time to read the slides and then asked to provide a yes or no response to a question. For the switch dilemma, the

question was “Is it morally acceptable to turn the trolley away from the five and onto the one?”, and for the push dilemma the question was “is it morally acceptable to push the man to save the five people?” After selecting either a “yes” or “no” as an answer for the moral dilemmas, participants were then asked to provide a rating on the moral reasoning response scale that reflected the reasoning behind their answer. Once the two moral dilemma conditions were completed and responses recorded, EEG recording was stopped and the electrocap was removed and cleaned for use with the next participant. In total, it took approximately one hour to complete data gathering with each participant.

Chapter 4

Results

Prior to running any analyses, raw EEG recordings for each part of the research protocol (i.e., eyes closed, eyes opened, and both moral dilemma conditions given pre-and post prime) were evaluated and scored using NeuroGuide (version 2.8) QEEG software developed by Applied Neuroscience, Inc (http://www.appliedneuroscience.com). In particular, data were screened for evidence of artifact and cleaned where artifact seemed apparent. Cleaning entailed removing the problematic part of the EEG recording so that only artifact-free data remained. Thereafter, absolute power (measured in microvolts squared) for all spectral frequencies (i.e., theta, delta, alpha, beta) for the selected electrode sites of interest (i.e., Fp1, Fp2, F3, F4, and Fz) was calculated for each study condition separately. Next, after consulting with an expert in QEEG (Thatcher, personal communication), absolute power values were summed across all spectral bands to produce a total absolute power score for each electrode for each study condition separately. Finally, total absolute power scores for electrodes used to designate VMPFC (i.e., F3, F4, Fz) and DLPFC (i.e., Fp1, Fp2) respectively were averaged to generate a total mean absolute power score for the two brain regions for each of the study conditions.

Frequencies and Descriptive Statistics

Table 1 presents the frequencies of responses to the moral dilemmas along with means and standard deviations for moral reasoning ratings. Table 2 provides descriptive statistics for mean absolute power in both VMPFC and DLPFC for all study conditions.

Table 1

Frequencies and Descriptive Statistics for Moral Judgment and Moral Reasoning Across Moral Dilemma Conditions

	Before Prime (n=10)	After Prime		
		Mortality Prime (n= 5)	Neutral Prime (n= 5)	Total After Prime (n= 10)
Push (Personal) Dilemma				
Is it morally acceptable to save the five people by pushing the stranger to his death? (Yes or No)	Yes= 0 No= 10	Yes= 0 No= 5	Yes= 1 No= 4	Yes= 1 No= 9
Rating of Moral Reasoning (Mean/SD)	2.70/1.77	2.00/1.58	1.60/1.52	1.80/1.47
Switch (Impersonal) Dilemma				
Is it morally acceptable to turn the trolley away from the five and onto the one? (Yes or No)	Yes= 3 No= 7	Yes= 1 No= 4	Yes= 2 No= 3	Yes= 3 No= 7
Rating of Moral Reasoning (Mean/SD)	4.40/3.03	4.60/2.70	4.00/2.74	4.30/2.58

Note. For Moral Reasoning, lower scores reflect greater deontological reasoning while higher scores reflect greater utilitarian reasoning

Table 2

Mean Absolute Power for Ventral Medial Prefrontal Cortex (VMPFC) and Dorsal Lateral Prefrontal Cortex (DLPFC) for All Study Conditions

	VMPFC		DLPFC	
	Mean	SD	Mean	SD
Baseline Eyes Closed (N= 20)	78.79	46.08	85.42	74.78
Baseline Eyes Opened (N= 20)	82.52	63.64	113.04	71.91
Total Push Dilemma (N=20)	87.92	113.11	163.21	109.97
Total Switch Dilemma (N=20)	84.01	80.88	187.80	144.10
Pre-Prime Dilemma				
Push (n= 10)	64.06	41.78	123.65	74.62
Switch (n= 10)	99.66	104.32	221.23	161.45
Pre-Prime Overall Total (N= 20)	81.86	79.47	172.44	132.25
Post-Prime Dilemma				
Push with Mortality (n=5)	156.92	215.69	177.66	75.79
Push with Neutral (n= 5)	66.65	48.80	227.90	172.53
Total Push Post-Prime (n= 10)	111.79	154.91	202.78	128.39
Switch with Mortality (n= 5)	88.45	59.13	212.63	150.59
Switch with Neutral (n= 5)	48.26	29.22	96.10	56.87
Total Switch Post-Prime (n= 10)	68.35	48.81	154.36	123.65
Post-Prime Overall Total (N= 20)	90.07	113.98	178.57	125.17

Note. Absolute Power measured in microvolts squared (μV^2).

This section of the results chapter is organized so as to report analyses aimed at testing each of the four hypotheses made. In all cases, the hypothesis is first given and stated verbatim as it appears in chapter 2. Thereafter, the type of analysis and results found are given along with a statement as to whether or not the findings provide support for the hypothesis.

Hypothesis 1. Type of moral dilemma would be associated with different types of moral judgments. Specifically personal dilemmas (e.g., push dilemma) would produce significantly higher deontological judgments while impersonal dilemmas (e.g., switch dilemma) would produce significantly higher utilitarian judgments.

In order to test this hypothesis, two different sets of analyses were completed. First, using the moral judgment variable in which participants provided a "yes" (i.e., "yes it is morally acceptable", considered to be reflective of utilitarian judgment by Greene, 2013) versus "no" (i.e., "no it is not morally acceptable", deemed reflective of deontological judgment by Greene, 2013) response to each type of moral dilemma, chi-square goodness of fit tests were done for the total personal/push dilemma and the impersonal/switch dilemma separately (i.e., responses for pre versus post-prime and type of prime were combined) using data from all participants (N=20). For the personal/push dilemma, chi-square emerged significant ($\chi^2(1)= 16.20$, $p<.001$) with 19 participants providing a "no" response and only 1 providing a "yes" response (expected frequency used for the analysis was 10 for both response categories). This finding is consistent with expectation. For the impersonal/switch dilemma, chi-square was not significant ($\chi^2(1)= 3.20$, $p=.07$) with 14 participants giving a "no" response and 6 providing a "yes" response (expected frequency used for the analysis was 10 for both response categories). Though the non-significant finding does not provide

clear support for the hypothesis, the greater frequency of "yes" responses relative to the personal/push dilemma is in the direction that is generally in line with the research expectation.

To determine if the frequency of responses across the impersonal/switch and personal/push dilemmas are significantly different, a 2 (yes/no) x 2 (yes/no) chi-square test of independence was conducted and was found to be non-significant ($\chi^2(1)= 0.45$, $p= .50$). The contingency table for this analysis can be found in Table 3. This finding indicates that the frequency of "no" versus "yes" moral judgment responses did not significantly differ across the two moral dilemmas. Examination of frequencies suggests that regardless of the type of moral dilemma, the majority of participants gave a response of "no."

