Kaldjian 2000; Bachrach 2004). Nazi policies of sterilization and extermination were an extreme expression of this way of thinking. Nazi eugenics fused basic eugenic prejudices with older anti-Semitic views. It followed that if the soul resided in the genes and the Jewish soul was diabolical in nature, then 'the Jewish problem' could only be solved by the elimination of 'Jewish genes'. Programs of sterilization, forced abortion, confinement, and genocide followed.

Our current debates about abortion, embryo research, and stem cells provide another vivid example of the tendency to metaphysicalize genes. In trying to determine at what stage nascent human life becomes morally protectable, it is tempting to look for some quality that is associated with the individual's coming into being and that remains in place as long as the individual is alive. In traditional religious and metaphysical thinking, this feature is the soul. It is believed to come into being some time near the individual's conception and it departs at death, when the sanctity of the physical person comes to an end. Against this conceptual background, it is not surprising that genes have come to play a leading role in abortion debates. In the minds of many who oppose abortion, it makes sense to see life as beginning in a moral sense with the creation of a novel genome at conception. As long as the genes remain active, informing all the other functions of the body, the person is 'alive'. At death, genetic material ceases to activate bodily functions and personhood ends. In all these ways, the genome seems to be an effective surrogate for the soul.

Despite the attractiveness of this idea, it is misleading and capable of seriously distorting complex scientific and ethical realities. For one thing, we know that the unique diploid genome is not established at conception. Twinning and embryo fusion can occur during the first 2 weeks of embryonic development, resulting in one genome in two persons or two genomes in a single individual. Hence conception cannot logically be the starting point for the unique human individual (Ford 1998; Shannon and Wolter; Mauron 2002). As twins themselves reveal, the genome itself is not the sole basis of personal identity. At the end of life, gene functioning can persist at the cellular level even though the person, as a moral or legal entity, is gone. This tells us that the genome is not the same as the soul and should not be regarded as the unique person-making feature of the organism.

As natural and attractive as the equation of the genome with the person may be, it also obscures key ethical and philosophical questions. Do we really want to associate what is most valuable and most protectable in human beings with the genes? What are the implications of doing so? If ethics and law require 'bright lines' to facilitate social policy and decision, is the emergence of genetic identity the best bright line to select? Could other alternatives serve us better? The real problem with genetic metaphysics is that it tends to bypass these morally difficult questions. It falsely equates the genome and the soul, and then uses the power of this equation to replace reasoned argumentation and analysis.

Mauron (2003) points out that neuroscience may be even more susceptible to this metaphysical allure than genetics. In many respects, the brain is closer to the core of the self than are the genes. Understanding a person's brain involves a profound penetration of the self. Changing brain states can also alter one's destiny and one's self-conception. Neuroethicists have noted that, in addition to the ethics of neuroscience, there is an emerging field that has been called the 'neuroscience of ethics' (Roskies 2002; see also Chapter 2). This involves the study and understanding of the neural bases of moral reasoning and behaviors. Thus neuroscience promises greatly increased understanding of what it means to be a moral agent and how variations in neural functioning can affect our sense of self, our values, and our conduct.

Because of the proximity of neuroscience to so many basic ethical and metaphysical questions, a metaphysics drawing on cognitive neuroscience research can lead to many misconceptions. One problem is the tendency to equate brain structures or processes with metaphysical realities. Selfhood, free will, or moral responsibility might be identified with some associated brain state or function. The presence or absence of this structure or function in an individual could easily lead to extravagant moral and legal conclusions. We can understand a defense attorney seeking to persuade a jury that his client should not be convicted or punished because the client possesses neural structures associated with a tendency to uncontrollable violence or lacks the functional abilities necessary for free choice. This is already being attempted in some legal cases (Murphy 2005), and pseudo-colors have even been used in scans (a black lesion against a red and green background) to identify an alleged problem area (Illes *et al.* 2004; see also Chapters 3 and 17). But from here it is just a short and misleading step to the conclusion that there really is one locus for good or evil in the brain and that all people with the undesirable feature pose a risk to society. We can imagine such findings being used to promulgate racist notions. And we can imagine a repressive regime choosing to imprison or otherwise marginalize individuals with this feature. Here, deterministic and actuarial ways of thinking are magnified by becoming allied with older metaphysical notions of an indwelling good or evil soul, now identified with some neural structure.

