The Psychobiology of Conscience:
Signatures in Brain Regions of Interest

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A partial transcription of the Power Point presentations entitled **The Psychobiology of Conscience:** ***Signatures in Brain Regions of Interest with Special Reference to' A Lady'*** to the **CONSCIENCE PROJECT** Quarterly Meeting, Indianapolis, Indiana 12/6/2008 and to the **Predictive Health Ethics Research** (PredictER) **Program Indiana University Center for Bioethics**, 3/2/09 given by M Galvin and M Gaffney.

ABSTRACT
OBJECTIVES : 1) to highlight studies in the last eight years in which functional magnetic resonance imaging or other neuroimaging techniques have been employed in identifying brain activities as putative correlates of various TASKS proposed to represent essential MORAL PSYCHOLOGICAL FUNCTIONS and 2) to consider how NEUROIMAGING STUDIES of CONSCIENCE FUNCTIONAL TASKS might be conducted which provide more depth and meaning in future moral psychobiological investigation. **METHOD**: Brief descriptions of the principles and caveats of interpreting findings from NEUROIMAGING are provided. A GLOSSARY OF TERMS derived from cognitive sciences including neuropsychology and developmental psychology is presented. These terms, it is suggested, are necessary but not sufficient in understanding the DOMAINS OF CONSCIENCE. Existing NEUROIMAGING STUDIES of putative MORAL PSYCHOLOGICAL FUNCTIONAL TASKS that (at least nominally) address aspects of each CONSCIENCE DOMAIN are reviewed. These STUDIES are organized according to the following subtitles (with the CONSCIENCE DOMAIN of concern identified parenthetically): MORAL COGNITION: MORAL JUDGMENT AND VALENCE (CONSCIENCE DOMAIN: VALUATION), EMPATHY (CONSCIENCE DOMAIN: MORALIZED ATTACHMENT), MORAL EMOTIONS (CONSCIENCE DOMAIN: MORAL EMOTIONAL RESPONSIVENESS), and SELF CONTROL (CONSCIENCE DOMAIN: MORAL VOLITION). No existing NEUROIMAGING STUDIES clearly correspond to the anchor domain, CONCEPTUALIZATION OF CONSCIENCE. The CONSCIENCE DOMAINS are briefly characterized with reference to the empirical research supporting each. **CONCLUSIONS:** In the last several years, a number of intriguing findings have emerged from NEURO-IMAGING STUDIES relevant to putative MORAL PSYCHOLOGICAL FUNCTIONAL TASKS. However, in addition to caveats attaching to any attribution of activity to neurological structures and their connections based upon signals captured via NEURO-IMAGING, serious concerns also arise regarding the validity of the TASKS currently employed in these studies as truly representative of CONSCIENCE FUNCTIONS. Instruments designed to inquire into relevant CONSCIENCE DOMAINS are put forward. Complementary TASKS more sensitive to each CONSCIENCE DOMAIN are imagined and offered for consideration as ways to provide more depth and meaning to future NEUROIMAGING STUDIES OF CONSCIENCE.
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Key words: DOMAINS OF CONSCIENCE (CONCEPTUALIZATION OF CONSCIENCE, MORALIZED ATTACHMENT, MORAL EMOTIONAL RESPONSIVENESS, MORAL VALUATION AND MORAL VOLITION); MORAL PSYCHOLOGICAL FUNCTIONS (MORAL COGNITION, MORAL JUDGMENT, VALENCE, EMPATHY, MORAL EMOTIONS, SELF CONTROL); MORAL PSYCHOLOGICAL TASKS; NEUROIMAGING STUDIES.

INTRODUCTION
Our last overview of the subject, psychobiology of conscience, was seven years ago (contained in Galvin et al, 2001). At that time we expressed the opinion that conceptions of conscience functioning ought not be confined to behavioral inhibition. The modal modifier 'ought' put our opinion in the form of a mandate; and, as we had long been accustomed to inquiring of others about the rationale for their mandates, we thought it only fair to identify the BECAUSE'S behind ours. Among our BECAUSE'S for following our mandate we adduced:

- MORAL-EMOTIONAL RESPONSIVENESS requires behavioral action and commitment in the processes of reparation and healing as well as prosocial behavior.
- The domains of MORAL SELF VALUATION and MORAL VOLITION are related to the maintenance of self-esteem and the developmental progression from autonomy to moral agency.
- [Such] conscience functions will likely be found to depend upon neuromodulation different from that involved in behavioral inhibition.

Keeping in mind, "It would be surprising indeed if the complexities of conscience were not matched in complexity by its psychobiological basis…" we concluded with the speculation: "There will likely be additional implications of the study of maltreatment for a more general psychobiology of conscience as neuro-imaging and assessment of conscience functions in health and psychopathology become more refined."

ABOUT NEUROIMAGING

As recently explicated by Gerber and Peterson (2008):

> An image is simply a two dimensional, physical array of much smaller, two dimensional squares or rectangles, which are elemental units of the picture called PIXELS. Each pixel corresponds to a three dimensional square or rectangular chunk of brain tissue called a volume element or VOXEL. Each pixel of the image is typically assigned either a level of visual grayness ranging from black to white or an arbitrary color that represents a numerical value. In the case of a functional magnetic resonance imaging (fMRI) map, what is captured in each pixel is the variation **across time** in the level of deoxygenated hemoglobin, which in turn indexes the level of neural activity, in the corresponding brain voxel. The degree to which that temporal variation in deoxyhemoglobin in each voxel correlates with the temporal variation in behavior or sensory experience of the person being imaged is assessed statistically and that statistical index is assigned to the corresponding pixel of the image. That statistic is color encoded and literally painted on the brain image, usually by being superimposed on a corresponding grayscale representation of brain structure to help locate where the brain activity is located.

Neuroscience research proceeds at an astonishingly rapid pace. Since our last review, much has transpired. At the 2005 **Annual Meeting of the American Psychiatric Association (APA),** Peter Bandettini, PhD Chief of the Functional Magnetic Resonance Imaging Methods Unit for the National Institute of Mental Health (NIMH), opened his presentation by remarking that there had been nearly exponential growth in the number of papers published on the subject of fMR-neuroimaging between 1992 (at which point there were very few) and 2004 (at which point there were more than 1700). He noted as well an ever enlarging proportion of papers dealing with higher order cognition and emotion. Even more recently, in the November of 2008 issue of the **Journal of the American Academy of Child and Adolescent Psychiatry**, Ellen Leibenluft, MD (2008)with the Section on Bipolar Spectrum Disorders, Emotion and Development Branch at NIMH wrote an editorial entitled *Skating to Where the Puck will be: The Importance of Neuroimaging Literacy in Child Psychiatry.* Analogizing from the strategies employed by a savvy hockey player, Dr Leibenluft urges educated consumption of the emerging neuroimaging literature but she emphasizes " ... these are early days : the brain and brain illnesses are remarkably complex , our corpus of neuroimaging data is still limited, and the technology is still relatively new...." Conveying the message even more emphatically, the following cautionary

statements were abstracted for ***American Psychiatric Association Headlines*** *from* ***USA Today*** *9/10 /2008* with the by-line *EXPERTS URGE CAUTION IN INTERPRETING fMRI STUDY RESULTS*:

> A revolution in 'functional' magnetic resonance imaging (fMRI)...is being used by researchers to pinpoint the pieces of the brain that people rely on to think and feel. In order to produce brain images, the magnetic pulses are tuned to resonate with oxygen molecules in blood. Volunteers are given a task or asked questions, and the scanners show where oxygen-heavy blood flows are headed, causing certain parts of the brain to light up in fMRI images.
>
> Neurophysiologist Nikos Logothetis, PhD, of Germany's Max Planck Institute, explained that many studies that claim to have found a brain 'center' for some activity assume that these areas of high blood flow are where the particular activity occurs in the brain that corresponds to the task at hand. But, due to the brain's complexity, Logothetis warns that we are seeing something that may have 10 other explanations. And, according to neuroscientist and philosopher Adina Roskies, PhD of Dartmouth University, because fMRI delivers images as well as data about brain activity, the technology is particularly susceptible to over-interpretation.

DOMAINS OF CONSCIENCE

There was a time when many researchers, even in developmental moral psychology, would scrupulously avoid CONSCIENCE LANGUAGE in interpreting their findings. Nonetheless, among the papers dealing with higher order cognition and emotion to which Dr. Bandettini might have been referring, there are found several pertaining to CONSCIENCE. In a presentation eleven years ago (Galvin et al, 1997), we described the conditions of scholarship which then obtained, declaring that psychology [had] suffered long enough from a reduction of INNER STATES to just two categories: cognitions and affects. In the context of moral development, we then made a plea that we would do better to accept the irreducibility of at least the following INNER STATES:

THINKING. FEELING. VALUING. WILLING.

Each, we averred, should be treated as irreducible to the others. None should be treated as existing independently from the others. Nothing has emerged in the literature to convince us otherwise. Indeed, as will be discussed further on, positing a distinction between FEELING and VALUE (which are often lumped together as affective conditions) would seem to comport (albeit with a modicum of reduction) to the notion of two dimensions of AROUSAL and VALENCE— for example, in the AFFECTIVE CIRCUMPLEX MODEL (POSNER, 2008)—dimensions which, in turn, correlate with activities in different brain regions.

For now we are content to correct an error of omission by including another among the INNER STATES, one especially critical when we are speaking of the internal representations of principal attachment relationships:

THINKING. FEELING. VALUING. WILLING and **CONNECTING.**

For heuristic purposes, we will reorganize the terms as follows:

VALUING. CONNECTING. FEELING. WILLING. THINKING.

These inner states correspond, respectively, to the DOMAINS OF CONSCIENCE characterized in empirical research: MORAL VALUATION (Stilwell et al, 1996), MORAL ATTACHMENT (Stilwell et al, 1997), MORALEMOTIONAL RESPONSIVENESS (Stilwell et al, 1994) MORAL VOLITION (Stilwell et al, 1998) AND CONCEPTUALIZATION OF CONSCIENCE (Stilwell, et al, 1985, 1991). These DOMAINS OF CONSCIENCE remain our focus in this review of NEUROIMAGING. Since 1997, CONSCIENCE LANGUAGE has become respectable in at least some quarters of neuroscience and even, it may be observed with some irony, is finding its way back into ethical discourse. This felicitous (albeit belated) state of affairs has allowed a literature search (courtesy Ms. Sue London at the Ruth Lilly Medical Library) using keywords pertaining, on the one hand, to the name (if not the core concept) of each DOMAIN OF CONSCIENCE identified in **CONSCIENCE THEORY**[1] and, on the other hand, to NEUROIMAGING STUDIES, chief among them those employing functional magnetic resonance imaging, thereby providing the basis for today's overview.