Table 3
Contingency Table for Chi-square Test of Independence for Hypothesis 1

	Impersonal/Switch		
Personal/Push	No	Yes	Total
No	13	6	19
Yes	1	0	1
Total	14	6	20

Note. $\chi^2(1)= 0.45$, $p= .50$

The second analysis employed to test hypothesis one involved the use of the moral reasoning variable (i.e., rating on 11 point scale with deontological anchor at low end and utilitarian anchor at high end). In particular, a paired samples t-test was used to compare the mean rating for moral reasoning responses for the impersonal/switch dilemma to the mean rating for moral reasoning responses for the personal/push dilemma across all study conditions for all participants (N=20). The statistic came out significant ($t(19)= 3.05$, $p=.007$;

mean rating for impersonal/switch= 4.35 [SD= 2.74], mean rating for personal/push= 2.25 [SD= 1.65]). This finding indicates that on average, participants gave significantly higher (i.e., more utilitarian) responses to the impersonal/switch dilemma, a result which is consistent with the hypothesis. With that stated, it should be noted that the mean response for both moral dilemmas falls on the lower half (deontological) of the response scale. Consequently, it could be argued that regardless of type of dilemma, deontological considerations were given greater weighting by participants when making moral judgments.

Hypothesis 2. Different types of moral judgments would be associated with elevated activity in total power in specific areas of the frontal lobes. Specifically, the DLPFC would show higher power level for utilitarian judgments and the VMPFC would show higher power level for deontological judgments.

In order to test this hypothesis, the original analysis plan focused on the use of a test of group differences (e.g., ANOVA). However, as can be observed from the moral judgment response frequencies reported above, there are simply too few participants who provided responses falling in both response categories (i.e., "yes" for utilitarian and "no" for deontological) for both moral dilemmas to permit for the robust use of such statistics. For instance, across all 40 ratings for both moral dilemmas given by all participants, there are only 7 yes/utilitarian responses while there are 33 no/deontological responses. On a similar note, participant ratings on the moral reasoning variable that used the 11-point response scale produced mean scores falling below the mid-point of the scale (i.e., means less than 5). In addition, examination of frequencies of responses given to the moral reasoning variable revealed that only one out of 20 participants gave a response greater than 5 for the personal/push dilemma and only five out of 20 participants did so for the impersonal/switch

dilemma. As a result, the use of this variable to create deontological and utilitarian groups via a mean or median split did not seem defendable as it could be readily argued that the utilitarian group is mostly if not entirely comprised of participants who actually relied more upon deontological rather than utilitarian reasoning to arrive at their moral judgment

Consequently, in lieu of the originally planned analyses, the author decided to use product-moment correlation. In particular, correlations were calculated between the moral judgment and reasoning variables and VMPFC and DLPFC mean absolute power scores for the personal/push and impersonal/switch dilemmas, respectively. As far as the hypothesis is concerned, it was expected that VMPFC scores would generate negative correlations with both the moral judgment (responses of "no" reflective of deontological judgment were coded 0, responses of "yes" coded 1) and moral reasoning variables (lower scores reflective of deontological reasoning) while DLPFC scores would produce positive correlations with both the moral judgment (responses of "yes" reflective of utilitarian judgment coded as 1, responses of "no" coded 0) and moral reasoning variables (higher scores indicative of utilitarian reasoning). Since the power of significance tests with correlations is heavily influenced by sample size, less attention was given to p-level and more weighting given to the strength of the coefficients. As such, hypothesized correlations were expected to be of at least medium (.30 or higher) magnitude. Table 4 presents the correlations. To determine if the correlations of the moral judgment and reasoning variables with VMPFC and DLPFC computed with the total sample (N= 20) were significantly different, Steiger's z was computed. Steiger's z is a statistic that permits the testing of difference between dependent correlations (Steiger, 1980). It was only calculated for total sample correlations as it cannot be computed with n=10.

Table 4
Product-moment correlations between moral judgment and reasoning variables and mean absolute power scores for Ventral Medial Prefrontal Cortex (VMPFC) and Dorsal Lateral Prefrontal Cortex (DLPFC) and Steiger's Z for testing significance of dependent correlations

	Moral Judgment-Personal/Push	Moral Reasoning-Personal/Push	Moral Judgment-Impersonal/Switch	Moral Reasoning-Impersonal/Switch	Steiger's Z
Moral Dilemma-Personal/Push (All conditions) VMPFC (N= 20)	.14 (p= .570)	.21 (p= .382)	---	---	-0.18 (p= .855)
Moral Dilemma-Personal/Push (All conditions) DLPFC (N= 20)	.70 (p= .001)	-.23 (p= .326)	---	---	2.76 (p= .006)
Moral Dilemma-Impersonal/Switch (All conditions) VMPFC (N=20)	---	---	.24 (p= .313)	.36 (p=.116)	-0.59 (p= .553)
Moral Dilemma-Impersonal/Switch (All conditions) DLPFC (N= 20)	---	---	-.05 (p= .832)	.41 (p= .073)	-2.23 (p= .025)
Steiger's Z	-2.75 (p= .006)	1.84 (p= .065)	1.91 (p= .055)	-0.36 (p= .722)	
Moral Dilemma-Personal/Push (Pre-prime only) VMPFC (n= 10)	N.C.	.11 (p= .765)	---	---	
Moral Dilemma-Personal/Push (Pre-prime only) DLPFC (n=10)	N.C.	.07 (p= .850)	---	---	
Moral Dilemma-Impersonal/Switch (Pre-prime only) VMPFC (n= 10)	---	---	.56 (p= .090)	.56 (p= .094)	
Moral Dilemma-Impersonal/Switch (Pre-prime only) DLPFC (n= 10)	---	---	.28 (p= .428)	.82 (p= .003)	
Moral Dilemma-Personal/Push (Post-prime only) VMPFC (n= 10)	.09 (p= .798)	.43 (p= .220)	---	---	
Moral Dilemma-Personal/Push (Post-prime only) DLPFC (n=10)	.79 (p= .007)	-.31 (p= .388)	---	---	
Moral Dilemma-Impersonal/Switch (Post-prime only) VMPFC (n= 10)	---	---	-.40 (p=.258)	-.06 (p= .865)	
Moral Dilemma-Impersonal/Switch (Post-prime only) DLPFC (n= 10)	---	---	-.49 (p= .150)	-.20 (p =.576)	

Note. For moral judgment variables, 0= no response, 1= yes response. For moral reasoning variables, lower scores reflective of greater levels of deontological reasoning and higher scores reflective of higher levels of utilitarian reasoning. Cells with three dashes= correlation not applicable. N.C.= Not Calculable due to the fact that all participants responded the same ("no" response) to the moral judgment personal/push variable. Correlations cannot be calculated when variable is a constant. Steiger's Z, cannot be computed using only n=10.