Another example of what I would call metaphysicalized brain science comes from its use in the abortion/embryo research/stem cell debates. Again, the quest is for a defining biological feature that identifies our humanity—a feature whose presence marks the beginning of moral protectability and whose absence marks the end. But if genes will not do this work, perhaps neural activity will? Hence some bioethicists and cognitive neuroscientists have proposed a neural test for personhood (Gazzaniga 2002; Sass 1994; Veatch 1994; see also Chapter 10). If the cessation of brain activity is now widely recognized legally and morally as signifying death, why not regard the start of neural activity, sometime around the first trimester of a pregnancy, as the moral/legal beginning of life? Here, neural activity performs a similar role to that played by the rational soul in classical Thomist metaphysics, where it was seen as being infused some weeks after conception (Wallace 1995).

As attractive as this approach may seem to some pro-choice people or advocates of stem cell research, it is no less misleading than the genetic one. A brain-dead individual differs from an early embryo or fetus. Although the neural structures of an embryo have not yet begun to function, they will do so if development is allowed to proceed. The same cannot be said of a brain-dead individual. Furthermore, the absence of neural activity is a concept requiring much greater specification. How much 'absence' counts? Must the brain as a whole be nonfunctional, or are there special regions (e.g. the cerebral cortex) that are important? How long must nonfunctioning continue? Are individuals in a persistent vegetative state 'persons'?

Behind these questions are a host of further scientific and ethical determinations. We may conclude that the absence of neural activity in certain circumstances is a useful marker for the beginning or end of moral and legal protection, but if we do so, it is because a variety of considerations, including the social costs of maintaining brain-dead individuals, lead us in this direction (Green 2001). Those matters will be ignored if we short-circuit this reasoning process by a metaphysical leap that equates brain functioning with the soul.

The lesson here is that science is not metaphysics, and neuroscience is not neuroethics. Scientists provide insight into physical realities. They have no special expertise in answering our enduring metaphysical and ethical questions. Neuroscience and neuroscientists can provide important new information about the human brain. But, while that information can feed into ethical reasoning, it cannot itself replace the ethical judgment needed for individual and social decision-making. Those who engage in what might be called 'metaphysical neuroscience' ignore this and find it tempting to jump from physical and physiological observations to moral, religious, and philosophical conclusions. This is a temptation that should be avoided.

Conclusion

Neuroscience and neuroethics can learn from the experience of genetics. Many of these lessons are quite specific and can be gleaned from the extensive literature produced by the ELSI program of the Human Genome Project. For example, when should a test move from the research context to widespread clinical implementation? The experience of those in genetics working with tests for disorders like sickle cell disease, cystic fibrosis, or Huntington's disease can help to provide answers to this question (Holtzman and Watson 1998).

In addition, however, neuroscientists can profit from the broad lessons of the Genome Project and ELSI research. These include awareness that there will almost always be a gap between improved diagnosis and our ability to intervene to prevent and cure disease. The existence of the therapeutic gap urges caution in making treatment predictions, and alerts clinicians and investigators to a host of ethical problems that would not exist if the understanding of the etiology of a disease condition led immediately to its treatment or cure.

Deterministic ways of thinking are always a danger in fields where predictions are probabilistic and where average findings have importance but there are also significant differences at the individual level. The lesson here for neuroscientists and neuroethicists is not to overemphasize the certainty of cognitive neuroscience findings and to be ready to consider how we should use information that has actuarial value but may not be relevant to each individual patient or subject.

Finally, neuroscientists must be careful not to succumb to the metaphysical employment of their findings in ways that lead to overly broad claims about human nature or that attempt direct support of ethical or legal conclusions. Neuroscientists make their best contribution when they convey the knowledge developed in their field and make clear the limits of that knowledge. It remains for those working in the fields of philosophy, religion, ethics, law, and the social sciences, as well as those working specifically in neuroethics, to collaborate with scientists to develop the implications of this field for these other areas. Geneticists have had to learn all these lessons by trial and error. Neuroscientists can minimize their own mistakes by learning from this experience.

References

American Society of Human Genetics (1998). Professional disclosure of familial genetic information (statement). *American Journal of Human Genetics* **62**, 474–83.

Bachrach S (2004). In the name of public health—Nazi racial hygiene. *New England Journal of Medicine* **351**, 417–420.