Nevertheless, it must be stressed that, while NEUROIMAGING has become ever more refined and ever more widespread, the same cannot truly be said for assessment of conscience in health and psychopathology. As will be seen, for all the CONSCIENCE LANGUAGE that has been employed within reports of new research, the driving hypotheses have rested upon an impoverished conceptualization of conscience in each of its domains, thus casting serious doubt upon both face and construct validity of the studies. We will have some remedies to propose.

OBJECTIVES

Our objectives for this review are:

1)to highlight studies in the last eight years in which functional Magnetic Resonance Imaging (fMRI) or other NEUROIMAGING techniques have been employed in the study of brain activity correlating with conscience functions,

[While doing so we wish to keep in mind the question: How, given available technology, can current methodology be improved to more fully capture signals of brain activity correlating with **moralization** of cognitive, affective, valuational and volitional mental states?]

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[1] CONSCIENCE THEORY *per se* has three essential components: INVARIANT HIERARCHICAL STAGES, INTERDEPENDENT DOMAINS and INTRINSIC, DOMAIN-SPECIFIC, VALUES. An elaboration of CONSCIENCE THEORY is our CONSCIENCE-CENTERED THEORY OF ETHICS which begins with the following propositions:
i. Valuation exists.
ii. Valuation has intrinsic value.
iii. Valuation does not exist without attachment, cognition, emotion and volition, hence these too, must have at least instrumental (more probably intrinsic and, possibly in the case of volition, originative) value.
iv. Conscience formation is one means by which an organic unity of these developmental domains is attained, in virtue of which they are said to be moralized.
v. Choosing a life with conscience has intrinsic (originative?) value in virtue of which each of the other domains has intrinsic (bedrock) value. Hence the choice of conscience involves accepting certain values which govern, but in turn are shaped by, the practice of virtues.
vi. These values are: MEANING, CONNECTEDNESS, HARMONY, AUTONOMY, and GOODNESS

For a more detailed consideration, see Galvin M and Stilwell B (1997/2003): Conscience in the mental health professional, Edited by: M Galvin and M Gaffney for **CONSCIENCE WORKS, *Conscience and Ethics***. 2 (1): 1- 104.

2) to propose how neuroimaging studies of conscience functions might be provided more depth and meaning.

To assist in meeting the first of our objectives, it will be helpful to present a **GLOSSARY OF TERMS** deriving from cognitive sciences including neuropsychology and developmental psychology. These terms, all of which have currency in their respective literatures, we suggest, may be seen to relate to the DOMAINS OF CONSCIENCE, although no definitive correspondence of terms with domains will here be attempted. Immediately following, we have provided material to orient the reader to areas in the brain.

INSET 1.

GLOSSARY OF TERMS

Executive functions
(Posner and Snyder, 1975) is used to describe a loosely defined collection of brain processes the role of which is to guide thought and behavior in accordance with internally generated goals or plans. Citing Brown (2006), Gemelli (2008) identifies the following **executive ego functions**:

- Activation—organizing, prioritizing, and getting to work
- Focus—tuning in, sustaining focus, and shifting attention when appropriate
- Effort—regulating alertness, sustaining effort and adjusting processing speed
- Emotions– managing frustration and modulating emotion
- Memory—holding on to and working with information; retrieving memories
- Action—monitoring and regulating one's actions

Explicit and Implicit Memory
According to Daniel Siegel (2001): The forms of memory are:

- Early, non-declarative, procedural, implicit, and
- Late, declarative, episodic/semantic, explicit.

The developmental biology of memory involves:

- Implicit processing systems, present at birth, and
- Explicit processing systems, of which there are two:
  Semantic: developing by 1-2 years of age, and
  Autobiographical: showing progressive development with onset after the second year of life.

Implicit Memory

- A form of memory devoid of the subjective internal experience of "recalling," of self, or of time.
- Involves mental models and "priming"
- Includes behavioral, emotional, perceptual, and perhaps somatosensory memory.
- Focal attention is not required for encoding
- Is mediated via brain circuits involved in the initial encoding and independent of the medial temporal lobe / hippocampus

Explicit Memory

- Requires conscious awareness for encoding and having the subjective sense of recollection (and, if autobiographical, of self and time).
- Includes semantic (factual) and episodic (autobiographical) memory.

- Focal attention IS needed for encoding.
- Hippocampal processing IS required for storage.
- Cortical consolidation makes selected events part of permanent memory.

Dual Process Theories
(Kahneman & Sunstein , 2006)

- **System I (Intuitive)** Automatic, Effortless, Associative, Rapid, Opaque process, and Skilled
- **System II (Reflective)** Controlled, Effortful, Deductive, Slow, Self-aware, Rule-Following

Valence
(Friddja, 1986) especially in discussing emotions, means the intrinsic attractiveness (positive valence) or aversiveness (negative valence) of an event, object, or situation. Citing Bargh (1997), Zajonc (1998) and LeDoux (2000), Kahneman and Sunstein (2006) write that the assessment of whether objects are good (and should be approached) or bad (should be avoided) is carried out quickly and efficiently by specialized neural circuitry.

> [Cf: *A morning in the life of doctor every person,* CONSCIENCE IN THE MENTAL HEALTH PROFESSIONAL, **Conscience Works, *Conscience and Ethics*,** 2 (1): 15- 21**,** 2003.]

Mutually Responsive Orientation (MRO)
A term introduced by Kochanska (1997), which she clearly relates to **attachment** scholarship, is a positive, close, mutually binding, cooperative relationship that emerges in some parent–child dyads, and promotes many positive socialization outcomes, including children's conscience.

Bowlby conceptualized **ATTACHMENT** as a biological system with the proximal aim of providing a secure base from which the young may safely explore the world and a distal aim of preserving the species. Deficiencies and deviancies in caregiver attachment abilities have been causally linked to insecurity, social avoidance, social resistance and emotional/cognitive disorganization, as well as behavior outside the realm of societal acceptability (Magid and McKelvey, 1987) ℘

> ℘ Galvin M, et al (2001).

Affective Style (Davidson, 2006) refers to the individual differences in reactions to emotional incentives and in dispositional mood.

Effortful Control Quoting Posner and Rothbart (2000), we noted in 2001:

> Self-regulation involves complex questions about the nature of volition (effortful control) and its relation to our genetic endowment and to social experience. Within cognitive psychology, the mechanisms thought to be involved in self-control are collectively called attention. ATTENTION allows rapid changes in neural activity in local brain areas. Priority is produced, in the timeframe of milliseconds, by amplifying the amount of neural activity within the area performing the skill. When this is done voluntarily it is called EFFORTFUL ATTENTION. PRIMING, in the timeframe of seconds or minutes, involves efficiently tuning the process in which automatic pathways are established, over minutes to days, by PRACTICE. Learning further involves the establishment of new connections stimulated by new associations over weeks, which eventuate, over additional weeks, in RULE LEARNING mediated by new structures, and, over years, DEVELOPMENT dependent

upon more complex networks. Executive control is a second form of attention that emerges in the second year of life and is thought to involve the frontal midline…. ℘

℘ Ibid.

Mirror Neurons or Mirror Mechanisms.

As discussed by Giacomo Rizzolatti and Laila Craighera (2005) are:

> General neural mechanisms that enable individuals to understand the meaning of actions done by others [i.e. action understanding], their intentions [i.e. intention understanding] and their emotions [emotion understanding], through activation of internal representations coding motorically observed actions and emotions…. [I]t is very likely that the faculty for **imitation** developed on the top of the mirror system. However, its initial basic function was not imitation in the proper sense but enabling an individual to understand actions by others….
> … Brain imaging studies have allowed the localization of the cortical areas forming the human mirror neuron system: the observation of others activates, besides the visual areas, two cortical regions whose function is classically considered to be (fundamentally or predominantly) a motor one: the **inferior parietal lobule** … the lower part of the **precentral frontal gyrus** plus the posterior part of the **inferior frontal gyrus**….
> … The issue of whether intention comprehension (the 'why' of an observed act) could be mediated by the mirror neurons… [has also been] addressed in a study in which motor and visual properties of mirror neurons of the **inferior parietal lobule (IPL)** were investigated….
> … The *observing* individual may re-enact internally the observed action and thus *predict* the goal of the observed action… "reading" the intention of the *observed* individual….
> [I]n addition to mirror neurons that fire during the execution and observation of the same motor act … there should be neurons that are visually triggered by a given motor act but discharge during the execution *not* of the same motor act, but of another one that is functionally related to the former and is part of the same action chain…referred to as "logically related" mirror neurons….
> …The hypothesis that we perceive emotion in others by activating the same emotion in ourselves has been advanced by various authors…. Particularly influential in this respect has been the work of Damasio and his coworkers. According to these authors, the neural basis of empathy is the activation of an "as--if--loop," the core structure of which is the **insula**, [with a role attributed to] **somatosensory areas** like SI and SII, conceiving the basis of empathy to be in the activation in the observer of those cortical areas where the body is represented…."

Theory of Mind (ToM) is not any formal epistemological theory of mind but rather the ability anyone has to theorize both about others, and, as we believe essential for study of conscience, about oneself, to attribute mental states—beliefs, intents, desires, pretending, knowledge, etc.—to oneself and others and to understand that others have beliefs, desires and intentions that are different from one's own. Psychologist Baron-Cohen is often cited in the literature on autism for proposing an inability to develop theory of mind as the essential problem in the developmental psychopathology of autism. Many developmental psychologists identify the emergence of this ability in the child at around 4 years of age.

> [There are many thoughtful references to the subject to be found in: **Autism and Blindness**, **Research and Reflections** ed. L Pring , London: Whurr Publishers, 2005.]

The **Mentalizing function,** according to Gemelli (cited previously) is the capacity to use self reflection to become aware of possessing a mind and to gradually understand one's own mind and the minds of others as being complex, with different emotions, beliefs and conflicts.