Examination of the correlations computed with the total sample reveals two correlations that are consistent with expectation; the correlation between moral judgment personal/push and DLPFC absolute power across all conditions (r= .70, p= .001). This correlation was found to be significantly different from the coefficient obtained between VMPFC and moral judgment personal/push (Steiger's Z= -2.75, p= .006). The second was the correlation between moral reasoning impersonal/switch and DLPFC across all conditions (r= .41, p=.073). For correlations calculated with pre-prime responses only (n= 10), only the correlation between moral reasoning impersonal/switch and DLPFC came out in line with expectation (r= .82, p= .003). For correlations with post-prime responses, the correlation between DLPFC and moral judgment personal/push (r= .79, p= .007) and the coefficient between VMPFC and moral judgment impersonal/switch (r= -.40, p= .258) emerged in a manner consistent with what was hypothesized.

Hypothesis 3. Disruptive affect caused by priming of mortality salience would influence type of moral judgment with significant reductions in utilitarian judgments and significant increase in deontological judgments for both personal and impersonal moral dilemmas.

To test this hypothesis, a comparison of the frequencies of pre-to-post moral judgment responses was completed for participants exposed to the mortality salience priming condition (n= 10) across both personal/push and impersonal/switch dilemmas using chi-square test of independence. Also, since the hypothesis implies that there would be a difference in moral judgment across type of prime, a second chi-square test of independence was done to see if frequency of type of moral judgment differed across the mortality salience versus neutral prime. The contingency tables for these analyses can be found in Tables 5 and

6. As can be seen in the tables, while there was a slight change in the frequencies in both analyses in the direction

Table 5

Contingency Table for Chi-square Test of Independence Testing Pre-post Mortality Salience Prime Influence on Moral Judgment as per Hypothesis 3.

	Pre-Post Mortality Salience Prime		
	Pre	Post	Total
No/Deontological	8	9	17
Yes/Utilitarian	2	1	3
Total	10	10	20

Note. $\chi^2(1)= 0.73$, $p>.05$

Table 6

Contingency Table for Chi-square Test of Independence Testing Influence of Mortality Salience Versus Neutral Primes on Moral Judgment as per Hypothesis 3.

	Type of Prime		
	Mortality Salience	Neutral	Total
No/Deontological	9	7	16
Yes/Utilitarian	1	3	4
Total	10	10	20

Note. $\chi^2(1)= 1.52$, $p > .05$

Suggested by the hypothesis, both chi-squares were non-significant, indicating that the mortality salience prime did not have a significant influence on type of moral judgment made.

As an alternative approach to testing this hypothesis, moral reasoning ratings pre- and post- mortality salience prime were compared using a paired sample t-test. If the mortality salience prime had the effect on moral judgment as per the hypothesis, then it would be expected that the prime would result in significantly lower moral reasoning ratings (reflective of greater deontological reasoning) in the post-prime moral dilemma regardless of type of dilemma. The statistic came out non-significant ($t(9)= -0.31$, $p = .761$; mean rating before prime= 3.30 [SD= 2.50]; mean rating after prime= 3.60 [SD= 2.37]). Given the results of all analyses, hypothesis 3 was not supported.

Hypothesis 4. In the priming condition, mortality salience would be associated with higher absolute power in both the VMPFC and the DLPFC relative to baseline regardless of types of moral dilemmas (personal or impersonal). However, deontological judgments would be associated with higher absolute power in the VMPFC compared to the DLPFC.

To test the first part of this hypothesis, two split plot ANOVAS were completed using a three level within subjects variable (brain activity at eyes opened baseline, pre-prime, post-prime) and a two group between subjects variable (type of prime- mortality salience versus neutral). Separate ANOVAs were run for VMPFC and DLPFC at the three within subjects' time points.

The effect of type of prime was found to be non-significant (mortality salience versus neutral), $F(1,18)=1.21$, $p=.29$ for the VMPFC. Also there was no significant main effect of the absolute power (eyes open, prevmpfc, postvmpfc) in both prime conditions, $F(2,20)= .20$,

p=.82 for the VMPFC. Moreover, there was no significant interaction between the absolute power and type of prime, F(2,20)=1.70, p=.20. These analyses indicate that the absolute power value of the VMPFC across the three conditions (eyes open, pre-prime, post-prime) did not differ significantly in the mortality prime and neutral prime.

For the DLPFC, there was a nonsignificant effect of type of prime (mortality salience versus neutral), $F(1,18)=.15$, $p=.71$. However, there was significant main effect of the absolute power (eye open, prevmpfc, postvmpfc) in both prime conditions, $F(2,20)= 7.18$, $p=.002$ for the DLPFC. Finally, there was no significant interaction between the absolute power and type of prime, $F(2, 20)=.39$, $p=.68$. This tells us that the absolute power value of the DLPFC across the three conditions (eyes open, pre-prime, and post prime) did not differ significantly in the mortality prime and neutral prime.

Due to the paucity of utilitarian judgments given by participants to both moral dilemmas, the latter part of the hypothesis could not be statistically evaluated in a rigorous and robust way.

Chapter 5

Discussion

Overview

The aims of this study were to 1) determine whether different types of moral dilemma (personal vs. impersonal) would result in different types of moral judgments (utilitarian vs. deontological), 2) study the effects of induced anxiety (via reminders of one's own mortality) on moral judgments, 3) test Greene's (2001) theory that associates different areas of the prefrontal cortex with different types of moral judgments, specifically that deontological judgments are associated with increased activity in the ventral medial prefrontal cortex (VMPFC), while utilitarian judgments are associated with increased activity in the dorsolateral prefrontal cortex (DLPFC), 4) examine whether different types of moral dilemmas are associated with increases in absolute power in different parts of the prefrontal cortex, specifically whether deontological judgments increase absolute power in the VMPFC and utilitarian judgments in the DLPFC and, 5) investigate whether induced anxiety would be associated with an increase in absolute power in the VMPFC and the DLPFC as a result of increased cognitive load.

Recent studies in moral psychology are beginning to take advantage of advances in neuroscience, mainly the translational neuroimaging techniques such as fMRI, to examine the role of different brain areas and their contribution to moral reasoning and judgment (Verplaetse, 2009). Dual processing theory proposed by Greene (2001) describes two types of moral judgments associated with different brain areas: utilitarian moral judgments which are associated with increased activity in the DLPFC and are considered to be reflective a

slow/deliberative and rational processes, and deontological moral judgments that are associated with increased activity in the VMPFC and are considered to be reflective of fast and emotional processes. The present study utilized EEG technology to investigate Greene's findings and to study the impact of inducing anxiety via mortality reminders on types of moral judgment and on brain activity in the DLPFC and the VMPFC.

