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Abstract
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BUSINESS ETHICS: THE PROMISE OF NEUROSCIENCE

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BUSINESS ETHICS: THE PROMISE OF NEUROSCIENCE

ABSTRACT

Recent advances in cognitive neuroscience research portend well for furthering understanding of many of the fundamental questions in the field of business ethics, both normative and empirical. This article provides an overview of neuroscience methodology and brain structures, and explores the areas in which neuroscience research has contributed findings of value to business ethics, as well as suggesting areas for future research. Neuroscience research is especially capable of providing insight into individual reactions to ethical issues, while also raising challenging normative questions about the nature of moral responsibility, autonomy, intent, and free will. This article also provides a brief summary of the papers included in this special issue, attesting to the richness of scholarly inquiry linking neuroscience and business ethics. We conclude that neuroscience offers considerable promise to the field of business ethics, but we caution against overpromise.

Keywords: Neuroscience methods, brain structures, normative business ethics, empirical business ethics, ethical decision making

BUSINESS ETHICS: THE PROMISE OF NEUROSCIENCE

The field of business ethics has afforded an intriguing research journey since its inception as a focus of serious scholarly study in the latter part of the twentieth century. Now is an especially fascinating time to be a business ethicist especially because increasingly sophisticated empirical methodologies are being tested. Cognitive neuroscience, the study of the mind through the brain, has attained increasing importance in the field of business ethics and moral judgment, largely through advances in the tools of functional neuroimaging (Greene and Cohen, 2004, Salvador and Folger, 2009, Shehnav and Green 2014, Young and Koenigs 2007). This technology affords the opportunity to study what is happening in the brain as individuals encounter an ethical issue, process such an issue, and engage in unethical behavior, for example, lying (Abe et al., 2007; Farah et al., 2014) or cheating (Zeki and Goodenough, 2004).

This special issue of the *Journal of Business Ethics* aims to synthesize neuroscience knowledge and insights to inform theories in business ethics. The issue brings together scholarly work from a variety of disciplines, such as marketing and organizational behavior. It highlights various aspects of business ethics including normative theories and theories of moral decision making, as well as the more specific topics of sex differences, leadership, empathy, and justice. Topics are varied, as befits a relatively new stream of research and is in keeping with the originality of inquiry that this technology affords. An interdisciplinary approach that combines knowledge of the social sciences and neuroscience enables us to generate novel insights into ethical decision making and behavior and to look at different levels of analysis from an integrative point of view. It links questions related to the social (motivational and social factors), cognitive (information-processing mechanisms), and neural levels (brain mechanisms), using traditional neuroscience methods, neuroimaging and neuropsychology (Lieberman, 2007; Ochsner and Lieberman, 2001).

As such, business ethics joins a wide range of scholarly fields employing neuroscience methodology to study human decision making, including economics (Camerer et al., 2005; Frydman et al., 2014), social psychology (Amodio, 2010), marketing (Karmarkar et al., 2015), and organizational behavior (Becker et al., 2011). Salvador and Folger (2009) provide an excellent review of neuroscience research in business ethics; although still in a formative stage, interest in the topic is increasing, as this special issue attests. Neuroscience methodology is especially auspicious for the study of ethics because it is less subject to social desirability bias than survey research methods using participants' self-reports about their emotional and cognitive processes. In brain imaging research, it is possible to investigate processes of which subjects themselves are not aware.

This interdisciplinary approach that integrates cognitive neuroscience and business ethics provides both opportunities and challenges. The challenge is to forge meaningful links between brain biology and human behavior; research that succeeds in forging these links can provide significant contributions to business ethics theories. Although neuroscience methodology is by definition empirical, neuroimaging findings also raise significant normative questions about the nature of moral responsibility, autonomy, intent, and free will.

Therefore, the question that this article raises is: What value will cognitive neuroscience have to the field of business ethics? Will it enhance our understanding of unethical behavior? Or will nothing fundamental change? We have seen this debate play out in the question of the impact of neuroscience on law, in which one side of the argument believes neuroscience to be transformative, whereas the other side believes that little in the law is changed by neuroscience. Greene and Cohen (2004) imagine that "neuroscience will challenge and ultimately reshape our intuitive sense(s) of justice" (p. 1775). Morse (2004), on the other hand, contends that our present conceptualization and system of legal principles will not be altered fundamentally by findings from cognitive neuroscience. He believes that our theories of responsibility and personhood remain unthreatened by neuroscience. Both positions hold considerable validity and provide scope for discussion and debate among business ethics scholars.

In addition to these larger questions about the contribution of neuroscience to business ethics, we should point out that there are fundamental objections to the very use of neuroscience in the study of human behavior. One set of objections centers on the ethics of the use of neuroscience, a topic of great interest to business ethicists and one to which we will return later in this article. Other objections mounted by neuroskeptics include problems with the neuroimaging methodology itself and doubts about the interpretation or over-interpretation of results. For a discussion of neuroskepticism as well as a set of counterarguments, see, for example, Farah et al. (2014), and Rachul and Zarzeczny (2012). We appreciate the importance of exploring the validity of these objections, but at the same time we welcome the potential contribution of neuroscience to business ethics scholarship. We see the promise of neuroscience, but we are not blind to the possibility of overpromise.

Our approach is meant to be descriptive of what neuroscience is able and not able to do. To that end we provide an outline of neuroscience methodology, a synopsis of the brain areas most likely to relate to questions of business ethics, and a sense of the current state of neuroscience research on business ethics. At the same time, we support the exploration of possible future studies and imagine a world in which neuroscience offers one approach to the most provocative and important questions in business ethics.

The remainder of the article is structured as follows. In the following section two, we present a brief overview of neuroscience methods, as well as information about brain structure and connectivity. Section three delineates the territory of neuroscience research in business ethics. In this section we raise questions about the position of neuroscience in addressing normative issues. We also consider empirical research beginning with studies of individual characteristics, moving to individual decision making about ethical issues, to studies of interaction with others, and finally to organizational topics related to ethics. As we consider this research, we identify the topics that have been most researched as well as proposing future research directions. Section four introduces the articles that comprise the contributions of this special issue. Section five discusses the implications of neuroscience for the teaching of business ethics and touches upon ethical questions of conducting neuroscience research. The article ends with a conclusion that summarizes the contributions of neuroscience to business ethics research.

MAPPING THE BRAIN: A BRIEF OVERVIEW OF NEUROSCIENCE METHODS AND BRAIN STRUCTURES

Neuroscience Methods

The aim of neuroscience research is to relate brain activity to human cognition, emotions, and behavior. In the following we briefly discuss the most often used techniques (for further and more in-depth discussion of the methods, see, e.g., Dimoka, 2012; Glimcher et al., 2009; Huettel et al., 2014; Kable, 2011). Table 1 presents a summary of the advantages and disadvantages of the different neuroscience techniques.