SOME IMPORTANT BRAIN REGIONS

> **Korbinian Brodmann** (November 17, 1868 - August 22, 1918) was a German neurologist who became famous for his definition of the cerebral cortex into 52 distinct regions from their cytoarchitectonic (histological) characteristics. These areas are now usually referred to as **Brodmann areas** (BA). Some of these areas were later associated to nervous functions, such as areas 41 and 42 in the temporal lobe (related to hearing), areas 1, 2 and 3 in the postcentral gyrus of the parietal lobe (the somatosensory region), and the areas 17 and 18 in the occipital lobe (the primary visual areas).

BA 9 and **BA46**: each contribute to the **dorsolateral prefrontal cortex (DLPFC).**
The **ventrolateral prefrontal cortex (VLPFC)** consists of the **inferior frontal gyrus**: **BA 47, 45** is coming to be understood as a crucial region modulating affective responses in subcortical structures, in addition to its role in attentional control and response inhibition (Pavuluri and Sweeney, 2008).

According to Hannah Damasio (2005):

> The VMPFC is likely to play multiple roles in normals and its damage is thus likely to cause several defects. In all likelihood, the VMPFC region is necessary for triggering most of the salient social emotions, its functional role in this regard being akin to the amygdala regarding fear.... But the VMPFC is likely to play another role, that of a learned repository of the link between situations calling for a decision and the outcome of decisions, on the one hand, and on the other, the emotional state associated with the situations or with the result of the decisions. The VMPFC would house the record of the linkage between "situation–and–associated-emotion"or "outcome–and–resulting-emotion." When a situation of the same category as one previously experienced would present itself, the VMPFC would generate the emotion previously associated with that category of situation and with the outcome of the decision it prompted. In this role, the VMPFC is, once again, a trigger region for emotions, except that here the trigger is not an evolutionarily established, emotionally competent stimulus, such as the suffering of another, which triggers compassion. Rather, the trigger is a stimulus learned by the subject, in his or her past experience, and the triggered emotion may or may not be a social emotion….
> It should be noted that the normal VMPFC would operate by acting on other brain structures, namely, the DLPFC where we suspect signaling from the VMPFC plays a role in reasoning and decision–making, directly or via the intermediary action of subcortical regions , e.g. amygdala. In other words, the "somatic marker" signal evoked in VMPFC would depend on contributions from subcortical structures and exert its role in the guidance of behavior via the regions on which reasoning is likely to depend the most given their role in higher cognition: the DLPFC….

METHOD

Proceeding systematically we will first review existing NEUROIMAGING STUDIES that at least nominally address one or more aspects of each CONSCIENCE DOMAIN. For the sake of compatibility with the existing NEUROIMAGING STUDIES, the CONSCIENCE DOMAINS appear here in a different order than how they were originally investigated and reported in the literature. The NEURO-IMAGING STUDIES are subsumed by the following subtitles (with the CONSCIENCE DOMAIN of concern identified parenthetically): MORAL COGNITION: MORAL JUDGMENT AND VALENCE (CONSCIENCE DOMAIN: VALUATION), EMPATHY (CONSCIENCE DOMAIN: MORALIZED ATTACHMENT), MORAL EMOTIONS (CONSCIENCE DOMAIN: MORAL EMOTIONAL RESPONSIVENESS), and SELF CONTROL (CONSCIENCE DOMAIN: MORAL VOLITION). To our knowledge, there are no NEUROIMAGING STUDIES under the heading of CONCEPTUALIZATION OF CONSCIENCE (cf, MORAL IMAGINATION, we have used in clinical and educational settings less formally), although NEUROIMAGING STUDIES of Theory of Mind seem to us highly pertinent. Next, we will identify deep-level personal inquiries into the relevant domain. For the information of future investigators, there are two recommended forms of inquiry for children and adolescents: the **Stilwell Conscience Interview (SCI)** (questions from which are selected for this essay), and the **Structured Stilwell Conscience Interview (SSCI)**. For adults the SCI has been adapted as the **Indiana University (IU) Health Professional Conscience Interview** and the **IU Conscience Autobiography.** Immediately following the set of inquiries relevant to the CONSCIENCE DOMAIN, the domain itself will be briefly characterized with reference to empirical research. Finally, we will operationally define particular TASKS we have utilized in clinical and educational settings for each domain, which seem to us susceptible of being conducted in the near future given the current technology available for NEUROIMAGING STUDIES. These appear as INSETS 2-7 subsumed under the heading "IN THE THINK TANK."

NEUROIMAGING STUDIES ON MORAL COGNITION

MORAL REASONING. In *Conscience in the Mental Health Professional* (Galvin and Stilwell, 1997/2003) we critically reviewed this aspect, which, early on, dominated moral developmental psychology:

> Piaget (1965, 1976) began posing some dilemmas with moral characteristics to children of different ages to see how they reasoned morally, for example, about intentionality. He proposed two stages of moral development, the heteronomous and the autonomous. In the heteronomous stage, rules are explained as having authorship in some ultimate authority; in the autonomous stage, rules are explained as having been derived from mutual agreement and are amenable to change. Kohlberg extended the use of moral dilemmas, the most famous of which is The Heinz Dilemma. Kohlberg (1981) combined the concepts of cognitive development and moral philosophy into a stage theory of moral reasoning.

MORAL JUDGMENT may appear to be a concept closely related to – and in common parlance used in a manner difficult to distinguish from—MORAL REASONING. Still, even within the realm of common parlance, the former might be contradistinguished from the latter in that MORAL JUDGMENT conveys a component of VALUATION that at least some instrumental forms of REASONING need not possess, such as CONSEQUENTIAL, MEANS-END and ALTERNATIVE forms of THINKING, even when applied to moral matters. Adding even more complexity to the conversation, some theorists about MORAL JUDGMENT specify that it follows directly on the heels of an action analysis that is not at all explicit and that these processes are *antecedent* to both MORAL REASONING and MORAL EMOTION. Referring to DUAL PROCESSING SYSTEMS in the **Glossary of Terms,** one

will recognize what these theorists have in mind is something like SYSTEM I (INTUITIVE): an automatic, effortless, associative, rapid, opaque process, but more or less susceptible to skill building. Historians of moral philosophy may recognize an emphasis upon SYSTEM I as comporting with explanations of morality such as INTUITIONISM or MORAL SENSE or appeals to AN INNATE MORAL GRAMMAR (*à la* NOAM CHOMSKY), not readily available to an agent's conscious deliberation.[2]

To appreciate how nuanced the terms MORAL REASONING and MORAL JUDGMENT can be outside common parlance, we consider Antonio Damasio's (2005) remarks on how we produce moral judgments:

> Two main traditions are usually identified. One claims that, when we are faced with a situation, we use reasoning to detect a violation or an observance of the established norm, we use further reasoning to weigh and classify the violation or observance, and still more reasoning to pronounce a judgment and a sentence. This is the tradition identified with Kant, whose roots go back to Plato and whose modern exponent is the philosopher John Rawls. The psychologists Piaget and Kohlberg are also identified with this tradition.
> The other tradition, which is identified with David Hume and Adam Smith, claims that we react to the social situation emotionally and automatically. We instantly produce moral sentiments and intuitions that guide us towards our response to the situation. In this tradition, much of the 'moral reasoning' occurs *after* the moral intuitions have given us a first response. This late, after–the–intuition reasoning often takes the form of rationalization, the post-hoc construction of a case for a certain intuition rather than the deduction that led into it. Using Haidt's account (2002), we can say that moral intuitions are the judges but those judges are not against having attorneys construct a justification for their pronouncements. Moral reasonings, on the other hand, handle the whole judicial process. The kinder and gentler tradition of moral practice provided by moral intuition has some roots in Aristotle and, in a roundabout way, in Spinoza. Darwin and Freud were early adopters and Jonathan Haidt has argued this view persuasively.

Implicated in the psychobiology of MORAL JUDGMENT understood in this way are brain regions of interest, the DLPFC as well as the VMPFC in the human brain.[3] One particularly notable theory of VMPFC function is the SOMATIC MARKER HYPOTHESIS, accredited to Antonio Damasio (1994/2000). By this hypothesis, the VMPFC has a central role in adapting somatic markers–-emotional associations, or associations between mental objects and visceral (bodily) feedback—for use in natural decision making. This account also gives the VMPFC a role in moderating emotions and emotional reactions.

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[2] Further Reading: Hauser M (2006): **Moral Minds: How Nature Designed Our Universal Sense of Right and Wrong.** New York: HarperCollins. pp 1-55.]

[3] Its function has not been fully determined, but experiments suggest that it may have a role in the processing of risk and fear. The VMPFC has three subregions (dorsal anterior cingulate, prelimbic, and infralimbic). Note that different researchers use the term 'VMPFC' differently. Sometimes, the term is saved for the area above the medial orbitofrontal cortex, while by others, 'VMPFC' is used to describe a broad area in the lower (ventral) central (medial) region of the prefrontal cortex, of which the medial orbitofrontal cortex constitutes the lower-most part. Courtesy: **Wikipedia**.

In any event, in the tradition of Piaget and Kohlberg, current methodology relies heavily (but not exclusively— as the work of Zysset et al and Moll et al cited below attest) upon use of dilemmas for studying MORAL JUDGMENT.

In an early study conducted by Zysset et al (2002), judgments were defined as the assessment of an external or internal stimulus on an internal scale and fundamental for decision making and other cognitive processes. Evaluative judgments (e.g. 'I like George W. Bush: yes/no') were seen as a special type of judgment, in which the internal scale is related to the person's value system. The investigators used fMRI to examine brain activation during the performance of evaluative judgments as opposed to episodic and semantic memory retrieval. Evaluative judgment produced significant activation in the **anterior frontomedian cortex** (BA 10/9), the **inferior precuneus** (BA23/31), and the **left inferior prefrontal cortex** (BA 45/47). The results showed a functional dissociation between the activations in the anterior frontomedian cortex and in the inferior precuneus. The latter was mainly activated by episodic retrieval processes, supporting its function as a multimodal association area that integrates the different aspects of retrieval and newly presented information. In contrast, the **anterior frontomedian cortex** was mainly involved in evaluative judgments, supporting its role in self-referential processes and in the self initiation of cognitive processes.