In this chapter, the findings as they relate to each hypothesis, Greene's conceptual model, and the available literature are briefly overviewed. The chapter then focuses on a discussion of the study's limitations and expands on clinical implications of its findings on clinical work and on the role that anxiety plays in clinical decision- making.

Discussion of Hypotheses

Hypothesis 1.The first hypothesis concerned whether type of moral dilemma would be associated with different types of moral judgments. Specifically, it was expected that personal dilemmas (e.g., push dilemma) would produce significantly higher deontological judgments while impersonal dilemmas (e.g., switch dilemma) would produce significantly higher utilitarian judgments. The results indicate that type of moral dilemma is associated with type of moral judgments. Specifically, personal moral dilemmas produced a significantly greater number of deontological judgments, i.e. subjects elected not to push one person in order save five persons from an incoming trolley, while impersonal moral dilemmas produced more utilitarian judgments, i.e. more subjects elected to flip a switch killing one person in order to save five persons from an incoming trolley. The chi-square analysis indicated that the frequency of yes/no responses to the different types of moral judgments was found to be significantly different although not consistent with findings from

other studies about the distribution of yes/no responses to the different types of moral judgments.

The finding that one participant out 20 participants endorsed a deontological response to the personal/push dilemma is consistent with the writer's expectation and with other findings, mainly by Cushman et al (2007) who found after testing thousands of web users that only 11% agreed to push the man. However, for the impersonal/switch dilemma, only 6 out of 20 participants in the present study endorsed a utilitarian response (2 out of those 6 did not report a religious affiliation), a result that is not consistent with the finding by Cushman et al who reported that 89 % percent of web users agreed to flip the switch.

The results of the present investigation seem to indicate that overall individuals were inclined to respond with deontological judgments for both types of moral dilemmas (personal or impersonal) rather than utilitarian judgments. One possible explanation for the results of the first hypothesis might lie in the fact the sample used in the present investigation differs from the samples typically used in the studies of Greene and other researchers. In particular, Muslim participants used in this study outnumbered other religious groups by 8 to 7. Most samples used in previous studies were made of students who were mainly Christians. There is a lack of research that examines how Islamic faith might influence responses to the moral dilemmas.

An aspect of the Islamic tenets that stresses the concept of fate that embodies God’s grand plan might account for the reluctance of Muslims to endorse utilitarian judgments that can be perceived, at least in the context of the moral dilemmas used in this study, as interference in God’s plan (Kuyel, 2009). Additionally, the fact that in both dilemmas the

person that participants are asked to ponder killing to save five is an innocent bystander might explain the reluctance of participants identifying with the Islamic faith to endorse killing the individual person. The possible reason for that can be related to the strong prohibition in Islam toward killing innocent persons where it is considered to be equivalent to killing a thousand innocent people. Moreover, Young et al (2013) found that Christian fundamentalists relied more on religious rule-based moral processing and judgments. Rule based moral processing involves the unambiguous application of established moral codes, prohibitions, and rules. Thus, religious rule based moral processing appears to be more deontological, less flexible, and less utilitarian. Additionally, Christensen et al (2012) found the Catholic subjects were more inclined to respond deontologically and that "moral judgment can be influenced by an acquired set of norms and conventions transmitted through religious indoctrination and practice" (p. 240). Though this study did not ask subjects to report on their degree of religiosity, it is possible that subjects used in this study that identified with the religions of Islam and Christianity were highly religious and thus were likely to have been applying religious rule-based moral processing.

Thus, this study did not confirm Greene's findings about the percentages of participants that would respond in a utilitarian fashion to the impersonal dilemma and in a deontological fashion to the personal dilemma. Given that the sample used in this study had 8 Muslims and was conducted in a Catholic university, it seems that the overall sample used in this study is different from the ones used in Greene's research. Thus, it is a possible that Greene's findings about the distributions of percentages of utilitarian versus deontological judgments are not generalizable beyond the type of samples he has used. Additionally, this study as opposed to Greene's**,** used a moral reasoning rating scale to assess the degree to

which subjects attributed their yes/no responses to deontological vs. utilitarian reasons. The 11-point response scale ranged from 0 to 10. The zero-end of the scale had a descriptive anchor that was designed to reflect deontological reasoning (i.e., “Life of an individual is sacred and has value regardless of the total happiness of others”). At the other end of the response scale, a descriptive anchor was used to reflect utilitarian reasoning (i.e., “The sum happiness of five people overrides that of one person”). Responses at the extreme of the scale were interpreted as reflecting the influence of only one form of moral reasoning while responses falling in the mid-range values of the scale were interpreted as suggesting the both deontological and utilitarian reasoning processes were used to arrive at the moral judgment made in each dilemma. The finding that subjects’ average moral reasoning rating for both types of moral dilemmas (switch vs. push) fell mostly on the deontological end of the response scale i.e., “life of an individual is sacred and has value regardless of the total happiness of others” is reflective of the deontological bent of the sample used in this study. Thus, the heavy reliance of the subjects in this study on deontological reasoning may be explained because the sample is dominated by individuals identifying with Islam or Christianity as their religion. Moreover, the finding that even when subjects were utilitarian in their responses (yes/no) their moral reasoning ratings were toward the deontological extreme seems to support Haidt’s (2012) assertion that moral judgments comes first and that rationalizations of such judgments occur after the fact.

Hypothesis 2.The second hypothesis investigated whether different types of moral judgments are associated with elevated activity in total absolute power in specific areas in the prefrontal cortex. Specifically, it tested Greene's (2001) finding that moral judgment reflected the operation of two distinct neuropsychological processes: the first is fast, emotional, and

intuitive and is associated with increased activity in the ventromedial prefrontal cortex (VMPFC) and is reflective of deontological judgments, while the second is slow, deliberative, and rational and is associated with increased activity in the dorsolateral prefrontal cortex (DLPFC) and is reflective of utilitarian judgments.

The results indicate that overall moral judgment for the personal/push dilemma was significantly correlated with the total absolute power in the DLPFC across all conditions. Moreover this correlation was significantly different from the absolute power in the VMPFC and the moral judgment personal/switch. However, for the impersonal/switch reasoning, only pre-prime responses were correlated with the total absolute power in the DLPFC. The results of post-prime condition indicate that there is a correlation between DLPFC and the moral judgment in the personal/push condition and there is a correlation between the VMPFC and the moral judgment in the impersonal/switch condition.