Insert Table 1 about here

Electroencephalography (EEG), one of the first neuroscience techniques used in management research, is a method that places electrodes on the scalp to measure electromagnetic activity of the brain. It thereby tracks and records brain wave patterns. In studies relating to business ethics and corporate responsibility, Waldman et al. (2011), for example, used EEG to investigate the neurological basis of inspirational leadership behavior; their research focused specifically on leadership that emphasizes the social responsibility of business and the empowerment of followers. Similarly, Lee et al. (2014) used EEG to distinguish green consumers, those who choose environmentally products, from non-green consumers.

Functional magnetic resonance imaging (fMRI) has become the most commonly used method in the social neuroscience literature (Dimoka, 2012), particularly in the study of moral cognition. Participants are placed in an fMRI scanner and react to stimuli or perform tasks while their brain activity is measured. The most prominent measure is the blood-oxygen-level-dependency effect (BOLD). BOLD fMRI captures changes in the oxygen concentration of the blood flow in the brain. Neural activity increases blood oxygenation. The resulting changes in the magnetic field measured by fMRI are used as a proxy for brain areas that are active during a task or as a response to a stimulus (Dimoka, 2012; Huettel et al., 2014). In a relatively early use of fMRI in the study of moral cognition, Greene et al. (2001) scanned the brains of subjects faced with the "trolley dilemma" in its multiple variations; subjects have to decide if they are willing to sacrifice the life of one person to save five persons from being overrun by a trolley. The results of this study indicate that deontological decisions ("do not kill") are more likely driven by affective, emotional reactions, whereas utilitarian decisions ("kill one to save five") seem to be based on higher-order reasoning and cognition (Greene et al., 2001).

In addition to the previously mentioned methods, transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) afford the ability to directly manipulate brain activity. TMS uses electromagnetic induction to inhibit or activate certain brain areas (Rossi et al., 2009). A magnet coil is placed near the head of the participant. The magnet produces small electric currents that inhibit or trigger activity in the region of the brain. The method is non-invasive and the activation of the brain area is only temporary (Dimoka, 2013; Rossi et al., 2009). Knoch et al. (2006) used TMS to show that disruption of the right, but not the left, dorsolateral prefrontal cortex in the brain made participants more willing to accept unfair offers. Young et al. (2010) found that interfering with activity in the right temporoparietal junction, an area involved in reasoning about others' mental states, disrupts the capacity to use such mental states in moral judgment. In addition to studies of brain lesions, TMS and tDCS provide the possibility for experimental manipulation to draw better causal inferences about brain activity and human behavior and decision making. However, due to the controversial nature of such studies, researchers need to proceed cautiously in study design and implementation (Rossi et al., 2009).

Apart from brain imaging techniques, the study of hormones has become increasingly prevalent in investigating biological predictors of human behavior. Hormones are biochemical messenger molecules produced in an endocrine gland or the brain and released into the bloodstream. The release of different hormones in the human body has been related to social outcomes such as trust (oxytocin), aggressive behavior and power (testosterone), or altruism (dopamine) (Fehr, 2008; Kosfeld et al., 2005; Schultheiss and Stanton, 2009; Schultheiss et al., 2004). Research more directly related to business ethics investigated the role of testosterone in leader corruption (Bendahan et al., 2015) and utilitarian moral decision making (Carney and Mason, 2010).

Finally, scholars often count as neuroscience methods measures of physiological responses of the body, including the measurement of heart rate, skin conductance, pupil dilation, or eye tracking (Becker and Menges, 2013). An example of the application of such methods related to business ethics is the study of Decety et al. (2012), which combined neurophysiological measures, including eye-tracking, pupillary response, and fMRI to investigate reactions to morally salient situations. Participants viewed scenarios depicting intentional versus accidental actions that caused harm to people and objects. Eye-tracking and measures of pupil dilation showed that participants looked at the victims rather than the perpetrators and reacted more strongly to intentional harm; these physiological reactions were correlated with activation in the posterior superior temporal sulcus and amygdala. Overall, the findings indicate that morally questionable situations (e.g., harming others) induce a negative emotional reaction. The authors suggest that these negative emotional reactions sensitize individuals, making them aware of the moral nature of the situation and thus may play an important role as an antecedent to moral judgment (Rest 1979; Reynolds 2006).

Ethical Decision Making in the Brain: How Our Brain Helps Us Understand Ourselves and Others

Using the above mentioned neuroscience methods, scholars have started to classify different regions of the human brain associated with social cognitive processes. Studies draw inferences from brain activity related to behavioral tasks or stimuli and thereby try to "locate" basic emotions such as fear, anger, or happiness, but also more complex cognitive constructs including ethical decision making in the human brain. Research shows that most often multiple brain regions are involved in the same mental process related to social interaction, while at the same time, a certain brain region is responsible for several mental processes (Greene, 2015; Greene and Haidt, 2002; Lieberman, 2007). This latter point makes a reverse inference challenging, i.e., trying to draw social or psychological conclusions from the activation of certain brain areas may lead to over-interpretation of the results (Dimoka, 2012,; Lieberman, 2007). In the following, we provide an overview of brain areas associated with important facets of ethical decision making (see also Voegtlin and Kaufmann, 2012 for a similar overview with regard to ethical leadership). We call attention to specific brain regions, as these are important for understanding the most relevant findings of neuroscience research. At the same time, we attempt to make our discussion as accessible as possible to non-neuroscientists. The overview relates to the general mental capacity of an individual to understand oneself, and others, and to interact with others as the fundamental preconditions for ethical behavior (see Table 2).

Insert Table 2 about here

Understanding oneself: Self-reflection and self-regulation

Understanding oneself includes the mental capacities to understand and reflect about oneself as a moral person (Johnson et al., 2002; Lieberman, 2007). Self-reflection means actively engaging in the process of deliberation about one's own experiences (past or current), and one's positive or negative feelings about those experiences, in order to seek or avoid similar situations in the future (Lieberman, 2007). Evaluation of current experiences, autobiographical reflections of the past, and memory retrieval are strongly associated with activity in several parts of the pre-frontal cortex (Johnson et al., 2002; Lieberman, 2007). Research has shown that the pre-frontal cortex, but also the region of the brain involved in memorizing and in emotional reactions (amygdala) are important for a person's moral development (Greene, 2015). Self-regulation, another important competency of the self, enables an individual to reappraise emotional events and to control affective and emotional impulses (Lieberman, 2007). Studies have shown that specific parts of the brain (dorsal anterior cingulate cortex, lateral pre-frontal cortex) aid in intentionally overriding an impulse (Lieberman, 2007).

Models of moral reasoning dating back to Kohlberg (1969) have assumed a conscious, deliberate reasoning process. More recently the social intuitionist model considers moral judgment to be a function of immediate, intuitive processes, often (but not always) followed by more rational reasoning (Haidt 2001). The dual-process theory of moral judgment is a continuation of these findings and offers a significant contribution of cognitive neuroscience research to understanding how individuals make decisions about ethical issues. The theory is based on neuroscience findings and suggests that individuals make ethical decisions based on intuition and emotion as well as reason (Greene et al. 2001; Haidt 2001; Reynolds, 2006).