The *footbridge 'dilemma'* and the *trolley dilemma* are found in an article (2005) by Joshua Greene entitled "Emotion and cognition in moral judgment: evidence from brain imaging" and in Mark Hauser's book (2006) **Moral Minds.**

> Phillipa Foot's (1978) **Trolley Dilemma.** *A runaway trolley is headed for five people who will be killed if it proceeds on its present course. The only way to save these people is to hit a switch that will turn the trolley onto a side track where it will run over and kill one person instead of five. Is it okay to turn the trolley in order to save the five people at the expense of one?*
>
> **The Footbridge 'Dilemma.'** (Thomson, 1986)*As before, a runaway trolley threatens to kill five people, but this time you are standing next to a large stranger on a footbridge spanning the tracks, in between the oncoming trolley and the five people. The only way to save the five people is to push this stranger off the bridge and onto the tracks below. He will die as a result, but his body will stop the trolley from reaching the others. Is it okay to save five people by pushing this stranger to his death?*

Citing the studies (noted parenthetically in the excerpt), Greene (2005) reports differential brain activity according to whether a so-called personal (e.g. the footbridge) or impersonal (e.g. the trolley) moral dilemma is under consideration (N.B. both personal and impersonal dilemmas are hypothetical in character and not very likely to be derived from any common experience):

> Contemplation of personal moral dilemmas produced greater activity in three emotion–related areas: the **posterior cingulate cortex** (Maddock 1999), the **medial prefrontal cortex** (Phan et al, 2002) and the **amygdala** (Adolphs 2003; Phan et al, 2002).

Citing other studies of colleagues, Greene (2005) also reports:

> The effect was also observed in the **superior temporal sulcus** and the **temporal pole**, regions associated with various kinds of social cognition (Allison et al, 2000; Saxe et al, 2004).

> At the same time, contemplation of impersonal moral dilemmas, produced relatively greater neural activity in two classically 'cognitive' brain areas, the **dorsolateral prefrontal cortex** and **inferior parietal lobes**.

These are intriguing findings about brain activation correlating with specific tasks, but what about the interpretation imposed upon them, that they are informative about MORAL JUDGMENT. In his essay Eliot Turiel (2008) provides another perspective, one which insists upon consideration of "several serious problems with these methods of study and interpretation of findings," namely in:

- Treating trolley car tasks as representative examples of moral problems involving utilitarian calculations, and
- Presuming that rationality entails utilitarian calculations only.

> … [T]hese types of scenarios pose particular types of emotionally laden problems with multiple considerations that are difficult to reconcile without violating serious moral precepts in order to achieve serious moral goals. In this sense, the scenarios used in the neuroscience studies have affinities with the types of moral situations used by Kohlberg in his research. In both cases there has been a lack of attention to how individuals think and feel about the various components, and their coordination, in these types of situations. In the neuroscience research, gross generalizations are made from these unusual situations to moral functioning in general. The seeming inconsistencies in response to the supposedly same situations (i.e. utilitarian calculations) have been taken to mean that morality is due to evolutionarily determined, emotionally based intuitions and that reasoning is merely rationalization of and justification for subconscious decisions. These approaches to moral acquisition and functioning entail one-dimensional, causal explanations rather than ones that attempt to integrate biology, individual-environmental interactions, thought and emotions ….

Greene (2005):

> **The Crying Baby Dilemma.** *It is wartime, and you and some of your fellow villagers are hiding from enemy soldiers in a basement. Your baby starts to cry, and you cover your baby's mouth to block the sound. If you remove your hand, your baby will cry loudly, the soldiers will hear, and they will find you and the others and kill everyone they find, including you and your baby. If you do not remove your hand, your baby will smother to death. Is it okay to smother your baby to death in order to save yourself and the other villagers?*

The author acknowledges:

> This is a very difficult question. Different people give different answers, and nearly everyone takes a relatively long time. This response is in contrast to other personal moral dilemmas, such as the *Infanticide* dilemma, in which a teenage girl must decide whether to kill her unwanted newborn. In response to this case, people [we tested] quickly and unanimously say that this action is wrong.

On the investigator's analysis of the two dilemmas they identified a 'response conflict' present in the *crying baby* dilemma but not in an *infanticide* scenario**.** This response conflict, it was hypothesized, would be correlated with increased activity in the **anterior cingulate cortex**. In addition, the crying baby dilemma but not the infanticide scenario was hypothesized to evoke a strong cognitive response that would compete with a prepotent, emotional response, which would be correlated with activation in 'classically cognitive' brain areas.

Citing earlier work, Greene (2005) continues:

> These two predictions have held (Greene et al, 2004). Comparing high-reaction time personal moral dilemmas like the *crying baby* to low reaction time personal moral dilemmas like *infanticide* revealed increased activity in the **anterior cingulate cortex** (conflict) as well as the **anterior dorsolateral prefrontal cortex** and the **inferior parietal lobes**, both classically 'cognitive' brain regions.

These investigators also looked at what they classified as UTILITARIAN versus DEONTOLOGICAL responses to the *crying baby* dilemma and found increased activity in **bilateral anterior DLPFC**, the brain regions associated with cognitive control when subjects judged in accordance with utilitarianism. It should be noted that the theory of DUAL PROCESSING SYSTEMS is invoked as an explanation.

In the next study to be considered, this one by Moll et al (2001), dilemmas were not employed. Instead ten adults (six men and four women) engaged in silently judging propositions (given via auditory presentation) as right or wrong. Half the sentences were said to have explicit moral content (e.g. 'Old people are useless.' 'Every human being has the right to live.' 'We break the law when necessary.') while the other half were said to be true or false matters of fact (e.g. 'Stones are made of water.' 'Telephones never ring.' 'Every text has words.').

In this study BOLD fMRI demonstrated activity during moral judgment tasks. Adjusting for the effects of emotional valence, activations in **frontopolar** and **medial frontal** regions remained unchanged but were reduced in **anterior temporal** regions and the **pallidum** was no longer activated. The investigators concluded:

> So far, complex social actions requiring moral evaluations, empathy, theory of mind, and stable social bonds were conceived to rely on two main streams of processing: one more cognitively oriented and dependent on the **dorsolateral prefrontal** system and the other more emotion-oriented and mediated by **anterior temporal, limbic** and **orbito-ventromedial frontal** systems. We believe that the **FPC** which has been largely overlooked in current models of the brain mechanisms of social control, provides further regulation of social conduct… our results favor the view that the prefrontal cortex needs further functional fractionation, with polar, orbital, and dorsolateral sectors mediating distinct but complementary roles in the regulation of social cognition and behavior.

THE ALLURE OF VALUE[4]:
VALENCE IRREDUCIBLE TO- BUT INEXTRICABLE FROM-**EMOTION**

The idea of DUAL PROCESSING at work in MORAL JUDGMENT has appeal in that it provides roles for intuition as well as emotion and reasoning yet a dichotomy of emotion and reason is maintained. Another idea is that there is not a true dichotomy at all in the moral experience but rather a fundamental reliance in MORAL DELIBERATIONS (N.B. the shift in terminology here) upon imaginative processes engaged in metaphor and metonymy drawn from human embodiment. Philosopher Mark Johnson (1993) in **Moral Imagination, Implications of Cognitive Science for Ethics** characterizes **PROTOTYPES IN MORAL DELIBERATIONS,** which:

[4] We are indebted for the term ALLURE OF VALUE to Robert Nozick (1981).

- Represent experientially basic types of situations
- Carry with them the affective dimensions of the concrete situations in which they arise
- Are malleable and flexible
- Have meaning, point, and force that depend on the various narrative contexts in which they are embedded
- Will be the basis for whatever moral principles we have
- In their imaginative use play a central part of our moral development

We will return to MORAL IMAGINATION later. For the time being, it is sufficient to observe that, if Johnson is right about the nature of our moral deliberations, then they are characterized by affective dimensions which are inseparable from but not reducible to cognitive dimensions, in accordance with the aforementioned tenets at which we arrived in our developmental studies of conscience. As we have noted VALENCE often tends in modern psychology to be subsumed by the category of affective dimensions (and presumably is so categorized by Johnson), but one may be justified in wondering why VALENCE should not be accorded status *sui generis,* inseparable from but irreducible to both affects on the one hand and cognitions on the other. Perhaps the practice of subsuming valence (and value) to the realm of affect, has to do with the motivational aspect of both emotion and value which traditionally is not accorded to cognition itself. However, as we have seen, descriptions of evaluative judgment appear to cross freely between realms of affect and cognition.

The study of the AFFECTIVE CIRCUMPLEX (Posner, 2008), mentioned earlier, also follows custom in categorizing VALENCE as affective but nonetheless produces support that the psychobiology of VALENCE is different from that of the (less disputably) affective condition of AROUSAL.

In this study of 10 subjects there was correlation of BOLD signal ratings with ratings of valence and arousal during the presentation of emotion-denoting words. Valence ratings correlated positively with neural activity in the **left insular cortex** and inversely with neural activity in the **right DLPFC** and **precuneus cortices**. The absolute value of VALENCE (reflecting positive and negative extremes of valence) correlated positively with neural activity in the **left DLPFC** and **MPFC**, **dorsal ACC**, **PCC** and **right DPFC**; and inversely with neural activity in the **left medial temporal cortex** and **right amygdala.** Arousal ratings were and neural activity correlated in the **left parahippocampus** and **dorsal ACC**, and inversely in the **left DLPFC** and **dorsal cerebellum.**

Having made explicit the rather deep division that exists in the conceptualization of MORAL JUDGMENT, and having reviewed studies that rely upon methods ranging from simply recognizing a moral matter, to expressing one's agreement or disagreement with an evaluative statement, to making a forced choice in an extraordinary, hypothetical moral dilemma, we next consider a method that, at the interpersonal level of teacher –learner (Gaffney et al, 2002, 2005, 2007) and at the clinical level (Galvin et al, 2001, 2005a, 2005b, 2006; and Stilwell et al, 2006) appears to capture moral psychological signals. By proceeding according to this method, future investigators may better ensure that they are studying are relevant aspects of real moral lives in which subject-participants are genuine stake-holders simply because the real moral lives being studied belong to the subject-participants. In general, the method we propose entails PRIMING with a pertinent portion of a semi-structured interview, followed by TASKING, which it is hoped, will afford correlation of brain activity with moral psychological signals from the particular DOMAIN OF CONSCIENCE under investigation. The first application of our method may as well be to that DOMAIN OF CONSCIENCE which we have called MORAL VALUATION but in which, we believe, MORAL JUDGMENT, however it be conceptualized, is readily discernible.

