



## Why the Topic of Bioethics in Science Classes?

### A New Look at an Old Debate

by Carolyn Csongradi

## **How do we acquire knowledge about principles and values and make reasoned choices?**

How do we develop the skills to make hard choices, to appreciate how others feel, to shape the kind of world we want to live in, to be moral and live with integrity? The fundamental question of whether virtues are taught, inherited, or passed on by some other mechanism has been attributed to Plato more than 2,000 years ago. One current theory proposes that values and moral knowledge are acquired much in the same manner as other forms of content knowledge, through real world experience.

There are at least four plausible, overlapping hypotheses addressing the question of how the human mind gains knowledge about the world. Each hypothesis, supported by different lines of evidence, states one possible relationship between nature, which is inherited information, and nurture, which represents environmental influences. Spanning several centuries, the pros and cons of these hypotheses have been debated by philosophers, scientists, psychologists and others. An important point of contention woven throughout this long standing debate is whether object reality differs from what our mental image is of those same objects. In otherwords, the map is not all there is to describing the territory! These hypotheses focus on distinctions and relationships between "content" which is sensory information arising from real objects, such as shape or color; and "form" which are thoughts, inferences, about these objects. Cause and effect is an example of a property which cannot be directly observed, but develops from mental constructs based on experience and/or genetic information. Our knowledge of things is intimately tied to what we believe to be an objectively or even subjectively defined reality. Object knowledge is thought to be influenced by experience and moral knowledge, by social practices. And as the last hypothesis will propose, what we know about matter and values is likely relative and contingent on our place in history.



## What Is The Relationship Between "Nature" And "Nurture" In The Acquisition Of Knowledge?

"Nature" is more influential than "nurture":

Knowledge arises from genetic information honed by a process of natural selection. Some portions of this knowledge might be nurtured, but genetically determined forms also may modify how we categorize our experiences.

### Evolutionary view:

From an evolutionary point of view, certain things we know about the world are innate, although modifiable by interactions with family, education, religion and society. This knowledge about objects and what is valued is "natural" having been selectively reinforced over time. For instance, pack behavior observed in wolves is a form of collective behavior which supports kinship preferences and caring, while perpetuating a common genetic pool. These core values, associated with social groups, were used long ago by individuals who were successful in their primitive world and had the greatest chance of procreation. Accurately understanding the world enhanced both group and individual survival.

During the 1800's, Charles Darwin (<http://www.english.upenn.edu/~jlynch/Frank/People/cdarwin.html>) speculated that certain rules for conflict arbitration were needed at the point in time when a species evolved a longer memory, a keener imagination and became involved in social contracts. [\(See biblio.29\)](#) For example, a bird, which could leave an active nest to migrate with her group, choosing that instinct over the one to nurture, would find this choice too difficult with a better memory. He argued that certain instincts, such as caring for young as opposed to making a rapid decision to leave, were preferentially selected in any conflict because those values had longer lasting consequences. [\(See biblio.30\)](#) A reasonable alternative interpretation might be that those behaviors encouraging the survival of young also perpetuated those genes which might select for altruism at least among relatives. This form of altruism enhances the survival of the genotype of the altruist. Altruism for non-relatives is quite a different story because the personal pay-off or gain is less easily discerned.

### Neurological studies:

Oliver Sacks (<http://public.logica.com/-stepneys/bib/nf/sacks.htm>), author and neurologist, has devoted much of his recent book to describing the unique behavior of a group of his patients who are savants. [\(See biblio.37\)](#) A savant is someone who demonstrates an extraordinary talent in a particular field such as art, music, or mathematics. A large percentage of savants are autistic (<http://www.autism-society.org>) with limitations in their ability to personally relate to others. Sacks became "friends" with a young boy named Stephen, who was an autistic savant, capable of memorizing complex scenery at a glance and retaining the information for months. When asked he would accurately construct a pen and ink sketch from what he had observed earlier. He started his pictures at one edge of the paper, working across to the other edge, filling in the framework and all the details without an outline. While drawing, "the house could come down" and Stephen would not notice. He sometimes took artistic license and added features which did not originally exist, but the basics, the original flavor, remained. In a sense, having demonstrated his enormous talent at an early age, he had little need for nurture - from the environment or from other humans.