Belluck P (2005). To try to net killer, police ask a small town's men for DNA. *New York Times*, 10 January.

Berkowitz JM, Snyder JM (1998). Racism and sexism in medically assisted conception. *Bioethics* **12**, 25–44.

Boetzkes E (1999). Genetic knowledge and third-party interests. *Cambridge Quarterly of Healthcare Ethics* **8**, 386–92.

Boorse C (1975). On the distinction between disease and illness. *Philosophy and Public Affairs* **5**, 49–68.

Bouchard TJ (1994). The genetic basis of complex human behaviors. *Science* **264**, 1700–1.

Buchanan A, Brock DW, Daniels N, Wikler D (2000). *From Chance to Choice: Genetics and Justice.* Cambridge, UK: Cambridge University Press.

Carlson EA (2001). *The Unfit: A History of a Bad Idea.* Cold Spring Harbor, NY: Cold Spring Harbor Laboratory.

Centers for Disease Control (2004). Genetic testing for breast and ovarian cancer susceptibility: evaluating direct-to-consumer marketing—Atlanta, Denver, Raleigh–Durham and Seattle, 2003. *Morbidity and Mortality Weekly Report* **53**, 603–6.

Clayton EW (1998). What should the law say about disclosure of genetic information to relatives? *Journal of Health Care, Law and Policy* **1**, 373–90.

Clayton EW (2003). Ethical, legal and social implications of genomic medicine. *New England Journal of Medicine* **349**, 562–9.

Clayton EW, Steinberg KK, Khoury MJ, *et al.* (1995). Informed consent for genetic research on stored tissue samples. *JAMA* **274**, 1786–92.

Cook-Deegan RM (1994). *The Gene Wars.* New York: Norton.

Davis DS (2000). Groups, communities, and contested identities in genetic research. *Hastings Center Report* **30**, 38–45.

Davis DS (2004). Genetic research and communal narratives. *Hastings Center Report* **34**, 40–9.

Decruyenaere M, Evers-Kiebooms G, Boogaerts A, *et al.* (1997). Non-participation in predictive testing for Huntington's disease: individual decision-making, personality and avoidant behaviour in the family. *European Journal of Human Genetics* **5**, 351–63.

Dewan SK (2004). As police extend use of DNA, a smudge could trap a thief. *New York Times*, 26 May.

Diller LH (1996). The run on Ritalin: attention deficit disorder and stimulant treatment in the 1990s. *Hastings Center Report* **26**, 12–14.

Dwyer J, Neufeld B, Scheck B (2000). *Actual Innocence.* New York: Random House.

Farah MJ (2002). Emerging ethical issues in neuroscience. *Nature Neuroscience* **5**, 1123–29.

Farah MJ, Wolpe PR (2004). Monitoring and manipulating brain function: new neuroscience technologies and their ethical implications. *Hastings Center Report* **34**, 35–45.

Farah MJ, Illes J, Cook-Deegan R, *et al.* (2004). Neurocognitive enhancement: what can we do and what should we do? *Nature Reviews Neuroscience* **5**, 421–5.

Ford NM (1988). *When Did I Begin?* Cambridge, UK: Cambridge University Press.

Foster M (2001). Ethical issues in developing a haplotype map with socially defined populations. Available online at: http://www.genome.gov/page.cfm?pageID=10001683

Frith S (2004). Who's minding the brain. *Pennsylvania Gazette* 23–31.

Geller G, Tambor ES, Bernhardt BA, *et al.* (1993). Physicians' attitudes toward disclosure of genetic information to third parties. *Journal of Law, Medicine and Ethics* **21**, 238–40.

Gallagher NL (1999). *Breeding Better Vermonters.* Hanover, NH: University Press of New England.

Garver KL, Garver B (1991). Eugenics: past, present, and the future. *American Journal of Human Genetics* **49**, 1109–18.

Gazzaniga M (2002). Zygotes and people aren't quite the same. *New York Times*, 25 April, p.31.

Gert B, Culver CM, Clouser KD (1997). Malady. In: Gert B, Culver CM, Clouser KD (eds) *Bioethics: A Return to Fundamentals.* New York : Oxford University Press, Chapter 5.

Goulding NJ, Waddell HC, Doyal L (2003). Adherence to published ethical guidelines by the UK research community. *Nature Genetics* **34**, 117–19.