STILWELL CONSCIENCE INTERVIEW (SCI) QUESTION 12: MANDATE LISTS: *Now, I want you to make a list of the main principles (rules) (do's and don'ts) in your conscience.*

SCI QUESTION 14: VALUATION AND DEFENSES: *Sometimes there are good reasons for OBEYING rules; sometimes there are good reasons for NOT OBEYING rules. Let's look at your rules and see what you think about them. What are your best reasons for ---- ? What are your best reasons for not---- ?*

MORAL VALUATION (Stilwell et al, 1996) measures developmental changes in the way a child justifies compliance or non-compliance with rules of conscience based on both reasoning and psychological defenses. This domain has three subdomains based on how the child categorizes rules of conscience as authority- derived, self- derived and peer-derived.

THE VALUE MATRIX is an organizational schema to represent the dynamic process in which the interviewer facilitates the person of conscience's self- examination of the valuational contents of her conscience. Operationally defined, for any 'don't' (or 'do') *x*, **base motives** are usually the first (i.e. **base**line) responses a person makes to an inquiry in the form:

> If you (a person) went along with *x* , it would be *because* ---- (fill in the blank).

The facilitator records[5] this 'because' as a starting point for the dialogue but then stretches the person's moral imagination by hypothetically blocking the motivational power of whatever was put in the blank in order to assist the person of conscience in eliciting another because. The person of conscience adduces another 'because' and then is asked to *evaluate* the first 'because' with respect to the second 'because' in terms of which is *better* (the interviewer makes clear that what is meant by '*better*' is not '*stronger')*. This may turn out to be an iterative process, the end result of which will be the person of conscience's **best reason(s).** The person may then be asked to judge the relative *strengths* of all the '*becauses*' she has differentiated into **best reasons** and **base motives**.

> Example: *x* is 'Don't make myself die.' The initial inquiry takes the form: " How do you fill in the blank: ' I will not make myself die because-----'?" The patient responds: " I will not kill myself because I don't want to experience the pain." The psychiatrist hypothetically blocks the motivational power of the baseline 'because' by saying: "What if you could be very sure you would not endure any pain, then what would be your best reason not to make yourself die?"The patient responds: " I don't know. I'm worried about being condemned to Hell for taking my own life. I heard a minister tell me that suicide is the only unforgivable sin."The psychiatrist hypothetically blocks the motivational power of this '*because*' by saying:"And what if you were very sure of God's forgiveness, what would be your '*because*' then?" The patient responds: "Because it would hurt my mother terribly—for all the rest of her life." To actually complete the matrix the patient would also need to address the '*becauses*' for making herself die, again in terms of base motives and best reasons. Patient and psychiatrist would then proceed to sort these '*becauses*' according to which the patient thought was best and then again according to which the patient considered strongest. In so doing the patient becomes aware of the value-motive gap.

[5] Dry erase boards are most helpful in that what first appears as an only --and by default *best*—reason can be placed lower in the matrix as the examination proceeds.

Inset 2.

"IN THE THINK TANK." A Proposed Neuro-imaging Study of "Might versus Right"

Priming

- **Assisted by a conscience sensitive interviewer, the subject has responded to SCI Questions or IU Conscience Autobiography Questions 12 through 14**
- **Following the Value Matrix method previously described, the subject is further assisted in identifying the BECAUSE'S for observing or not observing a rule articulated as *a do or don't*, *a must or mustn't, a should or shouldn't* or *an ought or ought not.***

Neuroimaging (e.g. fMRI)

- **During the first run, the subject is provided a visual representation of the personalized VALUE MATRIX and is asked to mentally order the BECAUSE'S according to relative GOODNESS (BEST REASONS)**
- **During another run the subject is asked to order the list of the BECAUSE'S, according to relative STRENGTH (BASE MOTIVES)**

NEUROIMAGING STUDIES ON EMPATHY.

Decety and Jackson (2004) write that EMPATHY has:

Three Basic Macro-Components

1. **Affective sharing between the self and the other, based on perception –action coupling that lead to shared representations**[6]

> Automatic mapping between self and other is supported by considerable empirical literature in the domain of perception and action, which has been marshalled under the common-coding theory (Prinz, 1997). This theory claims parity between perception and action. Its core assumption is that actions are coded in terms of the perceivable effects…they should generate… This theory also states that perception of an action

[6] Some developmental landmarks of emotion sharing are:

> Discrimination of three facial expressions (happy, sad, surprised): 36 hours
>
> Affective synchrony in mother-infant play: 2-3 months
>
> Social referencing: 10 months
>
> Prosocial behaviors: 2nd year of life
>
> Emergent awareness of the subjectivity of other people's emotions: 18 months

should activate action representations to the degree that the perceived and the represented action are similar.

The authors report an fMRI study: when subjects are required to observe or to imitate facial expressions of various emotions, increased neurodynamic activity is detected in the **superior temporal sulcus**, the **anterior insula**, and the **amygdala** as well as the **premotor cortex** corresponding to the facial representation (Carr, Iacoboni, Dubeau, Mazziotta and Lenzi, 2003)

In another neuroimaging study conducted by Decety and Chaminade (2003), subjects were presented with a series of videoclips showing individuals telling sad and neutral stories, as if they had personally experienced them. Stories were told with either congruent or incongruent motor expressions of emotion. Watching sad stories versus neutral stories was associated with increased activity in emotion processing related structures (including the **amygdala** and **parieto –frontal** areas) **predominantly on the right side.** This network was not activated when subjects watched incongruent social behavior; instead there was strong hemodynamic increase in the **VMPFC** and **Superior Frontal Gyrus**.

The authors conclude the section on share representation thus:

> There is no specific cortical site for shared representations ; their neural underpinnings are widely distributed , and the pattern of activation (and also presumably deactivation) varies according to the processing domain, the particular emotion , and the stored information.

2. Self-other awareness. Even when there is some temporary identification, there is no confusion between self and other

> There is increasingly clear evidence of a specific developmental link between ToM and improved self control at around the age of 4…. [E]xecutive functions, especially inhibitory control, play a crucial enabling role in both the emergence and expression of children's mental state attribution. Furthermore, it has been demonstrated that the development of cognitive control is related to the maturation of the prefrontal cortex….Bunge, Dudukovic, Thomason, Vaidya and Gabrieli (2002) investigated with fMRI in children (ages 8 to 12) and adults. They found that children were more susceptible to interference and less able to inhibit inappropriate responses than were adults and that different brain regions were recruited between the two groups. Notably the response inhibition in children was not associated with the right ventrolateral prefrontal cortex as it was in adults….
>
> …There is evidence that a region around the **paracingulate sulcus** in **the medial PFC** plays a specific role in attribution of intention. This region contains **spindle cells**…which are thought to be involved in coordinating widely distributed neural activity involving emotion and cognition…. This region has been found to be reliably activated by mentalizing tasks of various cognitive difficulty ranging from:
>
> i. Judging the emotion in another person's gaze
>
> ii. Detecting the intention in simple dynamic animations
>
> iii. Attributing intention to cartoon characters, comprehending stories

iv. Detecting social transgression and appreciating humor.

Using fMRI, Fink et al (1996) found activation of a right hemispheric network of temporomesial (including the **amygdala** and **hippocampus**) **posterior cingulate**, **prefrontal right insula** and **prefrontal regions** during presentation of personal autobiographical memories versus impersonal statements. Two functional imaging studies have reported specific increase in activity in the **MPFC** and **posterior cingulate** during tasks that involved self reflection (Gusnard, Akbudak, Shulman & Raichle, 2001; Johnson et al, 2002).

An fMRI experiment demonstrated that the neurodynamic activity starts earlier in a number of cortical regions involved in motor control when the participants made judgments about their own actions versus those of others (Grezes, Frith and Passingham, 2004)

3. Mental Flexibility to adopt the subjective perspective of the other and also regulatory processes

Decety and Jackson (2004) summarize:

…a series of three neuroimaging studies of healthy volunteers investigating the neural under-pinning of perspective taking in three different modalities (i.e. motoric, conceptual, and emotional) of self-other representations. In a first study, participants were scanned while they were asked to either imagine themselves performing a variety of everyday actions (e.g. winding up a watch) or imaging the experimenter doing similar actions (Ruby and Decety, 2001). Both conditions were associated with common activation in the SMA, premotor cortex and occipito-temporal region. This network corresponds to the shared motor representations between the self and the other. Taking the perspective of the other to simulate his or her behavior resulted in selective activation of the frontopolar cortex and right IPL.

In a second study, medical students were shown a series of affirmative health-related sentences (e.g. taking an antibiotic drugs causes general fatigue) and were asked to judge their truth either according to their own perspective (i.e. as experts in medical knowledge) or according to the perspective of a layperson (Ruby and Decety, 2003). Although not statistically significant there was a tendency for response times to be slightly greater when the participants answered the question with the perspective of a layperson. The set of activated regions recruited when the participants put themselves in the shoes of a layperson included the medial PFC, the frontopolar and right IPL.

In a third study, the participants were presented with short written sentences that depicted real –life situations (e.g. someone opens the toilet door that you have forgotten to lock), which are likely to induce social emotions (e.g. shame, guilt, pride) or other situations that are emotionally neutral (Ruby and Decety, 2004). They were asked to imagine how they would feel if they were in those situations, and how their mother would feel in those situations. The mother was chosen as the target of empathy because she was the participants' best known person. Like in the previous experiment, a slight increase in the response times was observed when participants imagined the reaction of their mother elicited by neutral situations as compared to their own reactions. Reaction times were statistically greater when the subjects imagined emotion-laden situations, both from their own perspective and the perspective of their mothers. Activation was

detected in the **frontopolar cortex**, the **VMPFC** the **MPFC** and the **Right IPL**. When the participants adopted the perspective of their mother, regardless of the affective content of the situation depicted. Cortical regions involved in emotion processing were found activated in the conditions that integrated emotion laden situations, including the **amygdala** and the **temporal poles**.

Ruby and Decety (2001, 2003, 2004) found differential activations within each of the brain regions depicted here (**frontopolar, medial prefrontal /anterior paracingulate** and **posterior cingulate cortices**) when subjects overtly adopt the perspective of another individual versus self perspective. Hemodynamic changes were more pronounced in the right hemisphere.

[Also see: Decety J and Moriguchi Y (2007): The empathic brain and its dysfunction in psychiatric populations: implications for intervention across different clinical conditions. **BioPsychoSocial Medicine** 1:22]

Empathy has its home within the DOMAIN OF CONSCIENCE called MORALIZED ATTACHMENT and its place of work within the domain called MORAL EMOTIONAL RESPONSIVENESS.

