

Chapter 9 "Multiple Intelligences" Approaches to Understanding

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Three Uses of Intelligences

By now, my educational vision should be clear. Deep understanding should be our central goal; we should strive to inculcate understanding of what, within a cultural context, is considered true or false, beautiful or unpalatable, good or evil. Stressing that these are merely examples (though considered ones), I have called for a curriculum that fosters understanding of the theory of evolution, the music of Mozart, and the recent historical event called the Holocaust.

But can we draw on our expanding knowledge of human development, individual differences, and cultural influences as ways of enhancing the understandings of large number of students?

Finally, we are in a position to assemble the pieces of the puzzle of effective education. Put succinctly, such an education should be constructed on two foundations. On the one hand, educators need to recognize the difficulties faced by students in attaining genuine understanding of important topics and concepts. On the other hand, educators need to take into account the differences among the minds of students and, insofar as possible, fashion an education that can reach the infinite variety of students.

Here the perspective of multiple intelligences can become a powerful partner in effective teaching. I contend that a "multiple intelligences perspective" can enhance understanding in at least three ways:

1. By providing powerful points of entry. The pedagogical decision about how best to introduce a topic is important. Students can be engaged or turned off in quick order. Also, because of what psychologists term a "primacy effect," students are likely to remember the opening illustration or "attention grabber." The theory of multiple intelligences yields an abundance of ways in which to broach a topic.

2. By offering apt analogies Unfamiliar topics or themes are often grasped initially by analogy to a topic that is better known or understood. Alternatively, models drawn from familiar territory can also aid in conveying an initial grasp of an unfamiliar terrain.

Of course every analogy has both strengths and weaknesses. Since, by definition, analogies or models are drawn from remote realms, there will be important differences, as well as telling similarities, between the unfamiliar topic and the more accessible vehicle that is being used to illuminate it. Instructors must convey the power of the analogy; no less, they must indicate its limitations and the ways in which it might mislead.

3. By providing multiple representations of the central or core ideas of the topic. For pedagogical purposes, any topic or theme should feature a few important or central ideas. Teaching will be considered successful to the extent that these ideas have been grasped and to the extent that they can be drawn on appropriately in new situations.

Often instructors will think about these core ideas in a particular way. Yet, I doubt that there

exists any seminal idea that can be thought of in only one way. Indeed, I would go further. It is a characteristic of powerful ideas that they can be represented in more than one way-- as I shall express it later, that they can be embodied in a number of "model languages." A mark of the expert-- the person who understands a topic thoroughly-- is that he or she can create a family of representations, a set of model languages, a variety of "takes" on the core idea--and can go on to evaluate candidate new accounts of the topic.

There are numerous ways in which one can approach and introduce directly our "target triplet" of Evolution, Mozart, and the Holocaust. I have already indicated that each of these topics resembles an iceberg; and no observer can do more than survey parts of it. Until now, I have focussed on a "generative introduction" to each topic-- specifically finches, an operatic trio, the Wannsee Conference. From now on, I will deliberately draw examples from a variety of sites on each iceberg. And so, for example, in speaking about biological science, I will sometimes touch on the introductory example (finches), sometimes on the entire topic (Darwinian evolution), sometimes on more general considerations of scientific exploration and explanation. I will follow a similar "sampling strategy" with reference to Mozart and the Holocaust.

I adopt this ecumenical approach for two reasons. First, I want to show that a "multiple intelligences" approach is flexible; it can be employed with topics that are sharply focussed as well as topics that are generic. Second, not every aspect of multiple intelligences can be used with equal effectiveness for every pedagogical goal. Put concretely, while there is more than one "entry point" "analogy" or "model language" for each topic, there is no reason to suppose that

there will necessarily be 7 or 12 or 37 for each. The pedagogical challenge is to figure out which entry points hold promise for particular understandings; to try out a candidate entry point; to reflect upon successes and failures. The same reflective challenge obtains in the selection of apt analogies and model languages. I have sought to use examples that make sense, not merely to invent examples that, checklist-style, will occupy every space in an a priori grid.

Even though I make no claim to being exhaustive, I do provide numerous examples in the pages that follow --for a reason. All too often, the theory of multiple intelligences has been invoked to convey trivial examples, or to present important examples in an offbeat or anecdotal way. ("Let's sing our times tables, children.") Here I offer an existence proof: A multiple intelligences approach can be drawn upon in a thoroughgoing way to present ideas that are consequential. And while I have in mind teachers working in classes with students, I believe that this approach can be of use to any individual who seeks to master any significant topic...including those who have not been inside a classroom for decades.