Greely HT (1997). The control of genetic research: involving the 'groups between. *Houston Law Review* **33**, 397–430.

Green RM (2001). *The Human Embryo Research Debates* New York: Oxford University Press.

Green RM, Leone AP, Wasserman EM (1997). Ethical guidelines for rTMS research. *IRB* **19**, 1–6.

Guttmacher AE, Collins FS (2003). Breast and ovarian cancer. *New England Journal of Medicine* **348**, 2339–47.

Holtzman NA, Watson MS (eds) (1998). *Promoting Safe and Effective Genetic Testing in the United States: Final Report of the Task Force on Genetic Testing.* Baltimore, MD: Johns Hopkins University Press.

Hur YM, Bouchard TJ (1997). The genetic correlation between impulsivity and sensation seeking traits. *Behavior Genetics* **27**, 455–63.

The brain, specifically the frontal lobe of the cerebral cortex, is the part of the body that differentiates us from other species. The brain enables our body, our mind, our personality, and, many argue, our personhood. Thus, being able to identify when the brain develops in the human embryo should have a significant impact on the question of when to confer the moral status of being human on an embryo. Conferring moral status is a different issue than 'when life begins' and it is an important distinction—one that the neuroscientists suggest should be made.

Biological life and growth of the human organism begins at the moment of conception. But when does *human* life begin? The answer to this question has important implications for debates on abortion, *in vitro* fertilization (IVF), and biomedical cloning for stem cell research. Many neuroscientists and some bioethicists believe that human life begins when the brain starts functioning—we cannot have consciousness before the brain can operate. Consciousness is the critical function needed to determine humanness because it is a quality that, in its fullness with all its implications for self-identity, personal narrative, and other mental constructs, is uniquely human. Following this argument, it would seem that neuroscience would establish the beginning of human life as the point of development when the embryo has a nervous system and brain that is able to support consciousness.

However, as with many ethical issues, once the brain is involved, things tend not to be so black and white. Our grey matter creates many grey areas, and in the case of the embryo I would argue that there are different answers on this issue. The context of the question is everything when it comes to neuroethical questions. And there are several relevant contexts for this topic. First, for instance, if we ask when Sally's life began, the answer is at conception. But, again, when a specific human life began and when life begins are subtly but substantially different questions.

If fetal development alone is considered, the facts are as follows (Nolte 2002). The first signs of the brain begin to form around week 4 when part of the embryo called the neural tube starts to develop three bulges that will eventually become the forebrain, the midbrain and the hindbrain. The first sign of electrical brain activity occurs at the end of week 5 and the beginning of week 6 (Brody 1975). This is far from the beginning of conscious brain activity; it is primitive neural activity. (It is also worth noting that there is also neural activity in brain-dead patients, yet throughout the world and across cultures there is no problem in declaring such brain states as no longer human.) It is not until weeks 8–10 that the cerebrum truly begins to develop, with neuron proliferation, anterior commissure development, and a small first interhemispheric connection. Development continues: in weeks 12–16 the frontal and temporal poles begin to grow, and in week 16 the corpus callosum, which is responsible for communication between the two hemispheres, begins to develop; synapses start forming during week 17 and multiply rapidly around week 28, continuing at a rapid pace up until 3–4 months after birth. However, despite all this amazing and rapid growth and development, it is not until week 23 that the fetus can survive, with major medical support, outside the womb. Before this, the fetus is simply laying the foundations for a brain—a very different thing from having a sustainable human brain.

Life beginning

Now take all of these facts about early fetal development and look at the arguments that are made for drawing a line regarding when life begins. The fact that the fertilized egg does not start the processes that begin to generate a nervous system until day 14 is one of the reasons why those engaging in biomedical cloning for stem cell research use the fertilized embryos only up until day 14. We have to jump all the way down the development time line to 23 weeks to reach the point where the fetus can survive outside the womb, and then only with the help of advanced medical technology. Thus one could argue that from the neuroscience perspective the embryo is not a human being, or deserving of the moral status of a human being, until week 23. Indeed, this is when the Supreme Court has ruled that the fetus has the rights of a human being. But here is where the fully-formed adult brain kicks in with its own opinions, sometimes drowning out the rational, purely scientific analysis. For instance, there is something about the look of a sonogram at week 9, or stage 23 of the Carnegie development stages of fetal development, where I have a personal reaction as a father to the image of the fetus—when it starts to look human. Despite what I know, this triggers a perceptual reaction that this forming ball of sensory–motor processes is one of us.