Seminal studies of patients with brain damage highlight the importance of emotions in being able to act ethically in the first place (Damasio, 1994). The famous case of Phineas Gage, whose ventromedial pre-frontal cortex was damaged after he was hit by a steel rod, shows that Gage was still able to engage in abstract moral reasoning, while emotional reactions and real-life ethical decision making were clearly impaired (Damasio, 1994). Additional brain lesion studies confirmed that individuals with similar brain damage make poor decisions because they are unable to generate feelings; these individuals have weak affective responses to harm (Greene, 2015; see also, Greene and Haidt, 2002; Damasio, 1994). Damage to regions relevant for generating and regulating responses to salient stimuli (ventromedial pre-frontal cortex, amygdala) seem to be major catalysts for psychopathy (Greene, 2015). These and other neuroscience studies investigating patients with brain damage indicate that it is both having emotions that make individuals care for others, and being able to regulate these emotions, that are necessary for making ethical decisions.

Understanding others: Theory of Mind and empathy

Apart from understanding oneself, understanding others, i.e., the way in which an individual experiences the mental state or mind of another person, is important for ethical behavior. The theoretical concepts in neuroscience considered to be of key importance for explaining human interaction in a social context are theory of mind (ToM) and empathy, both of which are relevant for understanding the ethical beliefs and intentions of others (Frith and Singer, 2008) and for understanding why individuals behave ethically or unethically. ToM can be considered largely cognitive and involves the ability to represent the mental states of others (ability to mentalize); empathy, on the other hand, is considered largely affective and describes the capacity to understand what others feel (Frith and Singer, 2008; Singer et al., 2004). (Note that some conceptions of empathy also include a cognitive dimension, but for our purposes we focus on the affective dimension.)

ToM is relevant for understanding the psychological traits of another person in order to make more accurate judgments about dispositions for certain behavior. Based on the cognitive capacity to perceive oneself as a subject expressed by personal pronouns ("I", "me"), perceptions, and experiences, ToM is the ability to assign such capacities of the self to others, which is crucial for any kind of social interaction and communication (Frith and Singer, 2008). As such, individuals draw upon their personal theory of how minds operate in order to infer the mental states of others (Lieberman, 2007). Several studies indicate that ToM usually involves neural activation in specific brain regions (primarily the anterior paracingulate cortex, posterior superior temporal sulcus, and temporo-parietal junction) (see, Rilling et al., 2004b; Vogely et al., 2001).

The second important theory for understanding others refers to empathy—namely, the capacity to understand what it feels like when someone else experiences something like happiness, pain, a touch, or sadness. Neuroscientific studies suggest that an empathic reaction in the brain associated with feeling an emotion is caused by seeing another person's facial expression of this same emotion (Gallese, 2001; Lieberman, 2007). Singer and colleagues (2004) found that empathy with the pain of others does not include activation of the whole pain matrix in the brain, but rather those areas representing the affective dimension of pain. The authors concluded that these regions (basically the rostral part of the anterior cingulate cortex and anterior insula) have a dual function in that they are important both for the formation of subjective feelings with respect to the self and for understanding others' emotional states (Singer et al., 2004).

In a meta-analysis of neuroimaging studies, Bzdok et al. (2012) found that brain areas related to ToM and empathy (temporo-parietal junction, medial pre-frontal cortex, middle temporal gyrus) are engaged in moral decision making, emphasizing again the relevance of both abstract-cognitive and intuitive-emotional skills for ethical behavior. Furthermore, the results of the study suggest that these brain regions, “emerged as potential nodes of a network common to moral cognition, ToM, and empathy” (Bzdok et al. 2012, p. 789). In a study connecting neuroscience methods and the business ethics context, Bagozzi et al. (2013) investigated the relation between ToM, empathy, and Machiavellianism, i.e., social conduct that aims to manipulate others for personal gain. As expected, brain regions associated with ToM were negatively correlated with Machiavellianism. However, interestingly and perhaps counterintuitively, activation of brain regions connected to empathy indicated that Machiavellians were better able to detect the emotions of others, particularly negative affect, and might use this to facilitate manipulative acts (Bagozzi et al., 2013).

Social interaction

Successful social interactions are based on phenomena such as trust, fairness, cooperation, and ultimately, ethical decision making. Using social cognitive neuroscience and neuroeconomic lenses, the view of trust, cooperation, and fairness has been enriched by a brain-based perspective and explanations (Fehr, 2008; Van IJzendoorn and Bakermans-Kranenburg, 2012; Yoder and Decety, 2014). Many of these studies are framed as a monetary exchange situation in which individuals participate in an economic game (Glimcher et al., 2009; Sanfey, 2007). For trust and related behavior, such as cooperation or fairness, neural activation occurs in regions of the brain important for memory and emotional reactions (amygdala), regions involved in memory and learning, and error and conflict detection (cortical regions), those involved in body movement, learning, and memory (caudate nucleus), and regions important for feelings of reward (nucleus accumbens, ventral striatum) (Adolphs, 2003; King-Casas et al., 2005; Rilling et al., 2004b).

From understanding oneself and others to moral judgment

On a more aggregate level, scholars have started to map moral judgment in the brain. Over time, moral cognition has been relatively consistently associated with a number of brain regions (anterior pre-frontal cortex, orbitofrontal cortex, posterior superior temporal sulcus, anterior temporal lobes, insula, precuneus, anterior cingulate cortex, and the limbic system) (Moll et al., 2005). However, activation of brain regions differs according to the situational cues of the study design and is dependent on the nature of the moral problem, the decision difficulty, and contextual stimuli, including the time participants have to make decisions. For this reason, as well as the connectivity of brain regions, it is difficult to isolate any particular brain region as housing moral cognition.

Greene et al. (2001, 2004) demonstrated that utilitarian judgments involve cognitive areas (lateral pre-frontal cortex, anterior cingulate cortex), whereas emotional areas (medial pre-frontal cortex, posterior cingulate cortex, superior temporal sulcus) are correlated with deontological moral judgments. Pincus et al. (2014) found that individuals with a stronger neurobiological representation (left ventrolateral pre-frontal cortex) of deontological rules demonstrate "deontological resolve," meaning that individuals will resist bending the rules, when others do so. The study of Prehn et al. (2015) indicates that subjects at Kohlberg's (1969) post-conventional level of moral reasoning are characterized by increased gray matter volume (ventromedial pre-frontal cortex, subgenual anterior cingulate cortex), compared with subjects at a lower level of moral reasoning. Furthermore, studies have found overlap between moral sensitivity brain regions (anterior pre-frontal cortex, orbitofrontal cortex, superior temporal sulcus, and limbic regions) and regions associated with basic emotions such as disgust or fear (Moll et al., 2005).

Finally, the nervous system plays an important role in ethical decision making. Hormones act as neurotransmitters that stimulate our bonding with others and reward us for pro-social behavior (Keltner et al., 2014; Schultheiss and Stanton, 2009). Oxytocin and vasopressin "promote attachment and caregiving" and target "emotional processing areas in the brain, including the amygdala, septal area, and reward circuity" (Keltner et al., 2014, p. 445). Dopamine is related to reward stimuli we experience when acting in a manner that is "good" or pro-social. Furthermore, our emotions and cognitive processes are regulated by the neurotransmitter serotonin. Serotonin is responsible for a multiplicity of processes (e.g., regulating mood, appetite, sleep). Experimentally lowering serotonin levels was found to reduce cooperation and increase the likelihood of punishing unfair behavior (Keltner et al., 2014).