Thus, hypothesis 2 testing indicates that for the moral judgment personal/switch, the absolute power in the DLPFC was positively correlated with the judgments across both prime conditions. That is, the level of absolute power in the DLPFC was found to increase in response to making moral judgment to the personal/push dilemma in the pre and post prime condition, while the same did not hold for the VMPFC. This indicates that subjects seemed to show more deliberative work and processing when responding to personal dilemmas.

While increased absolute power was found at electrode sites designated to represent the DLPFC for pre and post primes, increased activity was not noted at electrode sites assigned to represent the VMPFC for pre and post-primes. To explain why the second hypothesis was not supported, we need to examine the results of this hypothesis in terms of

the results obtained from the first hypothesis. In particular, not finding results in the first hypothesis that are consistent with Greene's findings may explain not getting significant results in support of the second hypothesis. The testing of the second hypothesis did not show a significant difference in the activation of VMPFC versus DLMPC in the push Dilemma (deontological judgments) versus the Switch Dilemma (utilitarian judgments) possibly because the sample tested in this study did not exhibit that great of a difference in performance in terms of utilitarian versus deontological judgments in response to the switch and push dilemmas. The sample tested in this study was highly deontological in outlook as the testing of the first hypothesis showed. Greene's finding of different activation in the DLPFC versus the VMPFC via fMRI makes sense given his finding of significant differences in performance in his sample between the two dilemmas. Thus, the deontological outlook of the sample tested in this study could possibly explain the failure of finding the same differential activation between the VMPFC and the DLPFC found in Greene's fMRI study.

However, the finding in this study that there is a correlation between absolute power in the DLPFC for both types of moral judgment across both condition (pre and post) is a significant result that deserves further attention. This finding seems to contradict Greene's results and view of two distinct ways of making moral judgments: intuitive one reflective of increased activity in the VMPFC and a more reflective/rational one reflective of increased activity in the DLPFC. To explain the difference between Greene's finding and this study's findings it is important to examine how fMRI studies work. FMRI measures relative determinations of activation by subtracting brain activation in one condition from brain activation in a second condition. Thus, a large utilitarian response for the impersonal dilemma will show activation in the DLPFC that is significantly different from the activation

of VMPFC (and vice versa for a large deontological response in the personal dilemma condition). This study's utilization of EEG technology does not apply the same subtraction of activation across the different conditions and thus the DLPFC is found to be activated by deontological judgment as the VMPFC is also activated by utilitarian judgments measured by absolute power.

Furthermore, emotion and thinking may be involved in all forms of moral judgments. In this study it seems that both types of moral judgments (utilitarian and deontological) reflect the operation of brain processes and activities that rely on rational/deliberative thinking irrespective of the type of judgment subjects made. Thus, Greene's assertion that utilitarian judgments were the only types of judgment that reflect rational and deliberative processes does not appear to be completely accurate as these same processes were evident in this study even when individuals endorsed deontological judgments. The subtraction method used by Greene might be argued as suppressing the role of both types of moral judgment processes (i.e., fast versus slow) and resulting in him making claims that one type of moral judgment only involves one type of thinking (and associated brain activation). This study has shown that the DLPFC is involved in deontological judgments as well as in utilitarian judgments, thus indicating that Greene's assertion that deontological judgments are reflective of VMPFC activation may need to be reconsidered.

It appears that the results for the second hypothesis are more congruent with Haidt's (2012) theory about moral judgment. Haidt proposed that moral judgments are mainly reflective of gut feelings and intuitive responding and that reasoning was a post hoc process that comes later to help justify/rationalize the decision already made. Thus, the finding of increased activation in the DLPFC even when subjects were predominantly making

deontological judgments could be reflective of subjects trying to rationalize their decisions after it has already been made. The results of this study are also supported by the additional finding that subjects that responded in a utilitarian manner by saying yes to both types of dilemmas still responded in deontological terms when giving their ratings of the reasons behind their yes/no response (where for moral reasoning lower scores reflected deontological reasoning and higher scores reflected utilitarian reasoning). The fact that the sample was predominantly Muslims, who can be argued to rely on rule-bound religious reasoning processes to arrive at moral judgments, might indicate that moral reasoning ratings reflect the influence of religious belief on judgments and on ratings of moral reasoning.

In so far as the findings of the present study are valid, it appears that the separation of moral judgments into two types that are reflective of different brain regions and processes needs to be questioned. Greene (2004) has endorsed a view of moral judgment/reasoning processes that borrows most of its theoretical foundations from recent work and findings about the brain (e.g., Kahneman, 2001) that there are two systems in the brain involved in decision making; a fast system that is intuitive, emotional, and heuristic, and a slow system that is logical and deliberative. The demarcation of fast and slow systems is used by Greene to demarcate different brain responses for moral judgments. It is possible that such separation of fast and slow systems in moral judgment making may be an oversimplification that is not warranted and that both systems are involved in moral judgment irrespective of the types of moral dilemmas. Moral judgment skill acquisition might be quite different from cognitive skills. In acquiring a cognitive skill that one first exerts conscious and deliberate effort to learn and apply the rules associated with the skill, and as one masters the skill, the skill becomes more automatic and in need of less conscious and deliberate effort to apply or

access. Thus, it is possible that moral reasoning of any type relies on both emotional and rational resources and is different from learning other cognitive skills. It is also possible that moral judgment relies on fast heuristic judgments that are affected by the emotional factors, such as type, quality, and valence, as Prinz (2015) concluded in his review of the role emotions play in moral judgments**,** where he found significant support to the idea that moral judgments are always grounded in emotions.

Furthermore, the specificity of the selected electrodes to tap the specific brain areas that this study examined, mainly the DLPFC and the VMPFC, should be evaluated as a possible limitation. EEG measures brain activity from the surface that also includes activity from the scalp. According to Matre and Tran (2009), some type of guess is involved when researchers attempt to localize brain activity from the recorded electric fields. Such guesses also include guess about current source locations. Moreover, brain activity recorded via EEG is susceptible to the conductivities of the skull and scalp and thus can be contaminated.

Finally, the sample investigated in this study included 5 individual who reported being on some type of medication. Research has shown that certain types or classes of medications appear to affect/alter brain waves (Garrido et al, 2016). It is possible that the lack of support for this hypothesis was partly due to the effect of having 5 subjects (25% of the sample) taking some type of medication. However, since no information on what kinds of medication subjects were taking at the time of the study, it becomes difficult to assert what role did medication played in this study's findings.

Hypothesis 3.The third hypothesis investigated the impact of increased cognitive load in terms of disruptive emotions on moral judgments. Specifically, it was hypothesized that coping with death anxiety would increase cognitive load and would be associated with

reduction in utilitarian judgments and an increase in deontological judgments for both types of moral dilemmas. The results indicate that while introducing the mortality salience prime did produce a slight change in subjects' ratings in a direction consistent with the hypothesis (i.e., there is a slight increase in the frequency of deontological judgments post-prime and a slight decrease in the frequency of utilitarian judgments post-prime), nonetheless the results were not significant. Thus, introducing the mortality prime did not markedly affect the type of moral judgments made.