### Multiple Entry Points to Rich Topics

Taking off from the theory of multiple intelligences, in a rough rather than a slavish way, one can find at least seven powerful entry points to diverse concepts. These varying "opening gambits" help to introduce important and challenging topics.

Narrative Entry Points. Perhaps the most effective way to involve a large number of learners is through the telling of a vivid, dramatic narrative. Individuals of all ages find stories to be inviting.

Narratives, of course, activate the linguistic as well as the personal intelligences; and it is also possible to convey narrative in other symbolic forms, such as mime or cinema, that engage other intelligences.

Each of our three cases lends itself readily to narrative entry points. With the example of evolution, one can tell the fascinating story of Darwin, a young man of promise but also of personal weaknesses and foibles; his epochal voyage on the *Beagle*; his struggles to formulate the theory of evolution; his reluctance to make his awesome conclusions public; the strange coincidence of Wallace's co-discovery of evolution and the uncharacteristically gentlemanly resolution of this "struggle for priority;" and the pitched battles that followed upon the public unveiling of the theory in 1859. How ironic that a shy man who shunned publicity would inspire so compelling a drama.

The narrative can extend beyond Darwin himself. There are other fascinating protagonists in the story of evolution, including his predecessor Lamarck, his contemporary Wallace, Thomas Huxley ("Darwin's bulldog"), and Darwin's own evolutionist grandfather Erasmus. And stories can transcend individuals; it is inviting to cover the saga of a particular species (such as the finches across the Galapagos chain), or even the grand story of evolution itself-- the story begun so vividly, if non-scientifically, in the opening verses of Genesis and in other "myths of origin".

Mozart and his family (featuring an ambitious and difficult father) furnish a promising narrative-- as Peter Shaffer showed in his play Amadeus. So do other characters in the Figaro story.

Librettist da Ponte, for example, ended up teaching Italian at Columbia University; playwright

Beaumarchais became a secret arms supplier during the American revolution; and Mozart seems to have been in love with Nancy Storace, who played the role of Susanna in the original production of Figaro. There is also the story contained in the original Beaumarchais play, the story that comprises the Mozart opera, and even the story of how the play got turned into the opera, with sharp condensation and the deletion of most of the "politically-incorrect" material.

However, from a musical point of view, narrative takes on a different meaning. Now the reference is not to plot and characters but rather to motifs-- how they are introduced, elaborated upon, revisited in different guises and for different expressive purposes. The opening overture, for example, introduces a number of different themes--joyous, touched with intrigue or tension, and plaintive-- primarily in the triumphant key of D major. These themes, moods, metric patterns, and figures are played with throughout the opera; they capture portions of the action, and themselves are "acted upon" by the composer in order to achieve contrasting effects.

We even can trace the course of a theme in the "trio of colliding agendas." Basilio commences the trio with a simple declining motif of three notes, spanning a triad (F, E flat, D D), which competes for attention with the chromatic motif of Susanna. The declining motif is immediately inverted, when both the count and Basilio seek to help the fainting maiden. Basilio picks up the theme again, in a lower key, this time in an ascending passage, when he insists that he is only here to help Susanna; and he returns to the original descending figure when he explains apologetically that he was only communicating heresay about Cherubino. Finally, the concluding minute of the trio, with each of the three protagonists baring his or her soul, is similarly based on variations of this set of three notes, sometimes sung in ascending, sometimes in descending order. I could go

so far as to dub this trio as the "song of three notes"-- or the story of the ways in which three successive notes in a major scale can be used to convey diverse feelings and actions.

Like evolution and Mozart, the Holocaust proves a vast recruiting ground for compelling narratives. Few characters from modern history are as fascinating, if in a morbid way, as Adolf Hitler. His story, that of the Nazi party, and its more sensational leaders-- like Field Marshall Hermann Goering, chief propagandist Josef Goebbels, and Heinrich Himmler, the architect of the Holocaust-- engender enduring interest.