NEUROSCIENCE AND BUSINESS ETHICS

In the following section, we discuss the implications of neuroscience research for normative and empirical business ethics and point out directions for future research in both areas. There can be no empirical research without a normative basis to establish what is meant by unethical behavior. As Tenbrunsel and Smith-Crowe (2008) rightly point out, the first and most fundamental question to be asked is, "What is ethical?", and they appropriately levy criticism at empirical researchers who ignore this question. Normative ethicists aim to construct arguments about the ways that individuals should behave and to derive principles that guide decisions or action; normative theories are "prescriptive" or "action-guiding" (Donaldson, 1994, p. 158). The focus is on answering the question, "What ought to be?" Leading researchers in business ethics have contended that normative and empirical research are of equal significance and each can inform the other, but that they must by definition remain distinct (Donaldson, 1994; Treviño and Weaver, 1994).

We are not suggesting that neuroscience holds the answer for integrating normative and empirical perspectives in the business ethics field. After all, neuroscience is by its very nature methodological and thus empirical. However, neuroscience research results can prompt further questions of interest to philosophers and social scientists alike. Additionally, leading scholars long have acknowledged the field of business ethics to be interdisciplinary and have insisted that both normative and empirical insights into ethical issues have value (DeGeorge, 1987; Donaldson, 1994). Thus, it strikes us as worthwhile to consider the relevance of neuroscience to both normative and empirical business ethics.

The Contribution of Neuroscience to Normative Business Ethics

In this section of the paper we seek to explore the areas in which findings from neuroscience can contribute most usefully to the study of normative business ethics. Greene (2014) suggested that cognitive neuroscience generates knowledge about the nature of moral decision making so fundamental that it will lead to a reformulation of extant normative theories of business ethics. Earlier, Greene and Cohen (2004) made an equally bold statement, contending that findings from neuroscience will change the way we think about free will, responsibility, and intentionality. Similarly, Roskies (2002) believes that as we acquire more sophisticated knowledge about the neural structure of the moral brain, we may well need to revise our concepts of moral and ethical, even to the extent of modifying our existing philosophical theories.

If cognitive neuroscience is able to demonstrate that morally significant actions are driven by neural activity, as these authors suggest, does that mean that our notions of moral responsibility need to be re-examined? An underlying assumption of most normative approaches to business ethics is that morally significant actions are the result of individuals' autonomy and free will (Treviño and Weaver, 1994). But perhaps neuroscience is telling us that we need a deterministic model to explain ethical or unethical actions. Does determinism exclude moral responsibility? Does moral responsibility require free will? In exploring age-old philosophical questions such as these, cognitive neuroscience may well enhance our understanding of normative ethics and challenge future research to engage with these questions.

Neuroscience findings to date suggest that many decision processes in the brain are governed by implicit processes that never reach the level of consciousness (Burns and Bechara, 2007). If reactions to ethical issues are immediate and intuitive as Haidt (2001) argues, can we ascribe intent? For example, stereotypes are believed to operate automatically and unconsciously (Greenwald and Banaji, 1995). If one acts unconsciously on those stereotypes, should one be held less responsible than if one acts more consciously? (See Bowie, 2009, for an excellent discussion of the implications of cognition research for ethical behavior.) We do not wish to enter the longstanding philosophical discussion as to what constitutes moral responsibility (see, for example, Fischer, 1999), but only to suggest that what we learn from cognitive neuroscience may add to the discussion.

Legal scholars have pursued this notion as well, arguing that certain abnormalities in the brain may result in criminal behavior (Raine, 2013). If a part of an individual's brain is missing or impaired, some people may think about absolving the individual of moral responsibility for an action. But this does not mean that unethical behavior necessarily rests solely on a pattern of neural activity. If caution is advised in interpreting cognitive neuroscience findings about ethical decision making, even greater caution is needed to draw conclusions from neuroimaging data about assigning and taking responsibility for unethical actions. Parens (2014) considers that neuroimaging data can provide evidence that a particular person in a particular situation may have limited options for action based on that person's atypical brain functioning. However, this does not mean necessarily that every action of every individual is predetermined by brain structure or function. Parens instead concludes (perhaps not very satisfactorily) that we will likely have to get better at "oscillating between seeing our actions as determined and seeing them as freely chosen" (Parens, 2014, p. 52).

Another intriguing topic concerns how individuals process the actions of corporations and relates to the longstanding business ethics discussion of corporations as moral agents (see, for example, French, 1979; Velasquez, 1983; and Sepinwall, 2015). Cognitive neuroscience has examined brain activity as individuals blame other individuals, but there is little research looking at the question of brain activity as people blame an entity such as a corporation. In one study that does examine perceptions of companies, Plitt et al. (2014) conclude that "our brains understand and analyze the actions of corporations and people very similarly, with a small emotional bias against corporations" (p.1). This question of brain processing of corporate ethical infractions provides a fruitful area for additional research.

We recognize that realistically neuroscience can perhaps bring us one step closer to understanding questions of moral responsibility, autonomy, intent, and free will, but neuroscience findings cannot in and of themselves answer these questions. Instead the contribution of neuroscience to these debates warrants considerable further discussion and research.

The Contribution of Neuroscience to Empirical Business Ethics

Perhaps the most basic aim of empirical business ethics research is to understand why and under what circumstances individuals make decisions about ethical issues and behave unethically. (Of course, there is interest too in why individuals behave ethically, but this has not been the focus of as much research.) Broadly speaking empirical research in business ethics has sought to answer this question by examining several levels of possible explanation for unethical behavior: the individual, the situation or context, and a combination of the two (person-situation interactionist theory) (Treviño, 1986). Individual characteristics include age, gender, personality, and stage of moral development. Situational characteristics include variables ranging from the task at hand, to organizational compensation systems, to national culture. Several decades of empirical research have advanced our knowledge of the variables leading to unethical behavior, but many questions remain and neuroscience methods may provide tools to address these questions.

Neural imaging studies have been effective at documenting the underlying brain structure and connectivity of individual characteristics or dispositions, including gender (Ruigrok et al., 2014) and age (see, for example, Grady, 2012 on the ageing brain and Defoe et al. 2015, on the adolescent brain). Our task is to understand how these results have an impact on ethical and unethical behavior. We choose to focus on these particular characteristics because they have received a great deal of research attention in the business ethics literature, as well as in studies of cognitive neuroscience. However, fMRI research also affords the opportunity to investigate other factors that have not been traditional independent variables in the business ethics literature. These include, for example, the consequences of sleep deprivation and the impact of stress on brain activity that affects ethical decision making. In the following sections we present a brief overview of the research on individual characteristics and then focus on the connection between neuroscience research and two specific organizational factors relevant for business ethics, i.e., rewards and leadership. A complete literature review is beyond the scope of this paper.