## Philosophical discussion:

In examining the relationship between what was inherited and what was learned from experience, philosophers Hume (<http://www.geocities.com/Athens/4753/index3.html>) and Kant ([http://www.ilt.columbia.edu/academic/digitexts/kant/bio\\_kant.html](http://www.ilt.columbia.edu/academic/digitexts/kant/bio_kant.html)) were echoed by the behaviorist, Freud, when they spoke of nature's contribution as a force to be reckoned with, educated or subdued. Human nature was always a "fact" to contend with. In a more extreme view from the 1500's, Descartes (<http://www.geocities.com/Athens/4753/descartes.html>) questioned whether anything existed outside of the mind. He finally conceded that if there were real things instead of only our thoughts about them, God was responsible for the interpretation. Kant, who realized that Descartes' position made all knowledge subjective to each individual, tried to move away from this restrictive view and proposed that the mind was an active participant in knowledge acquisition, constructing certain aspects of an experience. Kant believed we inherited certain categories or concept grids on which experiences could be sorted or organized. [\(See biblio.5\)](#)

To understand how the mind might "construct" an experience, the following experiment should be helpful. Obtain three bowls each holding about a gallon of liquid. Arrange them so that the first bowl contains hot water; the second, tepid; and the third, very cold water. Simultaneously, place your left hand in the hot water and your right in the cold. Wait one minute and immerse both hands in the tepid water. What has each hand told you about the temperature? Additional examples of the mind's involvement in interpreting experience are seen with optical illusions, the unnoticed retinal "blind spot" and other adaptive behaviors found in the nervous system.

One of the problems with a purely "nature" based argument is how to explain the existence or continuing survival of certain values which may involve actions for which there is no obvious natural selection pressure. For example, why should a choice be made contrary to an individual's stated preferences or which may result in actual punishment? Altruism for non-related individuals, truthfulness and justice as fairness are values difficult to support from an evolutionary view, particularly when some choices cause the death of an individual, effectively removing those genes from the pool. Hypothesizing these as primarily inherited values would generate a requirement for a very complex set of genetic directions having a large common human base of reference. The search for a potential common morality has provoked more debate than agreement among anthropologists, theologians, and philosophers. [\(See biblio.33\)](#)



## "Nurture" Is More Influential Than "Nature"

Experiences are written onto the mind, which is essentially a blank slate. We have knowledge of the world because we learn from experiences. "Prior to experience, the human mind is a 'white paper', void of all characters, without any ideas. " Each aspect of behavior is acquired from the environment. [\(See biblio.23\)](#)

### Philosophical discussion

The philosopher Hume thought the mind a blank slate (tabula rasa) on which experience could be written. Hume was preceded by another philosopher, John Locke (<http://swift.eng.ox.ac.uk/jdr/locke.html>) who was also a contemporary of Isaac Newton. They belonged to a school of thought known as Empiricism which states that knowledge is derived from experiment and observation and were joined by science contemporaries, Sir Francis Bacon and Robert Boyle. [\(See biblio.16\)](#) Locke thought all knowledge of the world was gathered through sensory experience. This information could be manipulated into more complex ideas by reflection and reasoning. He saw the mind as having innate powers of observation, but not of ideas which were to be constructed from sensory input. Hume, expressing the extreme of skepticism, felt nothing was objective, everything was chaotic, connections between impressions were imagined.