There are a variety of potential reasons for why the results did not confirm this hypothesis. First, the results testing the first hypothesis; where 19 out of 20 participants responded deontological to the personal dilemma; made it very difficult to get a significant effect even if the last person who in the pre-condition responded in a utilitarian fashion did change his response into a deontological one post-condition. Furthermore, this study had only 6 utilitarian responses to begin with, getting a significantly smaller utilitarian result in the impersonal dilemma as an effect of the mortality salience was unlikely given the low frequency of utilitarian responses for the impersonal dilemma. Thus, the strong deontological direction of the sample of this study could explain the failure of finding a trend indicating that mortality salience introduction increased the frequency of deontological judgment. The above also holds when taking into consideration subjects' moral reasoning rating which tended to be in the deontological extreme even when subjects endorsed utilitarian judgments /response.

Another possibility that could explain the findings and lack of support for this hypothesis concerns Greene's assumptions about deontological and utilitarian judgments based upon yes/no response to the trolley dilemmas. Simply put, his assumptions might be

wrong. The fact that most participants in the present study were closer in to the deontological pole of the justification scale (which stated, "the life of an individual is sacred and has value regardless of the total happiness of others") raises questions about Greene's assumptions. This result is not consistent with Greene's (2012) assertion that endorsing a "yes" response to either dilemma is reflective of a utilitarian judgment while endorsing a "no" response to either dilemma is reflective of a deontological judgment. The findings of this study with respect to a lack of support for the third hypothesis indicates that there may be a need to question Greene's philosophical assumptions that are a priori in nature and not grounded in Greene's findings. It is possible that the findings of testing this hypothesis indicate that there is no "pure" type of moral reasoning and moral judgment and that different reasoning processes may come to bear on both utilitarian and deontological reasoning/judgments.

Barrouillet (2011) for instance cautioned that the dual processing theory of decision making in general and moral decision making in particular discounts developmental process that might bear on both systems (i.e., the intuitive system and the deliberate rational system). Thus, it is possible that the processes of the intuitive system reflect the unfolding of old/unconscious evolutionary processes that are not amenable to developmental change and maturation. Alternatively, processes in the other system that are associated with the cognitive/deliberative and working-memory aspects of cognitive functioning are affected by maturational and developmental processes that allows for them to evolve with age and become more evident in both systems. Thus, it seems that the dual-process theory of morality as Greene proposes it might have given inadequate consideration of developmental questions that could bear on the importance of reasoning/deliberative processes on both the deontological and utilitarian reasoning/ judgments.

Hypothesis 4. The fourth hypothesis was concerned with the extent to which mortality reminders would be associated with higher absolute power in both the DLPFC and the VMPFC. Specifically, higher absolute power was expected in the post-prime condition in the DLPFC compared to the absolute power in the pre-prime and eye opened baseline conditions and higher absolute power was expected in the post-prime condition in the VMPFC compared to the absolute power in the pre-prime and eye opened baseline conditions. Results of analyses completed did not provide support for this hypothesis. The main finding was that absolute power did not differ significantly in the DLPFC and the VMPFC post-prime compared to the absolute power in the pre-prime and eyes opened baseline conditions.

The results of testing the fourth hypothesis indicates that absolute power did not differ significantly in the DLPFC and the VMPFC post-prime compared to the absolute power in the pre-prime and eyes opened baseline conditions. This result is not surprising given the results of testing hypothesis 1 and 2. The sample tested in this study is deontological in its outlook and such deontological outlook seems to have affected the activation of the VMPFC and DLPFC in both moral conditions. The failure of this study to establish a differential in activation between the DLPFC and the VMPFC (a differential found by Greene) made it difficult to test the fourth hypothesis. Testing the effect of mortality salience on the activation of the DLPFC and the VMPFC needed the establishment of a differential in activity between the DLPFC and the VMPFC: i.e., it needed hypothesis 2 to show that as Greene predicted the DLPFC was highly active when individuals endorsed utilitarian responses and vice versa the VMPFC was highly active when individuals endorsed deontological judgments.

It would be worthwhile to replicate this study with a sample resembling the one Greene used in order to test whether establishing the same frequency distribution, as Greene's, would yield different results than what this current study found.

Scientific and Clinical Implications

This study had three main goals in terms of potential contribution to moral psychology; first, this study utilized EEG technology as a complement to the use of fMRI regarding the study of moral dilemmas pioneered by Joshua Greene. Second, it introduced mortality salience as an experimental condition to examine whether such an introduction would affect the responses to the "personal" and "impersonal" moral dilemmas. Third, the inclusion of moral reasoning rating scale along with the moral judgments as a way to assess factors affecting subjects' moral judgments.

This study has theoretical and clinical implications. Theoretically, the study provides some support for previous findings about the response pattern for the two trolley dilemmas. Nonetheless, this study casts doubt on the theoretical soundness of dual process theory of moral judgment. The assumption that Greene made about the meaning of the responses to both dilemmas is in need of further testing and clarification. Assigning philosophical meanings to people's responses to different moral dilemmas seems to need more elaboration and clarification. Thus, there is a need to study the justifications people use for their responses as this study attempted to do.

Moreover, the view that deontological judgments are associated with more processing in the VMPFC and are also reflective of an inferior and intuitive mode of processing also needs questioning. This study did not find greater activation in the VMPFC when subjects

made deontological judgments. Greene seems to have utilized evidence of neural processing in different brain regions as indications of two different types of moral judgment that are, according to him, fairly distinct and separate in terms of brain processes and regions and in terms of evolutionary development. Greene endorses the belief that moral decision-making based on utility and impassionate calculation is superior to moral decision-making that is based on abstract principles as he himself stated " and yet as we, with our overgrown primate brains, can grasp the abstract principles bend's nature's machine and make them our own. On these pastures, something new is growing under the sun: a global tribe that looks for its own members, not to gain advantage over others, but simply because it's good." (p.353, 2013) The philosophical assumptions of deontological and utilitarian schools of moral decision-making are projected to give meaning to brain processes and activity in Greene's theory. Thus, Greene made the assumption that when people responded with a "yes" to both dilemmas they were making utilitarian judgments and when they responded with a "no" to both dilemmas they were making deontological judgments. However, this study's inclusion of a moral rating scale appears to indicate that individuals reasoning did not correspond to their judgments given Greene's definition of these two types of judgments. Thus, Greene according to Nagel (2003) did not "limit himself to factual claims. He also asks how our moral belief and attitudes should be affected by these psychological findings."(p.2) Clearly, further research and collaboration is needed between psychology, neuroscience, and even philosophy to provide solid theoretical foundation of recent findings in moral psychology.