Gender

Beginning with gender there are well-documented differences between men’s and women’s brains (Cahill, 2006). However, business ethics research findings of gender differences in ethical awareness and behavior are mixed (Kish-Gephart et al., 2010). While some empirical studies have found evidence that women are more ethical than men or more sensitive to the presence of ethical issues (Betz et al., 1989; Dawson, 1997), other research has found no differences (Kish-Gephart et al., 2010). However, there are few studies that link any gender differences in the brain to gender differences in ethical awareness and behavior. Furthermore, caution should be exercised in interpreting fMRI studies of gender differences; some scholars have contended that the limitations of present-day methodologies may lead researchers to findings that reinforce gender stereotypes (Bluhm, 2013; Jordan-Young and Rumiati, 2012; Fine, 2012).

A further area of interest is the question of the link between gender, emotion, intuition, and ethical decision-making. Cognitive neuroscience research has established that emotion is a key component of ethical decision making (see, for example, Greene et al., 2001; Moll et al., 2002). Women are believed to be more emotional in their decision making than men (Croson and Gneezy, 2009), and some research contends that women are more likely than men to make use of intuitive decision making processes (Lieberman, 2000). Future fMRI research could investigate the anatomical basis for any gender differences in emotional and intuitive approaches to ethical decision making.

Finally, a major part of biological sex differences stems from differences in brain chemistry, more specifically, from baseline hormone levels and the number of neural receptors for those hormones. Women have a higher baseline level of oxytocin and lower levels of testosterone (Cahill, 2006; Schultheiss and Stanton, 2009). These hormones have been linked to aspects relevant for ethical behavior (e.g., trust, justice perceptions, aggressive behavior, and moral judgment) (see, for example, Carney and Mason, 2010; Riedl and Javor, 2012; Schultheiss et al., 2004). Future research could more clearly delineate the effect of gender differences based on hormonal dispositions for ethical behavior in the business context, e.g., by investigating the implications of hormonal differences between men and women in their reaction to organizational injustice or the aggressive behavior of colleagues.

Age

Although empirical research on the relationship between age and unethical behavior again is mixed, there is some evidence that older individuals are more ethical. Certainly Kohlberg (1969) and Rest (1979) built their model of the stages of moral reasoning on the assumption that movement through the various stages correlates with age. However, as we now know, the conscious deliberate processes on which their models are based constitute only part of moral reasoning. Decety et al. (2011) conducted a study of the role of empathy in moral reasoning with participants aged between 4 and 37 years; the study concluded that moral reasoning processes include a complex integration of emotion and cognition that does indeed gradually change with age. Furthermore, empathic responses and self-regulatory responses may increase with age, leading to more ethical decision making (Decety et al., 2011). More specifically, the period of adolescence is one in which changes in moral behavior may be observable; many brain regions that are germane to moral reasoning continue to mature until adulthood (Decety, 2016). In a study of adolescents and adults encountering everyday moral conflict situations, Sommer et al. (2014) found that adolescents chose significantly more hedonistic alternatives than did adults. Future neuroimaging research could confirm that there are individual differences in the brains of older and younger people such that they approach ethical issues differently. Particularly as business organizations face an aging workforce, future neuroscience studies on age and ethical decision making may provide arguments for retaining older employees.

Physiological factors

In addition to age and gender, the physiological underpinnings of unethical behavior remain largely unexplored. For example, we have evidence that sleep deprivation leads individuals to behave unethically. Barnes et al. (2011) found that sleep quantity and quality are positively associated with self-control and negatively correlated with unethical behavior.

Sleep deprivation has been linked to increased student cheating (Barnes et al., 2011), as well as employee cyberloafing (Wagner et al., 2012). Additionally, there is considerable neuroscience evidence of the effect of lack of sleep on cognitive functioning (Lim and Dinges, 2010). Future research could investigate how areas of the brain affected by lack of sleep are linked to unethical decisions, especially in (simulated) workplace settings that are characterized by long working hours, irregular shifts, or highly demanding workloads before deadlines.

Similarly, stress, although not strictly a physiological factor, has a direct impact on moral decision making (Starcke et al., 2011, Youssef et al., 2012). Youssef et al. (2012) found that subjects under stress tended to give fewer utilitarian and thus less rational responses to personal moral dilemmas. The authors conclude that their results provide corroboration of a dual process theory of moral reasoning, demonstrating that stress tends to stimulate more emotional, rather than rational, moral reasoning. However, stress does not necessarily lead to more egoistic decisions (Starcke et al. 2011). Starcke and Brand (2012) suggest that stress may be prompted by decisions involving a higher degree of uncertainty, a condition that applies to certain moral issues and is widely encountered in business organizations. Cognitive neuroscience affords an appropriate methodology for further investigation of the effects of stress on ethical decision making.

Other potential areas believed to have an effect on ethical decision making that may become salient in business settings include chronotype and time of day (differences between morning and evening people) (Gunia et al. 2014, Kouchaki and Smith 2014), cognitive load (V'ant Veer et al. 2014), and hunger (de Ridder et al. 2014). Each of these research areas is conducive to fMRI studies that can document brain activity based on manipulation of biological states and ethical decision making tasks.

Rewards

Traditional business ethics research has identified reward or the anticipation of reward as a key variable leading to ethical or unethical behavior (See, for example, Treviño 1986). An individual contemplating behaving unethically would most likely engage in some type of risk/reward calculation. The risk portion of this calculus involves both the risk of detection and the risk of anticipated punishment, if detected. The reward portion involves consideration of the benefits to be accrued as a result of behaving unethically. But some risks are simply not worth taking. Behavioral economics research tells us, for example, that individuals will only cheat up to a point that does not interfere with their self-image as an ethical person (Mazar at al., 2008). Similarly, individuals may be more inclined to behave unethically when the rewards (and the risks) are small rather than large (Jap et al., 2013).

There is a great deal of neuroscience research on reward activation in the brain. (Gottfried, 2011, Sanfey et al., 2003). When thinking about unethical behavior and reward, the most usual reward that comes to mind is monetary. But there are also more intrinsic rewards that may guide and motivate those behaving ethically. Abe and Greene (2014) used fMRI to investigate the role of the nucleus accumbens, one part of the brain's reward system, and its response to anticipated rewards as a predictor of dishonest behavior. Their findings identify the cognitive and neural determinants of honesty and dishonesty. The authors interpret their findings to mean that some individuals have a general tendency to be less interested in and motivated by monetary rewards. We know, for example, that in some instances a region of the brain associated with reward systems may be more active when making a charitable donation than when accepting a financial reward (Moll et al. 2006). Such a finding suggests that business ethics research would benefit from thinking beyond individual monetary rewards when considering motivation for ethical or unethical behavior. Future neuroscience research could investigate rewards more clearly linked to the business ethics context, for instance brain activity linked to monetary incentives such as bonuses or pay raises, short-term and long-term rewards, or the risks involved in unethical behavior in organizations (e.g., job loss, loss of status).