Critics observed that this line of thinking could not explain cause and effect in a novel situation unless one was allowed to rely on a multitude of previous experiences. Berkeley, a contemporary of Locke, argued that Locke's logic led to the conclusion that all knowledge ultimately becomes ideas in the mind which may or may not resemble reality. Our perception of nature is a mental experience. Kant, who was familiar with the discoveries of Newton, helped solve this conflict. He argued that while knowledge came from sensory information, we have inherited the ability to categorize sensory information with respect to time, space and causality. A rock thrown at a window will break the glass. The future should look like the past.

The "Natural Law Theory" argued that moral principles could be discovered through careful reflection. [\(See biblio.31\)](#) Reasoning was needed to counter or balance the natural inclinations of individuals. These laws of nature, rather than the individual customs and preferences, determined what action was "right". While the powers of reason were a part of the mind, principles were not. They remained to be found by observing nature.

Essentially, this is a philosophical discussion about how sensory knowledge is organized by the mind. Do we have an innate ability to manipulate objective sensory information or must this be learned entirely from experience? This difference in opinion is not likely to lead to any resolution of questions concerning the origin of values or moral knowledge nor explain the large body of scientific literature equating structural changes in biologic systems with learning.



## Neurological studies

In a recent best seller, neurologist Oliver Sacks examined a man, Virgil, who had had cataracts clouding both eyes following an early childhood illness. [\(See biblio.37\)](#) Earlier, several physicians had examined Virgil's eyes and concluded his retinas had been damaged as well by the same illness and concluded cataract removal would be futile. As an adult Virgil was functionally blind. At age fifty, Virgil was once again examined by a specialist whose opinion differed from earlier recommendations. This physician felt Virgil's retinas might have limited function and recommended removing both cataracts. Virgil agreed and thus became a fascinating opportunity for Sacks to study perception and the role of nature in visual learning.

After the surgery, Virgil reported seeing blurred visual images and had little ability to identify what he was seeing. For instance, a face seen wasn't known as a face until touched and he was unable to make sense of facial expressions. His primary route for knowledge of objects continued to be tactile. Over time, he showed little sense of depth perception, having difficulty judging objects in the distance from those which were close. He was as Sacks said, mentally blind.

After struggling for many months to learn to navigate visually, Virgil began to have long periods of spontaneous blurriness which were not observed by his doctor in patients who had had cataracts for a much shorter time. Sacks and the ophthalmologist concluded Virgil's visual cortex was in neural overload and responded by a sudden shutting down. This process of disconnection has been observed in many different animals when feeling overwhelmed.

In the end, his retinas continued to have the same physical appearance and Virgil's perception continued to deteriorate. Virgil became more blind than he had been before his operations, although he experienced rare moments when he could see something accurately. Whether this ultimate loss of vision was related to an intervening bout of a near lethal pneumonia or excess sensory stimulation could not be determined. What is clear is that nurture plays a major role in our ability to make sense of visual stimuli. Seeing is not necessarily "to see". Even if an alternative mode is developed for object identification, this conceptual information does not appear to transfer readily between sensory systems.



## "Nature" And "Nurture" Interact In Sequential Stages:

Certain experiences are crucial to the maturing brain which develops in a series of stages such that the success of the next developmental stage depends upon the previous one. Our inherited nature is augmented by appropriately timed stimulation and the results can be tested behaviorally.

### Behavioral observations

In the early 1900's, Piaget (<http://www-hcs.derby.ac.uk/tip/piaget.html>) was the best known proponent of the hypothesis that children are born with few of the concepts possessed by an adolescent. His ideas were based on a series of elegantly designed experiments which studied how babies and young children acquired the concepts of object, space, and cause and effect. He proposed that children pass through a series of developmental stages where one stage builds upon the other by a process of assimilation followed by accommodation to the realities of the world. The process is largely one of brain maturation with appropriately timed environmental stimulation.

Piaget has been criticized for emphasizing a specific form of thinking which is more relevant to Western cultures. Subsequent experiments have demonstrated that individual stages are achieved in a less step-wise, more continuous fashion over a wider range of ages than he would have predicted. His theories do not always generalize across different content areas. For instance, the same child may show a grasp of the conservation of volume in one situation but not in another.