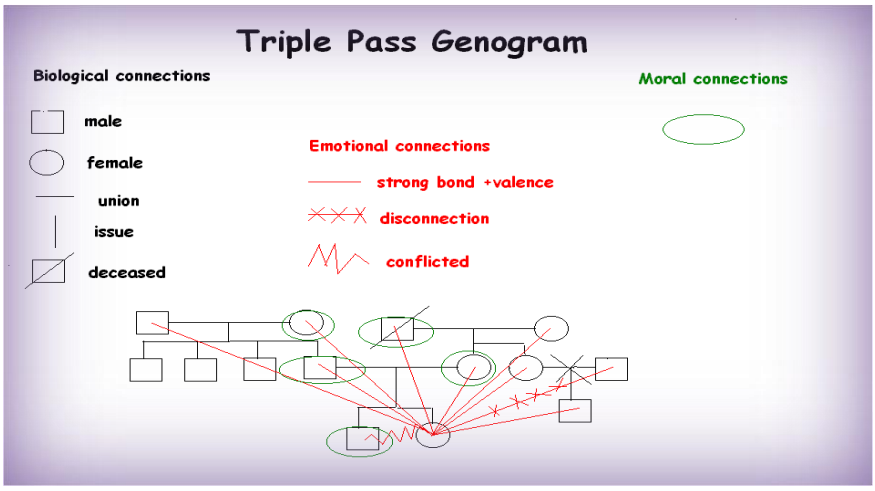
SCI QUESTION 9: WHO CARES ABOUT YOUR GOODNESS? *Other than yourself, who is most PROUD when you have done something good? Has this been true all your life? How do these person(s) show they care about your goodness?*

SCI QUESTION 10: WHO CARES ABOUT YOUR BADNESS? *Other than yourself, who is most ASHAMED when you have done something bad? Has that been true all your life? How do these person(s) show they care when you haven't been good?*

SCI QUESTION 13: MANDATE AUTHORS *Beside the rules [identified in response to Question 12] write the name of the person(s) who have helped the most in putting that rule in your conscience.*

MORALIZATION OF ATTACHMENT (Stilwell et al, 1997) measures developmental transitions in the youngster's response to parental prohibitions and demands based upon how s/he links feelings of security, empathy and oughtness to child- parent and other child/authority figure relationships.

MORALIZED GENOGRAM



IU Conscience Project (2003): The IU conscience project 1982-2003 a power point presentation, **Conscience Works, Theory Research and Clinical Applications.**

Inset 3.

"IN THE THINK TANK." A Proposed Neuroimaging Study: "Wired to Connect"

Priming

- **Assisted by a conscience sensitive interviewer, the subject has responded to SCI Questions or IU Conscience Autobiography Questions 9, 10, 13**
- **With further assistance the subject has completed parts one and two of the MORALIZED GENOGRAM**

Neuroimaging (e.g. fMRI)

- **During the run, the subject is provided a visual representation of the incomplete genogram and is asked to mentally encircle those symbols on the genogram representing moral attachment figures**
- **Following the run the subject is asked to record how the designated moral attachment figures show they care and/or what values those persons have transmitted across or within generations**

NEUROIMAGING STUDIES ON MORAL EMOTIONS

Brain imaging studies have been conducted on various emotions. For example, as reviewed by Giacomo Rizzolatti and Laila Craighero (2005), in the emotional experience of disgust, intense activation can be found in the amygdala and insula:

> The amygdala is a heterogeneous structure formed by several subnuclei. Functionally, these subnuclei form two major groups: the corticomedial group and the basolateral group. The former, phylogenetically more ancient, is related to the olfactory modality. It is likely that it is the signal increase in the corticomedial group that is responsible for the amygdala activation in response to disgusting stimuli.
>
> Similarly to the amygdala, the insula is a heterogeneous structure. Anatomical connections revealed two main functional subdivisions in it: an anterior 'visceral' sector and a multimodal posterior sector…. The anterior sector receives a rich input from olfactory and gustatory centers. In addition the anterior insula receives an important input from the inferotemporal lobe, where in the monkey, neurons have been found that respond to the sight of faces…. Recent data demonstrated that the insula is the main cortical target of interoceptive afferents…. Thus, the insula is not only the primary cortical area for chemical exteroception (e.g. taste and olfaction) but also for the interoceptive state of the body ('body state representation')….
>
> … As for the premotor cortex, it is plausible that in the insula there is a specific type of mirror neurons that match the visual aspect of disgust with its viscero –motor aspects. The activation of these (hypothetical) viscero-motor mirror neurons should underlie the first person knowledge of what it means to be disgusted. The activation of these insular neurons should not necessarily produce the overt viscero-motor response….

In a study by investigators (Takahashi et al, 2004) at Tokyo Medical and Dental University, nineteen healthy volunteers read sentences carrying neutral, guilty or embarrassing conditions during the scans. Both guilt and embarrassment conditions commonly activated the **MPFC, left posterior superior temporal sulcus** and **visual cortex.** Compared to guilt condition, embarrassment condition produced greater activation in the right anterior temporal cortex, bilateral hippocampus and visual cortex. The investigators comment that most of these regions have been implicated in the neural substrate of ToM and conclude:

> Our results support the idea that both [guilt and embarrassment] are self conscious emotions which are social emotions requiring the ability to represent the mental states of others. At the same time, our functional MRI data are in favor of the notion that evaluative process of embarrassment might be a more complex process than that of guilt.

In a study by Berthoz et al (2006), 12 subjects, all adult males, were asked to make evaluations regarding the degree of inappropriateness of social behaviors described in stories in which they themselves, or someone else transgressed social norms intentionally or accidentally. The example the investigators chose is presented in this slide.

Here we will provide details of the methods employed as these seem to us fairly readily adapted to the "Think Tank" studies we are proposing for each conscience domain.

Stories were presented twice, once with second personal reference and once with third personal reference. Stimuli were displayed on a monitor and presented to the subject via a 45 degree angled mirror positioned above the head coil. Beginning of the story was presented for 8 seconds and then replaced by the end of the story for 10 seconds. Participants were instructed to read the text silently, and to click the response key when they finished reading the second part of the story. They were instructed to imagine what they or the story protagonist would feel in the situation described. After the scanning session, half of the participants rated the stories in which the protagonist was imagined to be the subject himself, the other half rated the stories in which the protagonist was someone other than the subject. Ratings requested were i) how embarrassing they thought the situation would be, ii) how inappropriate they thought the behaviour to be and iii) how funny they thought the story to be.

Self accidental (SA) violation beginning: ' You are invited to a Japanese dinner at a friend's house' end: 'You have a bite of the first course , you choke and spit out the food while you are coughing.'

Other accidental (OA) violation beginning: 'Joanna is invited to a Japanese dinner at her friend's house' end: "She has bite of the first course, chokes and spits out the food while she is coughing.'

Self intentional (SI) violation beginning: 'You are invited to a Japanese dinner at a friend's house' end: 'You have a bite of the first course, but do not like it and spit the food back into your plate.'

Other intentional (OI) violation beginning: 'Joanna is invited to a Japanese dinner at a friend's house.' end: 'She has a bite of the first course , but does not like it and spits the food back into her plate."

Their equipment was a whole body MRI system with a head coil. As in the previously described study, BOLD contrast was utilized. They first analyzed the main effect of Intentionality [(SI plus OI) versus (SA plus OA)]. Significant differential activation was seen in the **left dorsolateral**, **superior frontal cortex**, **anterior cingulate gyrus**, **left inferior parietal cortex**, **left superior occipital cortex**, **left amygdala**, **right cerebellum** and **bilaterally** in the **precuneus**. In the inverse contrast Accidental > Intentional only the **right inferior temporal sulcus** showed more activation.

Next they analyzed the main effect of Agency [(SI plus SA) versus (OI plus OA)]. Significant differential activation was seen in the **left precuneus** and **right cerebellum**. In the inverse contrast, Other >Self, there were no significant differences in activation.

In order to identify brain areas specifically activated when evaluating self involvement in intentional violation of social norms, the following contrast [(SI-OI)-(SA-OA)] was calculated. This interaction revealed significant **bilateral amygdala** activation. A post hoc exploration of the parameter estimates showed that this effect was driven by a response to Self Intentional violation as compared to all other conditions. The only region that showed greater activation was the **Right DLPFC**.

To identify brain areas specifically activated when evaluating self involvement in accidental violation of social norms, the following contrast [(SA-OA)-(SI-OI)] was calculated. This interaction revealed significant increased activation in the **left parieto-occipital fissure** and the **left cerebellum**. A post hoc exploration of the parameter estimates showed that this effect was driven by a response to Self Intentional violation as compared to all other conditions. The only region that showed greater activation was the **right DLPFC.**

In Discussion the investigators make the following points:

Their critical finding was enhanced activity in the amygdala when participants narrated their own intentional violation of social norms. The amygdala is a crucial part of the neural circuitry by which stimuli trigger emotional responses that reflect an appraisal of value.

> The fact the amygdala was activated for intentional violation by the self alone, is consistent with the view that this structure is involved in emotional processing important for personal welfare, as in the perception of emotionally salient stimuli and stimulus-affect contingencies (Adolphs, 2003; Dolan, 2002). Thus, the present results further emphasize the role of the amygdala in weighing the consequence of one's own intentional action for the sake of one's own wellbeing. The previous neuroimaging studies on the neural correlates of morality did not address the influence of intentionality and agency, which are two core aspects in moral judgment (e.g., Greene et al., 2001; Moll et al., 2002a,b). For example, in Moll et al. (2002b) study, the subjects were instructed to read emotional unpleasant moral and non moral statements and to covertly judge them as being either right or wrong. However, these instructions did not require reference to the subject's own behaviour. This may explain why the amygdala was not activated in the moral judgement condition, even though the stimuli were rated as emotionally evocative. More recently, these authors (Moll et al., 2005) found amygdala activation when comparing statements evocative of pure disgust (e.g., *'One night you were walking on the street. You saw a cat eating its own excrement'*) to indignation (e.g., '*You went with a friend to a restaurant. When you passed the kitchen, you saw rats in the pans*'). Although the statements had a personal perspective ('You'), the participants were passive observers rather than being the agent of intentional social transgressions.