Leadership

Leadership is an influence relationship between leaders and organizational stakeholders (Maak and Pless, 2006). Thus, it is key to the recognition and reconciliation of stakeholder needs and interests. Within business organizations, leadership is especially relevant for the fair treatment of individuals, and neuroscience methods have recently been used to study the topic. Research to date has focused on individual characteristics of the leader and has investigated the neuroscience basis for complex leadership, i.e., leadership that can meet diverse role demands (Hannah et al., 2013), for inspirational leaders who espouse a high level of regard for others (Waldman et al., 2011) and the relation between empathy, perspective taking, and a Machiavellian leadership style (Bagozzi et al., 2013).

Future neuroscience research could look more closely at the ethical implications of the interaction between leader and followers. While this might prove difficult to achieve, recent research shows that the leader-follower relationship can be simulated in an fMRI study by using virtual partners as counterparts (Fairhurst et al., 2014). Johnson and colleagues (2013) in a team-neurodynamics study found evidence for neurophysiological indicators among leaders and followers in an ethical decision-making scenario. Miska and Mendenhall (2015) suggest that neuroscience research could investigate the cognitive and emotional challenges of responsible leaders who try to address a diversity of stakeholder demands and could foster our understanding of the neural mechanisms related to corporate social responsibility and sustainability. Maak et al. (2016) argue that cognitive and social complexity and a social-welfare orientation are conducive for a form of responsible leadership that is able to integrate diverse stakeholder concerns and competing goals. It would be interesting to research the neural correlates of such cognitive complexity and social value orientations.

THE CONTRIBUTIONS OF THIS SPECIAL ISSUE

The research areas we have addressed also surface in the contributions to this special issue; this section briefly introduces each of these articles. Drawing on decision neuroscience research, *George Christopoulos*, *Xiao-Xiao Liu* and *Ying-yi Hong* (2016) develop a framework detailing how model-free learning (learning by trial and error) and model-based learning (learning based on associations drawn from one's mental models of the world) have an impact on individuals' moral decision making. The authors demonstrate that concepts in decision neuroscience, such as valuation, risk, and time, are relevant for moral decision making. *Marc Orlitzky* (2016) also focuses on moral decision making, reflecting on the implications of neuroscience findings related to deontological and utilitarian moral decision making for normative theories of business ethics. The article summarizes neuroscientific evidence that points toward an evolutionary approach to individuals' moral thinking and moral subjectivism, a view that argues that morality is subjectively constructed by an individual's mental activity.

Russell Cropanzano, Sebastiano Massaro, and *William Becker* (2016) use organization neuroscience to focus on the link between three core processes that relate to individuals' fairness perceptions: justice rules, cognitive empathy, and affective empathy. The authors provide detail on the brain regions and processes related to their model of deontic justice and emphasize the relevance of intuitive, emotional responses for business ethics. *Kylie Rochford*, *Anthony Jack, Richard Boyatzis,* and *Shannon French* (2016) explore the implications of neuroscience for developing ethical leaders in organizations, contending that it is essential to achieve a balance between cognitive perspectives based on two large scale brain networks: the Task Positive Network (TPN) and the Default Mode Network (DMN). They suggest that business ethics education can help to develop ethical leaders who are able to find a balance between socio-emotional and analytical reasoning.

Lori Ryan (2016) highlights current sex difference findings from neuroscience and neuroeconomics research related to business ethics in six areas: trust, moral decision-making, organizational justice, moral development, the ethic of care, and female management styles. The article underscores the importance of hormones in biological sex differences and examines their role in individuals' reactions to ethical situations. *Patrick Hopkins* and *Harvey Fiser* (2016) develop a framework to analyze moral and legal issues in the potential use of neurotechnologies to detect and alter employees' performance skills and capabilities in the workplace. The article explores employer permission or prohibition of neurointerventions and discusses current and potential legal interventions concerning them.

Finally, *Steven Stanton, Walter Sinnott-Armstrong,* and *Scott Huettel* (2016) present both the benefits and ethical concerns of the use of neuroscience techniques to study marketing practices and consumer behavior. The article identifies steps that can help to mitigate the ethical risks of neuromarketing, especially of industry research, and proposes that the use of neuroscientific methods should be subject to the highest standards of scientific rigor and ethical supervision.

Overall this set of contributions provides a sense of the neuroscience topics receiving emerging attention from business ethics scholars. The topics and approaches vary, but all have a common aim to use neuroscience to extend theoretical and practical considerations in business ethics. The *Journal of Business Ethics,* as one of the leading journals in the field of business ethics, provides an ideal platform for this kind of research; further contributions in this area are both timely and needed.

DISCUSSION

In this article we have presented an overview of the current state of cognitive neuroscience and its impact on the field of business ethics. Looking to the future, the proliferation of cognitive neuroscience research that has taken place over the last decade is likely to continue. Business ethicists have the opportunity to shape and contribute to this research, particularly to the research on moral cognition. The paper has highlighted several areas of overlap between neuroscience and business ethics and pointed toward future research directions. A summary of these ideas for future research is presented in Table 3.

Insert Table 3 about here

Apart from what we have discussed with regard to unethical behavior, there are also more nuanced issues that could be studied as well. For example, it would be instructive to learn how the brain processes issues like the following: if a firm does not fully inform its employees of hazardous working conditions, at what point do individuals consider the omission of this information to be unethical? We know that individuals have an emotional reaction to unethical behavior, but we do not know how egregious the behavior has to be before this emotional reaction is triggered. Jones' (1991) conceptualization of moral intensity captures this notion of the egregiousness of the unethical act by identifying six components which increase moral intensity, including, for example, magnitude of consequences and concentration of effect. Future research could test how the brain processes ethical issues in which these components are varied.

Neuroscience research does not only offer future research directions and implications for ethical behavior, it can also contribute to business ethics education. The most important point to be made about implications for the teaching of business ethics from neuroscience research is that of the demonstrated plasticity of the brain (Pascal-Leone et al. 2005). We now know that brains can change according to individuals' experiences, and that plasticity is the mechanism for development and learning. In terms of teaching ethics, this means that business ethics professors have the opportunity to shape literally the thoughts of students about ethical issues (especially when the students are adolescents or young adults whose brains are not yet fully formed). At both graduate and executive levels, it seems promising to look at the effect of international service-learning programs in shaping the participants' emotional and ethical literacy. Pless, Maak and Stahl (2011) have demonstrated the profound learning impact of international service-learning programs, and it can be assumed that those effects can be measured in a neuro-cognitive study.

More specifically, in approaching the teaching of business ethics, neuroscience findings about the significant role that emotion plays in ethical decision making suggest that the discussion of ethics should not rest solely on a rational decision making model. Acknowledgment that decision making about ethical issues is not entirely a rational process can inform the manner in which classroom lectures and discussions are structured. Learning about ethics includes both cognitive and emotive learning (McCuen and Shah, 2007), and business ethics education should acknowledge both. Perhaps one of the most challenging dimensions of teaching business ethics is guiding students to recognize the ethical component of an issue and not just frame it as strictly a business issue (see Reynolds and Miller 2015 for an excellent discussion of the importance of the recognition of moral issues). Neuroscience research can inform our understanding of brain activity as an individual recognizes the ethical dimension of an issue (Robertson et al., 2007).