Another way to look at the interaction between the developing mind and environment has been to study the mother-infant bond. The mother is often considered the infant's first experience with an object from the world. During the 1930's Renee Spitz followed by John Bowlby studied infant deaths in foundling homes and in long term hospitalization. These sterile environments lacked visual and tactile stimulation and although they had adequate care in the strict sense, human contact was notably absent. A significant percentage of these babies died in the first year. In the early 1950's Harry Harlow experimented with social isolation in newborn monkeys which extended from birth to as long as one year. These monkeys were severely socially impaired as a result of the isolation. Such vulnerability was not detected when older animals were isolated. [\(See biblio.17\)](#)

D.W. Winnicott, a 20th century British psychiatrist, coined the term "good enough mother", theorizing that there was never just an infant, but an infant-mother pair. Babies gain knowledge about objects from their experiences with the mother. If young children are deprived of a nurturing environment, such as in the case of an alcoholic or abusive parent, infants learn that objects come and go unpredictably. He believed this early exposure to the concept of object permanence (or impermanence) continued to influence how these children learned about other real world objects in a skewed way through out their lives. [\(See biblio.43\)](#) A colleague, Arnold Modell, went one step further by stating the capacity to know and the capacity to love are not separate functions. [\(See biblio.22\)](#)

While the pre-programmed information for grasping, sucking and orienting toward human faces are instinctual requirements for Piaget's developmental theories, they may become impaired through neglect and abuse by caregivers. Reality is constructed from what we know and what we value as important from experiences occurring at a very early age.

In the developmental model, natural selection has encouraged the brain to be flexible at certain key periods rather than emphasizing an assessment of the environment. The nature based model valued receptors for gathering environmental information. The genes selecting for brain plasticity were less important. While we might reasonably expect to find a gene or genes for instinctual behaviors, the full development of an individual would depend on being exposed to certain stimuli, to establish the basic building blocks for sequential development.



## "Nurture" Is In Equilibrium With "Nature" During Critical Periods Of Vulnerability:

During critical windows of exposure, experiences chemically and anatomically modify the brain structures over a lifetime. We have inherited important capabilities and tendencies, but these require shaping.

### Physiological evidence:

The mammalian visual system has been studied extensively for more than forty years. In 1981, neuroscientists David Hubel and Torsten Wiesel received a Nobel prize for their work on the developing visual cortex ([http://www-inst.eecs.berkeley.edu/~ee20/lectures/12\\_Vision/node3.html](http://www-inst.eecs.berkeley.edu/~ee20/lectures/12_Vision/node3.html)). [\(See biblio.20\)](#) They performed experiments recording the activities of individual brain neurons after selectively depriving newborn animals of different types of visual stimulation. Early experiences (or lack thereof) have a direct influence on how the animal perceives the world as an adult and structural differences were observed in the brains of these animals. Scientist Francis Crick reflects the philosophy of Reductionism when he said, "The scientific belief is that our minds - the behavior of our brains - can be explained by the interactions of nerve cells (and other cells) and the molecules associated with them". [\(See biblio.8\)](#) This "reductionist" approach, which means a complex system can be explained by understanding the behavior and interactions of the components, has been a driving force in scientific development.

The evidence supporting the hypothesis that environmental experiences influence shape anatomical brain structures is powerful has been substantiated by neurophysiological experiments. For example, recent studies done on spinal cord paralysis and the role of a molecule called GAP-43, which turns on for cell growth and repair, suggests that the nervous system has critical periods of plasticity from a biochemical point of view as well as a structural one. This finding elegantly supports the behavioral observations of Piaget while offering an explanation for why children may recover from serious brain injuries where adults would have a very poor prognosis.