SCI QUESTION 3A: PLEASING THE CONSCIENCE *When you have pleased your conscience and done something morally right/good, what happens on the inside of you? Do you feel it in any particular place(s) in your body? What happens on the outside of you? How does it show? If I were to look at you, how would I know what is happening inside of you? What is the reaction of other people around you? What do other people do when they find out? [GET EXAMPLES]*

SCI QUESTION 3B: PLEASING...IF NO ONE KNOWS *Would you tell me of a time when you did something good/right and nobody knew about it....a time when you did a secret good deed. What happened on the inside of you in that situation? Did you feel it any special place in your body? What happened on the outside of you? If I just came into the room and looked at you....would I be able to tell that you had just done something good? Do other people figure it out? How do they do it?*

SCI QUESTION 4A: DISPLEASING THE CONSCIENCE *When you have gone against your conscience and done something morally bad/wrong, what happens on the inside of you? Do you feel it any special place in your body? What happens on the outside of you? If I were looking at you, how would I know something was wrong? What is the reaction of other people around you?*

SCI QUESTION 4B: DISPLEASING...IF NO ONE KNOWS *Tell me about a time when you did something wrong and no one found out. What happened on the inside of you? Did you feel it in any special place in your body? What happens on the outside of you? If I were looking at you, how would I know you had done something wrong? What is the reaction of other people around you?*

MORAL EMOTIONAL RESPONSIVENESS (Stilwell et al, 1994) measures developmental transitions in the way a child uses 1) anxiety and mood to regulate moral behavior and 2) processes of reparation and

healing after wrongdoing to regain the physiological state normally experienced when feeling like a good person.

Inset 4.

"IN THE THINK TANK." A Proposed Neuroimaging Study: "Activating Moral Emotional Mirror Neurons"

Priming

- **Assisted by a conscience sensitive interviewer, the subject has responded to SCI Questions or IU Conscience Autobiography Questions 3 and 4.**

Neuroimaging (e.g. fMRI)

- **During one run, the subject is instructed keep in mind a specific memory of right doing with special consideration of how the experience elicited anxiety, altered mood and/or produced psychophysiological responses**

  Following the run the subject is asked record the memory and considerations

- **During another run, the subject is instructed keep in mind a specific memory of wrong doing with special consideration of how the experience elicited anxiety, altered mood and/or produced psychophysiological responses**

- **Following the run the subject is asked to record the memory and considerations**

SCI QUESTION 5: REPARATION AND HEALING *A. When you have gone against your conscience and you do something wrong or bad, what do you do to make things right? B. What do you do to feel better?*

Inset 5.

"IN THE THINK TANK." A Proposed Neuroimaging Study: "Letters of Apology and Gratitude"

Priming

- **Assisted by a conscience sensitive interviewer, the subject has responded to SCI Question or IU Conscience Autobiography Question 5**

Neuroimaging (e.g. fMRI)

- **During one run, the subject is instructed to mentally compose a letter of apology as an exercise in moral imagination (i.e. the maleficence may not actually have occurred)**

- **Following the run the subject is asked to draft the letter**

- **During another run, the subject is instructed to mentally compose a letter of gratitude as an exercise in moral imagination (i.e. the beneficence may not actually have occurred)**

- **Following the run the subject is asked to draft the letter**

NEUROIMAGING STUDIES OF SELF CONTROL

As Marsh et al (2008) point out,

> [A]developmental process investigated extensively using fMRI is the ability to control behaviors that conflict with personal and societal norms. Both cognitive and emotional maturation requires the development of this capacity for "inhibitory control," making it one of the most centrally defining characteristics of healthy psychological development. Children must learn to engage inhibitory processes to filter and to organize their thoughts, feelings, and behaviors based on social and emotional cues, especially in the face of competing information or distracting stimuli.

Citing Bunge et al (2002), Casey et al (1997) and Rubia et al (2000), they add:

> Findings from fMRI studies of healthy individuals suggest that the maturation of these functions is associated with the development of the prefrontal cortex, along with anatomically connected, subcortical brain regions….

Among the tasks employed in these studies has been the well known Stroop task.

Citing Peterson et al (1999), Marsh et al state that brain activity during color naming of the mismatching compared with the matching stimuli have demonstrated activation in large expanses of anterior cingulate, prefrontal , and parietal cortices, as well as striatum, in both adults and children

The ability to commit to effortful engagement in prosocial or altruistic behavior is apparently less well-imaged.

In a study by Beauregard et al (2001) ten men viewed emotionally neutral and erotic films while fMRI studies were conducted. One functional run was conducted while subjects were instructed to attempt inhibition to the arousal from the erotic films. For both sexual arousal and attempted inhibition conditions, a conventional subtraction method was used to contrast brain activity associated with the viewing of the erotic film excerpts and that associated with viewing the emotionally neutral film excerpts. In viewing erotic film excerpts allowing arousal, BOLD signal increases were found in the **right amygdala**, **right anterior temporal pole** (BA 38) and **hypothalamus**. In the attempted inhibition condition, significant loci of activation were noted in the **right superior frontal gyrus** (BA10) and **right anterior cingulate gyrus** (BA 32). No significant loci of activation were detected in the amygdalas, the anterior temporal polar region and the hypothalamus

SCI QUESTION 15: SELF EVALUATION AND VOLITION *Does your conscience change as you grow? How? Do you think about your conscience (or morality) differently now than when you were younger? Are there changes going on in you now? Tell me about them. Is your conscience your friend or your enemy? Is it in charge of you or are you in charge of it? Do you work together or are you enemies? How much willpower do you have? How do you use your willpower to stay out of trouble, to please your conscience, to follow through on what you believe? When does your willpower fail for you? Are there ways that your feelings get in the way of following right and wrong? Do you sometimes think one way and behave another?*

MORAL VOLITION (Stilwell et al, 1998) measures developmental transitions in how a child uses his/her sense of autonomy in responding to and redefining rules of conscience.

Inset 6.

"IN THE THINK TANK." A Proposed Neuroimaging Study: "The New Year's Resolution"

Priming

- **Assisted by a conscience sensitive interviewer, the subject has responded to SCI Question 15 IU Conscience Autobiography Question 15 a and 15c**

Neuroimaging (e.g. fMRI)

- **During the run, the subject is asked to consider one rule or value which he or she had considered to be outside of the self (i.e. authority or peer derived) but which he or she predicted he or she would adopt (internalize) in the next year.**
- **Following the run the subject is asked record the rule or value and considerations.**

It is noteworthy that both Eliot Turiel, cited twice before, and Mark Johnson cited once before, acknowledge the insights of philosopher Martha Nussbaum.

Turiel (2008): "As some philosophers have stressed ,'human beings are above all reasoning beings' (Nussbaum,1999, p.71), and as reasoning beings 'all, just by being human, are of equal dignity and worth, no matter where they are situated in society, and that the primary source of this worth is a power of moral choice within them, a power that consists in the ability to plan a life in accordance with one's own evaluation of ends (Nussbaum,1999, p.57)…."

Johnson (1993) quoting Nussbaum (1986): "Arguing for the importance of extended narratives as a basis for moral philosophy, Nussbaum makes the case that 'a whole tragic drama, unlike a schematic philosophical example making use of a similar story, is capable of tracing the history of a complex pattern of deliberation, showing its roots in a way of life and looking forward to its consequences in that life. As it does all of this, it lays open to view the complexity, the indeterminacy, the sheer difficulty of actual human deliberation …. A tragedy does not display the dilemmas of its characters as pre-articulated; it shows them searching for the morally salient; and it forces us, as interpreters, to be similarly active.'"

The anchor domain of conscience, the one we studied first, we refer to as CONCEPTUALIZATION OF CONSCIENCE and/or MORAL IMAGINATION. Using these key words, our search of the literature on neuro-imaging and conscience functioning turned up no relevant articles. This is really very surprising, considering how much attention ToM receives in the discussion sections in many of the papers we have reviewed. To our minds anyway, CONCEPTUALIZATION OF CONSCIENCE or MORAL IMAGINATION could as well be called MORALIZED THEORY OF MIND when the MENTALIZING CAPACITY is engaged reflectively and directed to the self. If that is so, studies of this domain would seem to be foundational for any real understanding of the psychobiology of conscience.

SCI QUESTION 1: GENERAL DEFINITION *Have you heard of the word, conscience? What is it? How does it work? It's alright to guess. (1st Alternate) Is there a part of a person that knows about right and wrong? Good and bad? What is it? How does it work? (2nd Alternate) How does a person (boy/girl) know when*

s/he is being good? How does a person (boy/girl) know when s/he is being bad? Would you give me an example of what you mean?

SCI QUESTION 2: PERSONAL DEFINITION *Describe your own conscience and how it works. Can you give another personal example?*

SCI QUESTION 11: CONSCIENCE DRAWING *Now...I want you to use your imagination and draw a picture of your conscience (or the part of you that knows about right and wrong) (or a picture about being good and being bad).Now... would you tell me about your drawing?*

CONCEPTUALIZATION OF CONSCIENCE (Stilwell, et al, 1985, 1991) *measures the degree of inclusiveness and abstractness a person utilizes when providing a personal definition of conscience. Five transformations in conceptualization of conscience occur between the ages of 5 and 17. The most salient feature of each has been incorporated into the names of the stages: External Conscience (age 6 and under), Brain or Heart Conscience (ages 7- 11), Heart/Mind or Personified Conscience (ages12-13), Confused Conscience (ages 14- 15), and Integrated Conscience (ages 16- 17). Stage transitions in the other domains are anchored in the domain of conceptualization of conscience.*

Inset 7.

"IN THE THINK TANK." A Proposed Neuroimaging Study: "Moralized Theory of Mind"

Priming

- **The subject has responded to SCI Questions or IU Conscience Autobiography Questions 1 and 2**

Neuroimaging (e.g. fMRI)

- **During the run, the subject is asked to imagine how he or she would depict his or her conscience**
- **Following the run the subject is asked to actually render the image in a drawing and to describe it**

Hypotheses

- **One hypothesis of interest regarding children and adolescents is that there will be increased functional connectivity between VMPFC and amygdala correlating with advancement through stages of conscience development as discerned in SCI**
- **Another hypothesis of interest regarding adults is that activity will be more pronounced in some brain regions of interest more than others depending upon the subject's conscience contours as discerned in the conscience autobiography**

SUMMARY

In this review, we began with a basic appreciation of the process of neuroimaging. We offered a brief **GLOSSARY OF TERMS** deriving from cognitive sciences including neuropsychology and developmental psychology. These terms, with currency in their respective literatures, we suggested could be seen to relate to the DOMAINS OF CONSCIENCE. We then highlighted studies in the last eight years in which fMRI or other neuroimaging techniques had been employed in the study of brain activity during TASKS proposed to represent MORAL PSYCHOLOGICAL FUNCTIONS. We then examined the limitations of the MORAL PSYCHOLOGICAL FUNCTIONAL TASKS in light of what we know about the the complexity of the human CONSCIENCE. We next imagined CONSCIENCE FUNCTIONAL TASKS derived from those in current clinical and educational use susceptible of NEUROIMAGING STUDIES . This imaginative exercise was intended to highlight complexities in personal CONSCIENCE FUNCTIONS that do not readily appear while engaging in the kind of MORAL PSYCHOLOGICAL FUNCTIONAL TASKS (eg. trolley or footbridge dilemma resolution) hitherto employed. The CONSCIENCE FUNCTIONAL TASKS we have proposed may actually complement existing studies of MORAL PSYCHOLOGICAL FUNCTIONAL TASKS by providing more depth and meaning, or may simply stimulate future researchers to imagine other CONSCIENCE SENSITIVE TASKS susceptible of NEURO-IMAGING STUDY. In the following discussion we seek to put any actual use of CONSCIENCE FUNCTIONAL TASKS in the context of a overall vision of future studies of CONSCIENCE .