An important implication of this study has to do with the challenging the claims made by Greene regarding a clean and simple distinction between the VMPFC and the DLPFC in terms of their contribution to different types of moral judgments reflective of two different

cognitive systems: fast versus slow. EEG technology has the advantage of showing that activation in one area (whether the DLPFC or the VMPFC) is associated with activation of the other and that both the DLPFC and the VMPFC are connected to other brain areas and regions (Hare et al, 2014). Thus, EEG results from this study might suggest that the contrast and subtraction method utilized by fMRI research may paint a simplistic picture of what could be a more complex dynamic and interplay between the DLPFC and VMPFC and even other brain regions when making moral judgments.

Additionally, one important implication of this study regards the use of EEG technology. EEG technology with its high temporal resolution and with its ability to measure direct activation in brain regions is a good complement fMRI research. Neuroscience yields better results when very different technologies are utilized to address research questions. The results of neuroscientific studies are on solid grounds when they are open to different brain measuring technologies that correct or redirect theories assumed in their use.

Finally, from the clinical theoretical perspective, the existence of two types of moral judgments (deontological vs. utilitarian) depending on the type of moral dilemmas (personal vs. impersonal) open the door to investigating how clients' clinical presentations reflect struggles with daily life decisions involve in one way or another personal or impersonal stakes. Clients often present clinical pictures of inner turmoil and a clinician's understanding of the differences between personal vs. impersonal struggles and predicaments may help them better tailor their interventions so that they reflect accurately the intensity felt by clients. Additionally, one aim of this study was to test Greene's assumption that moral decision-making reflects the operation of two distinct brain processes and areas: the emotional/heuristic system and the rational/deliberative system. Greene's dual processing

theory of moral judgment parallels and borrows from recent findings in psychology about the existence of fast and slow systems in decision-making. As this study did not find support of Greene's theory of a dual system, it is more likely that both emotional and rational processes are implicated in moral decision-making. Clinical psychology in the last 30 years has been affected by such a distinction**,** as the cognitive and behavior therapies (CBT) encourage clinicians to focus their efforts on helping clients to strengthen the rational/deliberative processes and to challenge what they call the impulsive/emotional processes.

Limitations and Future Directions

There are several limitations to the present study that should be considered. First limitation concerns the sample used. The study had a sample that was predominantly Muslim and Christians (mainly Catholics) and thus the possibility that religiously affiliated individuals rely on rule-religion based reasoning to make moral judgments limits the generalizability of the results. Future studies need to assess not only for religious affiliation but also assess for degrees of religiosity. Second, the sample size used in the present study was small. Some of the non-significant results, particularly those involving parametric statistics like correlations and ANOVAs, may be the product of low statistical power. Also, the type of sample used (university students with a high representation of Muslims) places limitations on the generalizability of the findings to the American population as a whole.

Third, it remains a big question whether the stimulus (trolley dilemmas) used in this study to solicit moral decision-making and responses can be generalized to real life moral decision-making. Thus, findings from this controlled lab study need to be considered before being applied to "real life" settings outside of the laboratory. Moreover, this study's lack of

information on how religious affiliation, political identification, gender, and age affect moral judgment is a limitation of this study. Future studies should assess how religious affiliation, political affiliation, gender, and age interact and affect the pattern of moral responding. For instance Antonenko Young et al (2013) showed that religious and political ideologies were substantially overlapping in the United States and both were associated with the use of rule-based moral processing when responding to abstract moral dilemmas. Additionally, future studies should include questions about types of medications subjects are taking and their possible role in altering brain waves.

The fact that this study focused only on four electrodes associated with the prefrontal cortex and did not obtain brain activity information for the other 15 electrodes might have produced a sampling of brain activity that does not help with better understanding of how the morality prime actually manifested in changing brain activity. Thus, while Fp1 and Fp2 have been identified by research to correspond with brain regions in the brain associated with social awareness, social avoidance/approach behaviors, and cognitive emotional valence**,** there are other electrodes that are also associated with the functions related to cognitive deliberation such as F7 and F8 from the frontal lobe and T3 from the temporal lobe. The same also applies to the F3 and F4 electrodes where other electrodes associated with emotional processing and vigilance such as T6 and T4. Thus, a limitation of this study might be the lack of information about electrical activity in the whole brain as it responded to moral dilemmas.

Finally, future studies need to use better methods to capture subjects' responses. Participants in this study gave their responses by vocalizing them-- i.e., they said to the investigator "yes" or "no" or they said a number when rating their reasoning. The

vocalization possibly introduced possible artifact into the EEG record (auditory input, sound, and muscle movement). Thus, future studies should use something other than subjects' own vocalization to record their responses, such as a pressing a key (while that also can cause muscle movement it might introduce less artifact into the EEG).

Conclusion

Moral psychology and research have gained momentum in the last years and studies using brain-imaging techniques have widened our understanding of the different brain regions involved in the processes of moral judgment and reasoning. The aim of this study was to modestly contribute to the growing research on how moral judgment/reasoning is influenced by the prefrontal cortex**,** by utilizing EEG recording of electrical activity in the PFC**,** and to examine how moral judgment/reasoning could be disrupted by increasing cognitive load in the PFC though anxiety provoked via death reminders.

Moral reasoning studies have the potential to increase our understanding of the normative conditions under which moral decisions are made, but more importantly our understanding of how these normative conditions can be disrupted and can lead to different patterns of moral responses and decision-making. We live in an a world where we are required on daily basis to respond to real life moral dilemmas and conundrums and my vision is that one day we will have better understanding of how people's moral judgments can be shaped and conditioned through our increased understanding of the biological/neuropsychological, cultural, and evolutionary factors pressing on each and every one of us.