Additional support is found in a second relevant article, " Male Call " reprinted from a book by Robert Sapolsky. [\(See biblio.38\)](#) Sapolsky studied the relationship between aggression and testosterone levels in males. What he observed was that in castrated animals, changing the levels of testosterone over a wide range produced little differences between pre-surgical aggression and that seen with differing amounts of chemical replacement. He concluded that a minimum amount of testosterone was required to allow for aggressive behavior - "give permission" was his term. Social conditioning seems to more than make up for much of the lower hormone levels. The picture appears to be a complex interaction between environment, previous social experience and chemistry.

In his recent book, Nobel laureate neurobiologist Gerald Edelman developed a hypothesis supported by extensive neuroanatomical and physiological studies. He argued that repeated common experiences strengthen key neuronal connections through frequent firings. [\(See biblio.10\)](#) The result is to develop and reinforce anatomically based concept maps which are formed from groups of neurons linked by common experiences, not unlike the categories proposed by Kant. These concept maps subsequently modify how sensory information is processed and organized.



## Behavioral observations:

A recent article, "Name That Tone", was written by two geneticists who studied perfect pitch and its relationship to musical training. [\(See biblio.15\)](#) Some people have the ability to recognize or play a specific musical note without hearing a reference note. This is called "perfect pitch". To cast some light on whether "perfect pitch" was inherited and/or learned, a study was conducted in which 620 music students were surveyed for their ability to recognize a particular musical note. Those who received musical training before the age of two had the highest percentage of individuals with "perfect pitch" (about 7%), while only 2% had "perfect pitch" when given musical training after age twelve. Both nature and a critically timed nurturing were responsible.

A more familiar example is the medical condition known as "lazy eye". If the brain fails to receive input from both eyes in the early years of life, the information from the eye with very poor vision is permanently discounted even after corrective surgery or lenses. Yet, a baby swaddled for most of its first year of life will still walk normally during the second year. Plasticity seems at a maximum during the earlier years of human life, but there is evidence of residual plasticity in adults who recover from the devastating effects of strokes. [\(See biblio.11\)](#)

In species other than mammals, a similar pattern of critically timed vulnerability for the nervous system also exists. The acquisition of bird songs has been extensively studied in the context of what is inherited and if critical windows of exposure exist for normal song to develop. Some birds such as doves, who have a species specific cooing rhythm, are unaffected by efforts to disrupt their learning. Their song must have a genetic model which does not require environmental "priming". The sparrow, however, needs to acquire a "model" or template for the species specific song sometime during its first four months of life or it fails to produce a normal song even with subsequent adult song exposure. [\(See biblio.19\)](#)

One last thought provoking comment by an evolutionist, Ernest Mayr, "Man is distinguished from all other animals by the openness of its behavioral program... so in human beings ethical norms and definite values are laid down in the open behavior program of an infant." [\(See biblio.29\)](#) He further states this is a very special type of learning akin to imprinting based on an innate capacity to acquire the ethical beliefs. There is disagreement during what period humans most easily acquire these values. Daniel Keating, a cognitive scientist, believes adolescence is the period when individuals discover a role for feelings and aspirations which make sense in terms of the overall community needs and expectations. [\(See biblio.24\)](#) His work is strongly supported by the observations of educational psychologist Carol Gilligan, who concludes after a longitudinal study of young girls that adolescence is a period during which self in relationship to others becomes critically important. [\(See biblio.13\)](#)

### **In summary...**

A generous interpretation of all these data is that humans might learn anything at any time given sufficient stimulation with rare exception. Exceptions, such as autistics (<http://www.autism-society.org/>) who seem not to develop empathy for others, despite repeated exposure, are demonstrating a different neural learning program. Perhaps a more rationale conclusion is one which acknowledges that each species is primed to receive certain kinds of information which is most easily incorporated during critical windows of developmental opportunity. The nervous system likely has periods of greater flexibility with respect to learning in culturally sensitive periods. What also seems clear is that the loss of brain plasticity is neither linear with time nor completely predictable.



## Are The Reasoning Processes Which Manipulate Knowledge Of Objects Similar To Those Used To Manipulate Values And Principles?