But before considering what to do with these different reactions, let us consider the main arguments on this question: continuity and potentiality.

The continuity argument that life begins at conception views a fertilized egg as the point at which one's life begins, and where it should be granted the same rights as a human being. There is no consideration of any of the developmental stages for those who adopt this view. And there is no rational arguing with those who see it this way. The potentiality argument is similar, in that it views having the potential to develop into a human being as conferring equal status to that of a human being. I have made the point elsewhere (Gazzaniga 2005) that this is akin to saying that a Home Depot do-it-yourself store is the same as 100 houses because it holds that potential. The main problem, and one that neuroscience cannot ignore, is that this belief makes no sense. How can a biological entity that has no nervous system be a moral agent?

This all leads into a third argument that most often comes into play with stem cell research: intention. Two kinds of embryos are used for stem cell research, unused IVF embryos and those created using biomedical cloning specifically for stem cell harvesting. In the case of IVF embryos, the argument is that the intention of creating several embryos using IVF is to create one or two viable ones for implantation. In natural sexual intercourse and selection, up to 80 percent of embryos spontaneously abort. Thus IVF is simply a high-tech version of what happens naturally. There was never an intention for each embryo created to be implanted; therefore those that are not deemed viable should be able to be used for research. In the case of biomedical cloning, the intention is solely the creation of an embryo for research purposes only.

This brings us back to my sense that there are different answers to the question of when life begins, depending on the context. The markers I identified happen to be similar to those of the 'discontinuity arguments' that some ethicists make. Discontinuity arguments take the view that an embryo is not due the equal moral status of a human being, and look for stages at which to grant it intermediate status. The stages tend to be 14 days (in these arguments, because this is the date after which twinning can no longer occur and so the zygote is cemented) and the formation of the nervous system. However, it is immediately apparent that there can be many different arguments made for when the nervous system starts to develop, ranging from the 14-day marker up to 23 weeks. And if you start to look at when consciousness begins, the parameters are even harder to pin down: the 23-week mark, or when you leave home for college?

Why context is everything

Context is everything—and this, quite simply, is the lesson of neuroscience. It is our brains, enabling our decision-making processes, that allow us to reason, interpret, and contextualize. Indeed, as we shall we, we are wired to do this. Looking at the facts I see the contextual answers thus. A specific human life begins at conception. A 14-day-old embryo, a clump of cells created for research, has no moral status. An embryo is not a person. And yet parents may see the sonogram of a 9-week old fetus and see their future baby. What is worth noting on the question of the embryo is that, like many issues, despite what science presents us with, we still have a 'gut reaction' even though neuroscience tells us that a fetus cannot survive *ex utero* until week 23. Is this gut reaction an indication of a sense of moral instinct that our brains seek to make sense of with these various arguments? Cognitive neuroscientific research seems to be pointing towards this, as we shall see.

Defining practical boundaries for real-world neuroscience

The second area of importance is where cognitive neuroscience should not be commenting because of its limitations. Ironically, this tends to be the exact area where our counsel is most often sought: namely, the court of law. With new neuroimaging techniques, lawyers and investigators are excited by the possibilities of being able to identify areas of the brain responsible for everything from violent behavior to lying. If we can put someone in a scanner and see if they are lying, or identify brains that are angrier than others, cannot this information be used to prove or defend against guilt in a court of law? In fact, the answer should be an emphatic 'No'. While the advances in neuroimaging techniques are exciting, they are not reductive in this way. Being able to see an area of the brain light up in response to certain questions or to pictures of terrorist training camps, say, may reveal some fascinating things about how certain cognitive states may work, but it is dangerous and simply wrong to use such data as irrefutable evidence about such cognitive states. What we know about brain function and brain responses is not always interpretable in a single way and therefore should not be used as infallible evidence in the way that DNA evidence is infallible (Illes 2004).

For instance, take the example of recent work on whether there is a brain mechanism for prejudice. Phelps and her colleagues have used functional MRI (fMRI) studies to examine responses of black and white undergraduates to pictures of known and unknown black and white faces. The results are that the amygdala (an area of the brain associated with emotion) is responsive in white undergraduates when they are shown pictures of unknown black faces, while the amagdyla is not activated when whites are shown famous black faces such as Martin Luther King Jr, Michael Jordan, or Will Smith. They concluded from their study that 'amygdala and behavioral responses to black-versus-white faces in white subjects reflect cultural evaluations of social groups modified by individual experience' (Phelps *et al.* 2000).