Narratives can also encompass a broader range. There is European history, German history, the history of the Jewish people, the history of anti-Semitism. At a more focussed level, there are intriguing stories about individuals, including survivors, martyrs, and those who protected Jews and others under threat from the Nazi regime. And as we have seen, it is possible to tell the story of a specific event-- the Conference at Wannsee-- in terms of what explicitly was said there, what was not uttered, in light of the horrible events that led up to and flowed from it. Indeed, a cinematic or theatrical treatment of the Conference can prove as effective as an annotated version of the protocol prepared by Adolf Eichmann. Such a film was produced by Heinz Schirk in 1984.

To recapitulate: when one has elected to focus upon a rich generative topic, or a provocative question, the decision about how to introduce students to that topic proves a pivotal one.

Because stories hold much interest, they offer an inviting entry point. For each of the topics under consideration here, ample opportunities exist for the creation of arresting invitations, which

should generate initial curiosity and help to sustain interest in the topic.

But a variety of additional, promising entry points exist. More briefly, I will introduce each and suggest some ways in it can be applied to the triplet of topics at hand.

Numerical Entry Points. Some students like to deal with numbers and numerical relations. In the case of the theory of evolution, they might find it provocative to trace Darwin's own thinking during and following his tour of the Galapagos Islands. Darwin was struck by the variety of finches on closely related islands and tried to figure out the nature of the distribution and the reasons for it. In subsequent conversation with John Gould and others, he revised his numerical classifications; one can read the slightly differing accounts in his original and his published journals and in his Origin of Species. A century later, evolutionary biologist David Lack revisited the islands and made a targeted analysis of the number of species on each, even as he offered his own explanation for the observed distribution.

Nowadays, like the rest of biology, the study of evolution has become highly quantitative. Mathematically-oriented students find plenty to cut their teeth on in contemporary studies of life-- the mathematical models of evolutionary processes, or shifts in population, or dimensions of "artificial life," for example. However, discussion of the technical problems to which evolutionists apply mathematical tools would take us beyond the scope of this book.

Any work of music is presented in certain meters, and is organized according to specific rhythmic figures. One could take a look at two arias in Figaro, lay out their respective meters and rhythms,

and speculate about why these numerical patterns had been chosen by Mozart. Indeed, simply examining the motif of three ascending or descending scalar notes in the "trio of colliding agendas," one has available a large number of arrangements that can be experimented with in different keys, rhythms, and note lengths.

Fixed by the indelible figure of six million murdered Jewish men, women, and children, the story of the Holocaust is a story of numbers. One could examine the populations of various groups-- Jewish, gentile, and Gypsy, say-- before and after the third Reich. In some regions and countries, nearly all of the Jews were destroyed, while in others, most were saved; indeed, the issue of where achievement of "the Final Solution" was likely to be most effective proved central at Wannsee and policy discussions subsequent to it. Even the way by which the number "six million" was arrived at, and how accurate it is, has been a subject of controversy among the historians of the Holocaust-- and among those who would deny its existence or question its scope.

Logical Entry Points. Related to, yet distinct from an interest in numbers, is a preoccupation with logical propositions, their interrelations and their implications. Evolution can be expressed in syllogistic form:

If there are more individuals/species in a territory than can be supported;

and if there are variations among individuals/species;

It follows that those variants that survive best in a particular ecology will be able to reproduce and flourish.

As can the Holocaust:

If one wants to remove all Jews from Europe;

and if they can neither be moved elsewhere or allowed to die natural deaths;

It follows that one must devise a procedure for eliminating them.

Less strictly syllogistic, the logic in Figaro grows out of the relationships among the various plots and subplots. There are the love relationships at the start of the opera (Almaviva and the countess; Figaro and Susanna); the desired relations (Almaviva seeks Susanna; Marcellina wants to marry Figaro; Cherubino is in love with all women); the changes of circumstance (Marcellina discovers that she is Figaro's mother and should therefore marry his father Bartolo; and Cherubino and Barbarina are also paired). As in most comedies of the era, it is imperative that the villains get their comeuppance and everyone ends up paired with the person to whom he or she rightly "belongs." An initial imbalance must give way to a final balance in the crucial interpersonal ties. Those of a logical frame of mind are attracted by the challenge of delineating the limited number of ways in which the various tensions, antipathies, and passions among the characters can be resolved.

There is a logic as well within a particular musical composition. One can trace the relationships among the the count, Susanna, and Basilio over the course of the first act trio, and see how they are altered by events-- the fainting of Susanna, her sudden recovery, and then the untimely revelation of Cherubino hidden in Susanna's chair. Indeed, dramatic moments occur precisely

when the relationships of the characters are suddenly changed--in this particular instance, the men are proved right, the woman is unmasked...though only temporarily. And there is even a logic in the musical scoring. If a piece modulates to a distant key, or the rhythm suddenly shifts, it is assumed that eventually key and rhythm will return to "home base."