As attempts have been made to discover the ways in which adolescents solve moral problems, it is important to remember one fundamental question underlying this area of research: How do adolescents see themselves in relation to others and society at large? This could easily be phrased as: personal versus impersonal, or caring versus justice perspectives. No matter how the researcher explores the data, the continuing question remains one of authentically accessing the capacity of an adolescent to make inferences about what is acceptable behavior and choices extending beyond self.

A large area of research has explored adolescent conflict resolution by studying decision making behavior as related to social institutions and politics. The implicit assumption is that these behaviors are reflective of a more personal moral reasoning strategy. Research has largely centered around the theories advanced by Piaget, Gilligan and two other psychologists, Robert Selman and Lawrence Kohlberg (<http://snycorva.cortland.edu/~ANDERSMD/KOHL/content.HTML>).<sup>(See biblio.14)</sup> Selman's work originally focused on interpersonal relationships; Gilligan, on gender differences in moral thinking, and the others, on developmental stages.

Piaget's experiments involved a reasoning process which utilized mathematical concepts and object manipulation. There is no solid evidence to support that the reasoning strategies used in understanding concepts like conservation of volume are applicable to political or moral issues. In fact, some current psychologists believe that a generalized ability for people to make inferences from information learned across different subjects is not likely. Different tasks seem to require different reasoning skills.<sup>(See biblio.41)</sup> This generalization is consistent with an earlier criticism of Piaget based on observations that his theoretical formal operations do not appear generalizable across contents.

Kohlberg's theory of moral development, which has six different levels of moral reasoning, makes a similar assumption.<sup>(See biblio.40)</sup> Individuals, who are assigned to one particular stage as determined by testing their responses on a hypothetical moral dilemma, will respond to social and political issues at the same level. The hypothetical dilemmas used are at a more personal level than typical political issues and the assumption that these reasoning processes are similar should also be questioned. It is also not clear that responses to moral dilemmas involving fairy tales or other fictional accounts would necessarily be the same as real-life dilemmas.

The work of Kohlberg has been challenged by Gilligan<sup>(See biblio.13)</sup> and her followers<sup>(See biblio.14)</sup>, who have disagreed with both the contrived nature of the stories Kohlberg's group used, and with the fact that he fails to include caring for another person in his descriptions of the different stages. Gilligan argues that females are conditioned through cultural roles to value maintaining relationships - to stay connected. When asked about dilemmas that involve conflicts relating more to justice based issues, this conditioning creates a bias in the responses of young girls who are subsequently assigned a lower moral stage of development.

Selman's work proposes four stages of skills involved in interpersonal negotiations. These stages range from: allowing impulses to settle a dispute (a fight), giving in to the other person (flight), asking the other person to provide justifications, and finally, collaborating on a mutually acceptable outcome. The question remains one of being able to evaluate the adolescent's role of self in relationship with others, and in the broader context of the needs of the community.

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One conclusion, which appears as a common thread: significant changes in perspective are happening in the years from ages eleven to fifteen or sixteen. As the content knowledge base enlarges, some students do begin to appreciate that moral decision making involves more than their individual needs and they begin to view the bigger picture. However, it does not appear that processes which integrate knowledge of objects and make inferences are necessarily applicable to the manipulation of knowledge about values or social practices. "...many adolescents habitually reason about everyday moral issues at relatively low levels and find it difficult to see connections between ethical principles and their own lives or political issues involving the common good. In addition, many cannot focus easily on concepts outside their personal experience or perceive reciprocity and mutual interest." [\(See biblio.41\)](#)



## What does this mean for an educator?

If the acquisition and manipulation of all types of knowledge is dependent upon exposure to content, properly timed experience, and practice with different types of reasoning skills, then this strongly suggests two things about the process of conflict resolution. In the first place, we need to provide an opportunity for our students to engage in discussions that allow them to examine their own values, as we do with other forms of knowledge. Secondly, that discussion must have a real world context in which the moral reasoning process may occur. When one looks at classrooms in which open discussions around principles and values occur, increases in the level of moral reasoning occur. If we decide not to include bioethics in the science curriculum, we are assuming that students will develop these reasoning skills and acquire this moral knowledge in the context of science related issues, in another comparable environment. That is risking a lot.