Individuals have developed a myriad of ways to frame issues and deceive themselves such that the ethical dimension is absent from a business decision, including rationalizations (Patterson et al., 2012) and unconscious biases (Heinzelmann et al., 2012). Additionally lessons from neuroscience and social perspective taking, empathy, theory of mind

(Lieberman 2007), and intuition (Haidt, 2001) can play a role in designing curriculum that enhances students' ability to analyze ethical issues and to refine their own thinking about these issues. For example, case studies and role play exercises that encourage students to take the perspective of another are beneficial, given that social perspective taking and empathy are important ingredients of ethical reasoning. Additionally, the importance of self-reflection and autobiographical recall (Lieberman 2007) suggests that students engage in exercises to understand their own values and purpose, as well as how their previous experiences have shaped those values.

Finally, we should also point to the distinction between the neuroscience of ethics and the ethics of neuroscience (Roskies 2002, Salvador and Folger 2009). The neuroscience of ethics has been the focus of this paper, but we also acknowledge the responsibility of business ethicists to engage in assessing the ethics of neuroscience. The ethics of neuroscience examines questions about the use and application of neuroscience methodologies. Business ethicists have a great deal to contribute to the debate over the strengths and weaknesses of neuroscience, but particularly to the ethical implications of its use in studying human behavior.

Controversy over the ethics of neuroscience includes, for example, the questions raised by some critics as to whether marketers are trying to isolate a "buy" button in the brain, and if prospective employers will use brain images to select employees, introducing questions of invasion of privacy. Some hold the attitude that it is but a short step from the descriptive nature of brain imaging to the ability to manipulate the brain of a consumer or an employee, despite the fact that present-day neuroscience has limited ability to do so. In the field of ethics, as well as law, the fear seems to be that neuroscience can identify abnormalities in brain structure that can be used to establish excuses for unethical and illegal behavior. In other words, can unethical behavior be reduced to brain chemistry, and, if so, what are the implications? This type of anxiety on the part of the lay public has been stirred by the media and cannot be ignored by those conducting neuroscience research (Weisberg 2008). Finally, there are critical voices regarding the use of neuroscience in leadership research (Lindebaum, 2013; Lindebaum and Raftopoulou, 2014; Lindebaum and Zundel, 2013). Criticism centers primarily on the ethically problematic suggestions that neuroscience can be used to select and develop leaders. Neuroscience researchers must be cognizant of the potentially reductionist assumptions that certain activities in the brain are necessary for good leadership, i.e., care must be taken not to derive from brain activity what constitutes ‘good’ leadership (Lindebaum and Zundel, 2013). Business ethics scholars have the opportunity to engage in these controversies, analyzing and weighing arguments on both sides, and ultimately presenting a measured representation of what neuroscience can and cannot do.

Importantly, we need to consider how to foster meaningful dialogue between business ethicists and neuroscientists. Methodologies used by those in the two fields are dissimilar, and the analysis of fMRI data may prove daunting to those not schooled in cognitive neuroscience. Additionally, researchers in both fields need to exercise caution in interpreting findings (see, for example, Bowers, 2016, Lindebaum, 2016). Empiricists in the field of business ethics understand the complexity of factors underlying an individual’s decision to behave ethically or unethically. Any one study can only contribute a small piece of the complete puzzle needed to provide an explanation of behavior. Similarly, cognitive neuroscientists could fall prey to the temptation to conclude that activation in a particular area of the brain is the cause of a certain decision or behavior. Instead, complex behaviors materialize from interactions among various parts of the brain, and, moreover, are influenced by an individual’s environment (Parens and Johnston 2014).

CONCLUSION

In this article we have addressed the question of the value neuroscience can add to the study of business ethics to enhance the contributions of philosophy and other social sciences. In the normative realm, neuroscience continues to raise questions that have engaged philosophers for centuries. While neuroscience cannot provide answers to questions of, for example, freedom and autonomy, it can tell us how freedom is limited if certain brain regions are damaged or impaired. In the empirical realm, neuroscience adds to our knowledge of how individuals make ethical decisions below the level of consciousness and thus beyond what individuals themselves can tell us. Neuroscience thus brings us closer to understanding how individuals process ethical issues. As we have discussed, neuroscience has provided considerable evidence of the importance of emotion in ethical decision making. Additionally, psychology has suggested that unconscious biases govern our behavior; neuroscience can confirm these biases as well as provide information on effective means to counter them. Looking to the future, the proliferation of neuroscience research on moral cognition that has taken place over the last decade is likely to continue. We hope that this article, by introducing the promise of neuroscience to business ethics, can contribute to meaningful dialogue between business ethicists and neuroscientists and spark interest in using new methods to study business ethics phenomena.

Compliance with Ethical Standards

The article was not funded by any third-party organization. The article does not contain any studies with human participants or animals.

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TABLE 1: Overview of neuroscience methods

Neuroscience method	Measure	Advantages	Disadvantages	Examples related to business ethics research
Electroencephalography (EEG)	Technique based on changes in electric activity	Excellent temporal resolution (milliseconds) Can measure activity in different brain regions simultaneously Relatively easy to use, can be applied to group settings Relatively low cost (compared to fMRI)	Limited spatial resolution Restricted to surface levels of brain activity	Boksem and De Cremer, 2010; Hannah et al., 2013; Lee et al., 2014; Waldman et al., 2011
Functional magnetic resonance imaging (fMRI)	Technique based on changes in cerebral blood flow/metabolism	Excellent spatial resolution of the brain (up to one millimeter) Good temporal resolution (seconds) Can measure activity in different brain regions simultaneously	Relatively high costs Extensive preparations Participants are confined to a small space where movement is very limited	Bagozzi et al., 2013; Greene et al., 2001, 2004; Moll et al., 2002; Rilling et al., 2004a; Singer et al., 2004
Transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS)	Technique based on temporary inhibition or stimulation of specific brain areas or functions	Allows for experimental manipulation and the test of causal relations (between brain areas and cognitive functions)	Limited temporal resolution Restricted to surface regions of the brain and to manipulating a single brain region at a time Relatively high human subjects requirements	Jeurissen et al., 2014 ; Knoch et al., 2006; Young et al., 2010

Hormones (e.g., testosterone, cortisol, oxytocin)	Measures of hormone concentration in saliva or blood Possibility to manipulate hormone concentration (invasive)	Easy to use and to measure Relatively low cost Possible to measure the current state as well as to manipulate hormonal levels for causal inferences Possible to collect data in laboratory as well as field settings	Strong circadian variation over the course of the day Gender differences makes comparison between genders difficult	Bendahan et al., 2015; Carney and Mason, 2010; Fehr, 2008; Kosfeld et al., 2005; Schultheiss et al., 2004
Biological implicit measures	Include eye tracking, measures of pupil dilation, skin conductance by measuring perspiration	Relatively low cost Reliable measure of attention (eye tracking) Reliable measure of emotional reactions (skin conductance)	Difficulties in interpretation Requires careful design to rule out alternative explanation for bodily reactions	Decety et al., 2012; Pärnamets et al., 2015 Skulmowski et al., 2014