DISCUSSION

In their article *Integrating Functional Brain Neuroimaging and Developmental Cognitive Neuroscience in Child Psychiatry Research* Pavuluri and Sweeney (2008) begin with the recognition that fMRI data are an indirect representation of brain activation shown by an individual subject while performing a cognitive task, and go on to say that one can control either the conditions of an experiment or the subject groups. Different conditions require "no fixed or absolute baseline." Attention, emotional regulation, and memory are "the most basic brain systems" dealt with in this article.

CONCEPTUALIZATION AND INTEGRATION OF DOMAINS. Any existing findings about hierarchically organized tiers of brain functioning illuminate the integration of CONSCIENCE DOMAINS. We have in mind cortical interactions between the DLPFC and the VLPFC; interfaces between dorsal and ventral anterior cingulate cortex (pregenual and subgenual); interactions at the subcortical level between dorsal and ventral striatum and amygdala. Pavuluri and Sweeney (2008) describe models of top-down control in research with macaque monkeys. They review that the frontal mid-ventrolateral area of the prefrontal cortex seems to be important junction where inputs from dorsolateral executive systems are coupled and integrated with emotional processing systems. Top-down regulation of the amygdala plays a role in emotional modulation, providing information about anticipated and past reward and punishment for guiding future behavior.

MORAL VALUATION/COGNITIVE REASONING PROCESSES. Any existing studies on EXECUTIVE FUNCTIONS such as shifting attention, working memory, and response inhibition and the DLPFC are apt to apply to MORAL VALUATION.

In our clinical work we have introduced the notion of CONSCIENCE CONTOURING, strengthening a patient's most functional DOMAINS OF CONSCIENCE. Contouring brings to mind questions about baseline(s). Can our defined STAGES OF CONSCIENCE serve as "fixed or absolute baselines" for conscience contouring? Our developmental findings showed good stage correlation between the four supporting domains and the CONCEPTUALIZATION OF CONSCIENCE domain in normal subjects. Nonetheless, replication is required.

Investigations into conscience under varying conditions include Goenjian et al's (1999) study of the

psychological aftermath of a natural catastrophe compared different conditions while assuming that the groups were basically the same. Galvin et al's (1997) study of conscience functioning in psychiatric hospitalized boys makes comparisons according to the age at which maltreatment was first endured.

Forgoing the idea of normative baselines we could analyze conscience descriptions qualitatively, comparing subjects with different diagnoses or comparing a group with a particular diagnosis with a "free from diagnosis" group. The qualitative differences could then be graded dimensionally with various cutoff points defining the contours. Other studies could compare qualitative differences in conscience contours before and after treatment of a single symptom (suggesting a particular brain system) or a diagnostic cluster. Future conscience sensitive work (Hulvershorn et al, in progress), will address the following diagnostic clusters:

1. **MORAL VOLITION/ ATTENTION DEFICIT HYPERACTIVE DISORDER** (ADHD). Any existing findings (fMRI or other) about ADHD bring to mind its probable impact on MORAL VOLITION. So do spontaneous comments from parents of children medicated for ADHD: "His conscience works better now that he's on that medication." Pavuluri and Sweeney (2008) note that ADHD may disappear with age because of maturation of frontostriatal abnormalities. That probably means better MORAL VOLITION, too.

2. **MORAL VOLITION AND MORAL EMOTIONAL RESPONSIVENESS / ADHD vs Severe Mood Dysregulation** (SMD). Some findings appear to relate to psychopathological interference to both the MORAL VOLITION and MORAL EMOTIONAL RESPONSIVENESS domains in tandem or simultaneously. Descriptions of patients whose symptoms have ADHD/SMD overlap come to mind here, for example the adolescent who tears up his room in frustration over being thwarted from a reward (e.g. going out) and experiences a major emotional blowout.

3. All conscience domains across development (childhood through adulthood) in healthy, psychiatric controls. We anticipate that various conscience domains will have differential development as subjects age and corresponding long range connections between involved brain regions mature.

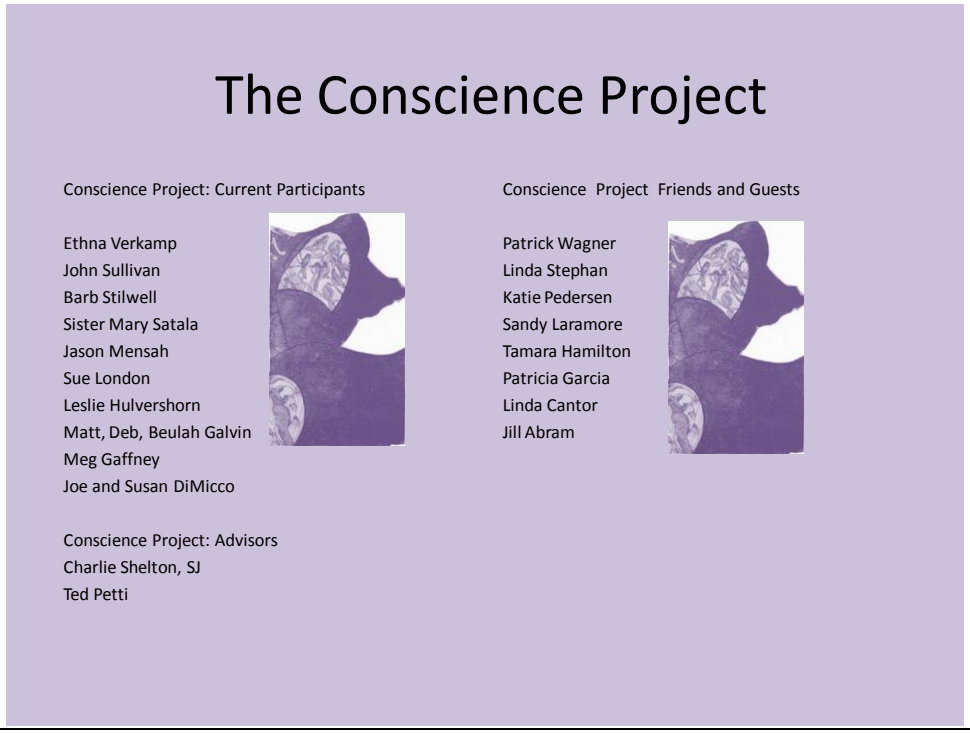
In addition, the following future studies should be kept under consideration:

MORAL EMOTIONAL RESPONSIVENESS /INTERNALIZING DISORDERS AND TRAUMA Any existing findings about the biological basis of symptoms related to anxiety, depressive disorder, or disorders of trauma, (for example, the delineation of fronto-limbic affective circuitry (amygdala-VLPFC) and the facial emotion processing system) bring to mind probable impact on MORAL-EMOTIONAL RESPONSIVENESS.

CONSCIENCE AS MORAL ENERGY. Is the inter-working of CONSCIENCE DOMAINS too complex to be studied in a functional way (i.e. by utilizing fMRI)? Perhaps. Perhaps the conscience is always functioning with dynamic contouring. Imagine the conscience as a whole as being an ever-expanding, increasingly sensitive, reserve capacity of moral energy. At some times moral energy may surge automatically, led by the more immediately aroused ATTACHMENT and MORAL EMOTIONAL RESPONSIVENESS domains–manifested by compliance, loyalty, shame, and guilt among other emotions and dispositions. At other times, where temptation or hostility are high and deception possible, survival-oriented, greedy, and revengeful impulses may vitiate moral energy across all domains. Under these conditions, conscience principles (lodging in the domain of MORAL VALUATION) can quickly be ignored, distorted, or rationalized away. When delayed decision making is possible, conscious deliberation may allow the justification weighting processes of the MORAL VALUATION domain to dominate, moving the person toward good OR bad actions,

right OR wrong ones. When the social conscience of the community is weak (e.g. weak regulation over banking systems of lending and borrowing), individual consciences may become de-regulated or de-moralized, too. The flow of MORAL ENERGY may be such that any attempt to view "what lights up when, where, and under different conditions" will be too simplistic to catch the complexly dynamic inter-workings of CONSCIENCE DOMAINS. Although various challenges to CONSCIENCE FUNCTIONING can be imagined, creating artificial paradigms to capture them fully with fMRI still seems overwhelming. At a minimum, respect for sheer complexity favors the idea that fMRI studies look at one domain at a time. Maybe each domain has enough specificity to correlate with particular brain systems. Would the domain, MORAL-EMOTIONAL RESPONSIVENESS, be the one most likely to correlate with known functions of the amygdala and the VLPFC? Can the processing of a personal moral conflict or dilemma culled from a personal conscience autobiography be analyzed into a "fast implicit processing" component and an "explicit conscience processing" component? In the moral realm, can this be conceptualized as a transition from MORAL-EMOTIONAL-RESPONSIVENESS to MORAL VALUATION? Is this dynamic contouring rather than static contouring?

In this essay we have concentrated upon what has been done, and what can be done. No less important are concerns about what should be done, how it should be done and how the findings of whatever's done are susceptible of **over**- or **mis**-interpretation and **over**- or **mis**-application. Perhaps there is hope that good literature will ward us from being too easily satisfied with a version of the story of human conscience too much abridged by what is technically feasible. In another essay (Gaffney et al, in progress) we will take up these philosophical, ethical and literary considerations.



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[All articles in **Conscience Works** may be found on-line at http://shaw.medlib.iupui.edu/conscience/]

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