The importance of these norms which interface scientific thinking with social practices is not to be overstated. Some of these values help to balance our individual selfish tendencies by imposing the need for us to consider what might be beneficial to the whole group. And, if object knowledge can modify brain structures and subsequently shape our perceptions of the world, then moral knowledge should be able to change social practices as those practices subsequently modify what is valued. We can assist adolescents in creating their own concept maps for the manipulation of objects and do likewise for values. This will happen not with our prescription of those values or norms, but by facilitating the process of adolescent self discovery.



## Bibliography

1. Akutagawa, *Ryunosuko, Rashomon and Other Stories*, "In a Grove," Norton Books, 1970.
2. American Medical Association, *Code of Medical Ethics*, American Medical Association, 1997
3. Bardige, Betty, "Things So Finely Human: Moral Sensibilities at Risk in Adolescence", in *Mapping the Moral Domain*, Carol Gilligan, Editor, Harvard University Press, 1988
4. Beauchamp, Tom and James Childress, *Principles of Biomedical Ethics*, 4th Edition, Oxford University Press, New York, 1994
5. Bell, David, "Kant" in Nicholas Bunnin and E.P. Tsui-James, Editors, *The Blackwell Companion to Philosophy*, Blackwell Publishers, Ltd., 1996
6. Carter, Stephen, *Integrity*, Basic Books, HarperCollins, 1996
7. Cowan, Ruth, "Genetic Technology and Reproductive Choice: An Ethics for Autonomy" in *Code of Codes*, Daniel Kevles and Leroy Hood, Editors, Harvard University Press, 1995
8. Crick, Francis, *The Astonishing Hypothesis: The Scientific Search for the Soul*, Simon & Schuster, New York, 1995
9. Davis, Nancy, "Contemporary Deontology" in *A Companion to Ethics*, Peter Singer, Editor, Basil Blackwell Ltd. 1993
10. Edelman, Gerald, *Bright Air, Brilliant Fire: On the Matter of the Mind*, Basic Books: HarperCollins Publishers, 1992
11. Gardner, Howard, *Frames of Mind: The Theory of Multiple Intelligences*, 10th Edition, Basic Books, HarperCollins Publisher, 1983
12. Gilligan, Carol, Editor, *Making Connections: The Relational Worlds of Adolescent Girls at Emma Willard School*, Harvard University Press, Cambridge, 1990
13. Gilligan, Carol, *In a Different Voice: Psychological Theory and Women's Development*, Harvard University Press, Cambridge, 1993
14. Gilligan, Carol, Editor, *Mapping the Moral Domain*, Harvard University Press, Cambridge, 1988
15. Gitschier, Jane and Nelson Freimer, M.D. "Name that Tone", University of California San Francisco (UCSF Magazine), Volume 17, April, 1997; Perfect Pitch: Nature or Nurture?" San Francisco Chronicle, July 13, 1997
16. Grayling, A.C. "Epistemology", in *The Blackwell Companion to Philosophy*, Nicholas Bunnin and E.P. Tsui-James, Editors, Blackwell Publishers Ltd. 1996
17. Harlow, Harry F. "Love in Infant Monkeys, in *The Nature and Nurture of Behavior*, Readings from Scientific American, W.H. Freeman and Co., 1973
18. Hart, H.L.A. *Law, Liberty and Morality*, Stanford University Press, 1963
19. Hooker, Barbara, "Birds" in *Animal Communication*, Thomas Sebeok, Editor, Indiana University Press, 1968
20. Hubbel, David, "The Visual Cortex of the Brain", *The Nature and Nurture of Behavior*, Readings from Scientific American, W.H. Freeman and Co., 1973
21. Hundert, Edward, "A Model for Ethical Problem Solving in Medicine, With Practical Applications", *American Journal of Psychiatry* 144:7, July 1987