What we have to be wary of is how we interpret such data. It seems that we do tend to categorize people on the basis of race. But this does not mean that racism is built into the brain. The tricky idea here is that the brain allows us to concoct stories and theories about sets of circumstances or data—indeed it is bound and determined to do so. But the stories, even when based on data, are not always incontrovertible. They are not fingerprints or DNA. For instance, we could say: 'Well the fact that the amygdala lights up when whites see unfamiliar black faces shows that they are afraid of unfamiliar black faces'. Therefore someone who stabs a black man who approaches him, as in the well-known case of Bernard Goetz, are only reacting to a built-in brain mechanism. And it is supposed that Blacks become angry when they see famous white faces. Thus the 'black rage' defense—a black man who shoots a famous white person is only responding to his brain wiring. This is a leap that one could easily see happening in the court of law where we love to weave stories. But it is clearly a dangerous—and more importantly, inaccurate—leap to make.

This example of how a cognitive neuroscience finding can be interpreted and used to draw unreliable conclusions brings up another crucial area where the law and neuroscience should be kept apart: the 'my brain made me do it' defense (see also Chapters 1, 3, 4, and 17). Neuroscience simply does not have as much to say on the issue of personal responsibility or free will as people would think or hope. Cognitive neuroscience is identifying mechanisms that help us to understand how changes in the brain create changes in the mind. The concern arises, then, that if the brain determines the mind and our actions, independent of our knowing about it until after the fact, what becomes of free will? Free will is still alive and well. As I have argued, even if an action can be explained by a brain mechanism or function or malfunction 'this does not mean that the person who carries out the act is exculpable' (Gazzaniga 2005). Personal responsibility is something that arises out of interacting with human beings. In other words, our actions and reactions are still guided by social rules of behavior in addition to any determined brain mechanisms that we may all have.

To understand this idea more fully, let us first look at an example of research in the cognitive neurosciences that illustrates the automatic brain. The work of Libet, in the 1980s, first brought this issue to the fore (reviewed by Libet 1999). Libet conducted experiments in which he had subjects make voluntary hand movements while he measured their brain activity using event-related potentials. He noted that 500–1000 ms before they moved their hands, there was a 'readiness potential', a wave of brain activity that seemed to indicate a time lag between receiving and executing a command. He performed a series of experiments to try to pinpoint the time in that 500–1000 ms window in which we make a conscious decision to move our hand (Libet 1991; Dennet 2003). He devised an experiment in which a subject was told to look at a black dot that was slowly moving. After moving his hand, the subject reported what position the dot was in at the moment he made the conscious decision to move his hand. Then Libet compared that moment with the time that a readiness potential was recorded from the subject's brain waves.

What he found was that the brain was active even before the subject was aware of having made the conscious decision to move his hand. About 300 ms elapsed between the brain activity and the conscious decision. Thus it seems that the brain knows our decisions before we do—or before we become conscious of them. Such data seem to imply that free will may be an illusion. However, Libet himself noted that there is still a 100 ms window for the conscious mind to allow the decision, or to veto it, calculating that it is 500 ms from the beginning of the readiness potential to the actual hand movement and that it takes approximately 50–100 ms for the neural signal to travel from brain to hand to initiate the movement. Thus he argued that free will is in the vetoing power (Libet 1999).

Such research (and there is much more) indicating that our brains may be responding automatically is gold to defense lawyers looking for a biological basis for defective reasoning that could explain myriad criminal behaviors. But this is not the lesson of neuroscience. Neuroscience seeks to determine how the nervous system functions. The brain is a highly complex system that interacts constantly with the environment. It works automatically, but it also adapts and learns as it goes along, responding to learned rules and social rules, as well as its own built-in rules. As I have argued in an earlier work:

> 'But', some might say, 'aren't you saying that people are basically robots? That the brain is a clock, and you can't hold people responsible for criminal behavior any more than you can blame a clock for not working?' In a word, no. The comparison is inappropriate; the issue (indeed, the very notion) of responsibility has not emerged. The neuroscientists cannot talk about the brain's