TABLE 2: Ethical decision making and the brain

Concepts related to ethical decision making	**Brain structure involved**	**Functions associated with brain structure and brain chemistry**	**Relevance for ethical decision making**	**Example references**
Self-reflection and self-regulation	Several areas of the prefrontal cortex (PFC) (e.g., medial PFC, ventromedial PFC, lateral PFC)	PFC is associated with cognitive tasks, personality expression, and the orchestration of thoughts and actions in accordance with internal goals; it fulfills an executive function in differentiating between conflicting thoughts (such as good or bad) Medial PFC is associated with reflecting on one's experiences and is active in self-judgment tasks; the ventromedial PFC is involved in autobiographical and episodic memory retrieval; the lateral PFC is associated with focusing on goals and inhibiting one's beliefs when necessary for making rational decisions; lateral and ventrolateral PFC are associated with emotional self-control	• Shows the relevance of emotions in ethical decision making • Understanding oneself helps reflection on one's ethical behavior and finding the balance between emotional and cognitive reactions when making ethical decisions • Highlights the possibility of self-regulation in the form of impulse control and the reappraisal of emotional events • Past and current experiences and positive or negative emotional stimulation trigger intuitive ethical behavior	Damasio, 1994; Dimoka, 2012; Greene, 2015; Johnson et al., 2002; Lieberman, 2007
	Dorsal anterior cingulate cortex (ACC)	ACC is relevant for affective, cognitive and motor control phenomena; also involved in controlling, avoiding, or regulating painful emotions		
	Amygdala	Amygdala is involved in perceiving and processing emotions, and in automatic affective processes		
Theory of Mind (ToM)	Anterior paracingulate cortex	ACC is relevant for affective, cognitive and motor control phenomena; also involved in controlling, avoiding, or regulating painful emotions	• Cognitive-rational understanding of others' motives and reasons helps to engage in deliberative ethical reasoning • ToM is a necessary precondition for ideal role-taking processes	Bagozzi et al., 2013; Bzdok et al., 2012; Dimoka, 2012; Rilling et al., 2004b; Young et al., 2007
	Posterior superior temporal sulcus (STS)	STS is attributed to multisensory processing capabilities (e.g. voices, speech and language recognition); involved in social perceptions		

	Temporo-parietal junction (TPJ)	TPJ is involved in information processing and perception; integrates information from the external environment and from within the body; important for self-other distinctions		
	Dorsomedial prefrontal cortex (PFC)	Dorsomedial PFC is associated with mentalizing and encoding the psychological traits of others		
Empathy	Anterior cingulate cortex (ACC)	ACC is relevant for affective, cognitive and motor control phenomena; also involved in controlling, avoiding, or regulating painful emotions	• Emphasizes the importance of recognizing other persons' feelings and emotional states for ethical decision making • Affective emotional reaction to others' harm or unethical treatment triggers ethical sensitivity and awareness	Bagozzi et al., 2013; Bernhardt and Singer, 2012; Bzdok et al., 2012; Dimoka, 2012; Singer et al., 2004
	Anterior insula	Insula plays a major role in representing and integrating emotions; involved in sensation, affect, cognition		
	Ventromedial PFC	Ventromedial PFC is relevant for encoding the emotional value of sensory stimuli; also important for adherence to social norms		
Social interaction (including trust, justice, cooperation)	Several areas of the prefrontal cortex PFC (e.g., ventromedial PFC, medial PFC, dorsomedial PFC)	PFC has been associated with cognitive tasks, personality expression and the orchestration of thoughts and actions in accordance with internal goals; it fulfills an executive function in differentiating between conflicting thoughts (like good or bad)	• Social lubricants like trust and fairness perceptions influence the propensity to engage in ethical or unethical behavior • Shows the importance of trust and justice perceptions for successful social interactions and highlights stimulus-response settings that trigger trusting responses and facilitate cooperation	Adolphs, 2003; Lieberman, 2007; Rilling et al., 2004a; Yoder and Decety, 2014
	Insula	Insula is associated with sensitivity to norm violations, care and justice cognition		
	Amygdala	Amygdala is involved in perceiving and processing emotions, and in automatic affective processes		
	Caudate nucleus	Caudate nucleus is important for feelings of reward		

Moral judgment	Ventromedial prefrontal cortex (PFC)	Ventromedial PFC is activated during moral judgment; it is associated with encoding the emotional value of sensory stimuli, emotional processing and adherence to social norms	• Combines the above mentioned mental abilities to make ethical decisions and behave ethically	Fumagalli and Priori, 2012; Greene et al., 2001 ; Moll et al., 2002, 2005; Young et al., 2007
	Dorsolateral prefrontal cortex (PFC)	Dorsolateral PFC is involved in problem-solving, cognitive control, cost-benefit analysis; it is associated with utilitarian moral judgments and deciding on appropriate punishment		
	Anterior cingulate cortex (ACC)	ACC is relevant for affective, cognitive and motor control phenomena and is associated with mediating the conflict between emotional and rational components of moral reasoning		
	Posterior superior temporal sulcus (STS)	STS is associated with multisensory processing capabilities is activated in moral dilemmas, social cognition, and ethical decision making		
	Temporo-parietal junction (TPJ)	TPJ is attributed to moral intuition and involved in belief attribution during moral judgment		
	Insula	Insula is associated with moral processing, sensitivity to norm violations, care and justice cognition		
	Amygdala	Amygdala is activated in processing moral emotions and consequently, during evaluation of moral judgment		

Table 3: Suggested future research directions

Areas related to business ethics	Research questions
Individual differences	Does brain activity in older individuals indicate that they process ethical issues differently than do younger individuals? What implications does this have for an ageing workforce? Does brain activity in men indicate that they process ethical issues differently than do women? Can brain activity tell us more about how the time of day (differences between morning and evening people) impacts ethical decision making? What can brain activity tell us about how stress or lack of sleep in highly demanding work environments are linked to ethical decision making?
Incentives and rewards	How does the brain process intrinsic rewards (e.g., altruism, cooperation, meaningful work) versus extrinsic rewards (e.g., money, organizational promotion)? Does ethical or moral behavior trigger reward activation in the brain? If so, does this differ by individual? Are there differences in brain activity for different kinds of rewards typical for business organizations (e.g., bonuses or pay raises, short-term and long-term rewards) How does the brain calculate the risks involved in unethical behavior in organizations (e.g., job loss, loss of status, etc.)?
Leadership	How does the brain process the cognitive and emotional challenges of ethical leadership? How do the brains of leaders and followers process issues of the leader-follower relationship? How does leaders' ethical role modelling relate to followers' brains' activities? What can brain activity tell us about responsible leadership? What are the neural correlates of social value orientations?
Teaching business ethics	Does a course in business ethics alter brain activity as students engage in ethical decision making? If so, how?