22. Hundert, Edward, "Lessons from An Optical Illusion: On Nature and Nurture, Knowledge and Values", Harvard University Press, Cambridge, 1995
23. Jones, Peter, "Hume", in *The Blackwell Companion to Philosophy*, Nicholas Bunnin and E. P. Tsui-James, Editors, Blackwell Publishers Ltd. 1996
24. Keating, Daniel, "Adolescent Thinking" in *At the Threshold: The Developing Adolescent*, Shirley Feldman and Glen Elliot, Editors, Harvard University Press, 1990
25. Keller, Evelyn , "Nature, Nurture and the Human Genome Project", in *The Code of Codes: Scientific and Social Issues in the Human Genome Project*, Daniel Devles and Leroy Hood, Editors, Harvard University Press, Cambridge, 1992
26. Kevles, Daniel and Leroy Hood, editors, *The Code of Codes: Scientific and Social Issues in the Human Genome Project*, Harvard University Press, Cambridge, 1992
27. Lyons, Nona, "Two Perspectives: On Self, Relationships and Morality", in *Mapping the Moral Domain*, Carol Gilligan, Editor, Harvard University Press, 1988
28. MacIntyre, Alasdair, *After Virtue*, Second Edition, University of Notre Dame Press, Notre Dame, Indiana, 1984
29. Mayr, Ernest, *Toward a New Philosophy of Biology: Observations of an Evolutionist*, Harvard University Press, Cambridge, 1988
30. Midgley, Mary, "The Origin of Ethics" in *A Companion to Ethics*, Peter Singer, Editor, Basil Blackwell Ltd, 1993
31. Munson, Ronald, *Intervention and Reflection: Basic Issues in Medical Ethics*, Fifth Edition, Wadsworth Publishing Company, 1996
32. Noddings, Nel, *Caring: A Feminine Approach to Ethics and Moral Education*, University of California Press, Berkeley, 1984
33. Outka, Gene and John Reeder, Editors, *Prospects for a Common Morality*, Princeton University Press, New Jersey, 1993
34. Pence, Greg, "Virtue Theory", *A Companion to Ethics*, Peter Singer, Editor, Basil Blackwell Ltd, 1993
35. Rawls, John, *A Theory of Justice*, Belknap Press, Harvard University Press, Cambridge, 1971
36. Ruse, Michael, "The Significance of Evolution" in *A Companion to Ethics*, Peter Singer, Editor, Basil Blackwell Ltd, 1993
37. Sacks, Oliver, *An Anthropologist on Mars*, Vintage Books, Random House, Inc, 1995
38. Sapolsky, Robert, "Male Call" San Francisco Examiner Magazine, June 8, 1997, from *The Trouble with Testosterone*, Simon and Schuster, Inc, 1997
39. Tarnas, Richard, *The Passion of the Western Mind: Understanding the Ideas That Have Shaped Our World View*, Ballantine Books, New York, 1991
40. Thomas, Laurence, "Morality and Psychological Development", in *A Companion to Ethics*, Peter Singer, Editor, Basil Blackwell Ltd, 1993
41. Torney-Purta, Judith, "Youth in Relation to Social Institutions", in *At the Threshold: The Developing Adolescent*, Shirley Feldman and Glen Elliot, Editors, Harvard University Press, 1990

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42. Young, Ernie W.D., *Alpha and Omega: Ethics at the Frontiers of Life and Death*, Addison-Wesley Publishing Company, Inc., California, 1989

43. Winnicott, D. W. *Home is Where We Start From*, Essays by a Psychoanalyst, W.W. Norton & Company, New York, 1986

44. Woolhouse, R.S. "Locke" in *The Blackwell Companion to Philosophy*, Nicholas Bunnin and E.P. Tsui-James, Editors, Blackwell Publishers Ltd, 1996