APPENDIX A – Measure and Material Background Survey

Please provide answers to the following questions:

1. **Age: _____**

2. **Gender:**

   ____ Female

   ____ Male

   _____Other (please specify):_____

3. **Ethnic Background**

   ____African or African American

   ____Asian

   ____Aboriginal (or Indian American)

   ____Caucasian

   ____Middle Eastern

   ____Other (please specify):_____

4. **Religious Affiliation**

   _____Yes (specify):_____

   _____No

5. Do you have any medical condition(s)?

___Yes (specify):_____

___NO

6. Are you currently taking any medication(s)?

___Yes (specify):_____

___NO

7. Employment:

_____Not currently working

_____Full-time employment

_____Part-time employment

8. Tuition:

_____Financial aid

_____Scholarship

_____ Loans

_____Parents pay for Tuition

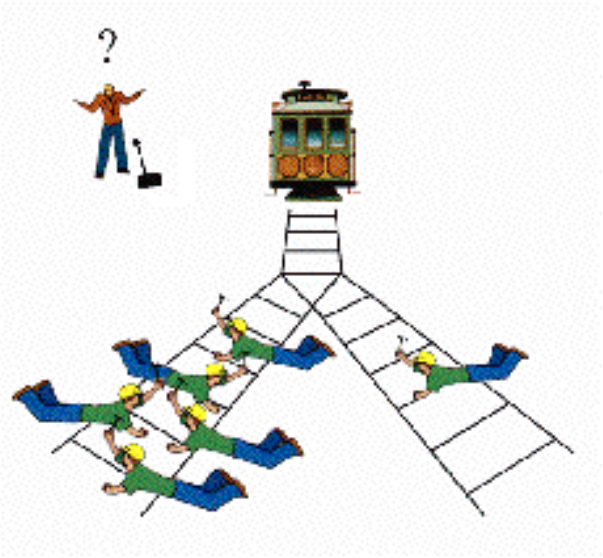
9. Major of Study:

APPENDIX B: Moral Dilemmas

Below are the “push” and “switch” moral dilemmas as they were presented to participants and used in the study. The dilemmas were shown on a computer screen as PowerPoint slides.

Runway trolley dilemma: A runaway trolley is headed for 5 railway workmen who will be killed. Next to you is a railway workman wearing a large backpack. The only way to save five people is to push this man off the footbridge and onto the track below. The man will die as a result, but his body and backpack will stop the trolley from reaching others. Is it morally acceptable to save the five people by pushing the stranger to his death?

The switch dilemma: A runaway trolley is headed for 5 railway workmen who will be killed. Next to you is a switch that will turn the trolley onto a sidetrack. You can save these five people by hitting the switch; unfortunately there is a single workman on the sidetrack who will be killed. Is it morally acceptable to turn the trolley away from the five and onto the one?



APPENDIX C: Debriefing Statement

DEBRIEFING STATEMENT

Moral judgment and the brain: The role of the frontal lobes and the moderating influence of mortality salience and type of moral dilemma on moral judgment.

Adnan Jaber

University of Detroit Mercy

Psychology Department

You recently participated in a research study attempting to study types of moral judgments and their relationship to brain regions. You were selected as a possible participant because you voluntarily provided your name and contact information for inclusion in the psychology department research pool at the University of Detroit Mercy. The purpose of this debriefing statement is to review what the study was about and to give you the opportunity to ask additional questions and to share any feelings or issues you may have.

The purpose of this study is examine the relationship of type of moral dilemmas (personal/push vs. impersonal/switch) to the type of moral judgment (deontological vs. utilitarian), (b) investigate the relationship between type of moral judgment (deontological vs. utilitarian) and brain/cortical activation with an attention to the regions in the prefrontal regions.

As a part of the study, I am interested in examining how strong emotions affect moral decision-making. In order to evoke the emotions, some participants have been asked to reflect on thoughts of their own death. You may be one of those participants.

The reason for using this emotion induction technique is that research has shown that reminding individuals of their own mortality triggers a host of cognitive and emotional

defenses aimed at managing the anxiety aroused by the thoughts of one's own death (Tremoliere et al, 2012, Greenberg et al, 1986). Inducing mortality awareness is an important tool utilized in Terror Management Theory proposed by Greenberg et al (1986) to study how individuals place high premium on the value, morals, and the life style of their own cultures when reminded of their own mortality. In my study, the induction of strong emotions associated with thoughts of one's death was used to see if it impacted the kind of moral judgments you make.

I would like to remind you that the records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely and only I will have access to the records. Electronic data on your brain activity will be kept in a password-protected file on a computer only accessible to the researcher and authorized associates.

If your involvement in the study has upset you in a way that you feel may affect your well-being and overall functioning, then please let me know and I will provide you with information about available support resources.

My name is Adnan Jaber, you may ask any questions you have now. If you have questions or concerns later, you are encouraged to contact me at 313-615-0124 or his Dissertation Advisor Dr. Douglas MacDonald at 313-578-0388 or by email at macdonda@udmercy.edu

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), you are encouraged to contact the Institutional Review Board's chair Dr. Elizabeth Hill at 313-578-0405 or hillelm@udmercy.edu

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ABSTRACT

MORAL JUDGMENT AND THE BRAIN: THE ROLE OF THE FRONTAL LOBES AND THE MODERATING INFLUENCE OF MORTALITY SALIENCE AND TYPE OF MORAL DILEMMA ON MORAL JUDGMENT

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Moral psychology has been an area of study advanced by philosophers and political scientists for the most part of its history. Although various psychological attempts have been made to study moral decision-making and development, mainly by Piaget and Kohlberg, nonetheless morality as a topic remained at the fringes of psychology.

The last 20 years saw the development of moral psychological theories that were informed by the latest neuropsychological developments of brain translational recording technologies. Specifically, two theories appeared: the social intuitive theory and the dual processing theory. The current study sought to investigate the validity of the dual processing theory utilizing EEG technology, while also introducing mortality reminders as an experimental condition affecting moral judgment. The current study used a mixed factorial within-between cross-over experimental design wherein a total sample of 20 participants were initially quasi-randomly assigned to a group were they were first presented with the push or switch moral dilemma and then, after the introduction of a

prime, were given the other dilemma (e.g., push group did switch dilemma; switch group did push dilemma). All participants received both moral dilemma conditions. In the case of the prime, there were two prime conditions- mortality salience and neutral conditions. Participants were quasi-randomly assigned to a prime condition. The dependent/outcome variables were type of moral judgment, moral reasoning, and brain activity operationalized in terms of absolute power across all spectral frequencies measured.

The results of the current study showed small support for the existence of two types of moral judgments (deontological vs. utilitarian) in response to two different types of moral dilemmas (personal vs. impersonal). However, the study did not find support for the assertion that utilitarian judgments were moderated by increased activity in the DLPFC, while the deontological judgments were moderated by increased activity in the VMPFC. The study also did not find support for the effect of heightened anxiety induced via mortality salience on types of moral judgments. Implication for these results, limitations, and directions for future research are further discussed.

Autobiographical Statement

Adnan Jaber is completing his Doctor of Philosophy in Clinical Psychology at the University of Detroit Mercy, where he received his Master or Arts degree in Clinical Psychology in 2010. Adnan completed his undergraduate degree in Psychology at Lawrence Technological University in 2007. Adnan is completing an APA-accredited internship at the Aurora Mental Health Center in Colorado.

His current research interests include moral judgment and reasoning and applying EEG technology to various questions and theories in moral psychology. Adnan's clinical interests include integrated primary care and working with students in various counseling and academic settings.

Adnan enjoys reading, soccer, and spending time with his wife and two kids.