Existential/Foundational Entry Points Of enduring interest to some individuals is the possibility of tackling deep questions about existence--the meaning of life, the necessity of death, the passions and vagaries of love and hate. The theory of evolution tells us about human beings as a species of nature; Mozart illustrates the wonderful creations of which human beings are capable--as well as portraying the spectrum of human emotional life; the Holocaust documents the awful potentials of humans, as well as offering some inspiring instances of kindness, courage, and heroism.

As for more specific existential questions, the theory of evolution provides the best scientific answer to the question of who we are as a species, what is our background and past, and what figures to be our future. Though evolutionar theory is often set in opposition to religious explanations, there is no necessary conflict between these stances. One can believe that evolution is God's plan, and that God has set in motion the elaborate calculus of mutations, struggles for survival, and the temporary ascendancy of certain species in certain niches. Indeed, the Catholic Church has recently made its peace with the account of origins offered by evolutionary theorists.

Alfred, Lord Tennyson wrote of the "flower in the crannied wall"--"if I could understand what you are, root and all, I should know what God and man is." For those who discern significance in

fine detail, the finches offer an inviting occasion to ponder questions of existence. The secrets of life and the mysteries of biological evolution can be epitomized in the varying shapes of beaks found on one variety of birds spread across the Galapagos' chain.

Figaro traffics in such powerful themes as love, intrigue, power, and social hierarchy. Like other convincing dramatic vehicles, it explores the relationships among human beings, in all their subtlety, complexity, foolishness, and occasional moments of nobility. Such themes are dealt with darkly in tragedy, with greater lightness or irony in the case of a comedy. In the closing measures of the trio, each of the characters is confronting the puzzles of his or her current existence: Susanna is asking what will become of her; Almaviva is coming to grips with the reality of his rival Cherubino, and the justness of his intended conquest of Susanna; and Basilio is confirming his cynical views of women, and of life altogether.

The Holocaust deals with the most extreme sentiments of human existence: hatred, cruelty, evil, and power used maliciously, along with some instances of courage and decency. It compels us to consider how a nation could come to the point where genocide became state policy; and how specific individuals could, sometimes eagerly, become the vehicles of that policy. It raises equally profound questions about what is civilization. The ideas of genocide took form in a nation that was considered in many ways the pinnacle of civilization; the plan was vetted by individuals holding doctorates from major universities; and the realities of genocide were carried out by individuals who somehow managed at the same time to pursue interests in literature, art, music, and religion. And especially for all those who were personally involved in the events, the Holocaust raises the most fundamental questions of meaning. How can one find reasons for living

in the face of such horrible human actions? Herein lies the urgency of writings by Elie Wiesel, Primo Levi, and other "survivors."

Aesthetic Entry Points Works of art are apprehended in terms of their organization, sense of balance and appropriateness, as well as more specific features of color, shading, tone, ambiguity of meaning. Each of our three topics can be introduced through works of art: evolution, through documentaries that illustrate the forces of nature at work; Figaro through various dramatic, operatic, and balletic interpretations; and the Holocaust through cinema, ranging from Leni Riefenstahl's propagandistic movies to Steven Spielberg's recent Schindler's list .

Unlikely aesthetic presentations may exert powerful effects. Robin Lakes' Dissonance seeks to convey the experience of the concentration camps in dance. Consider this description:

In the first section...we see the dancers in a series of split second flashes of light dying horrible deaths. A man suspended on a wire is electrocuted in his desperate attempts at escape. Bodies fall from the flaming ovens into a pile. The images are powerful in their detail; we feel the man's spasms against the fence as death throes, we feel the limp bodies stiffening into the contorted shapes only corpses could retain...scenes gradually lengthen into scenarios-- prisoners on their way to concentration camps, couples separated against their will.. nameless victims have become real, identifiable people before you...you really feel as if you might have a number tattooed on your arm. The arms of barbed wire in front of you could as easily be enclosing you. You could as easily be dressed in the dancer's rags and bandages.

Yet to think of art simply in terms of familiar genres is too limited. Key ideas and examples also have aesthetic properties. The shapes of plants, birds, and other animals, and their change over time, invite investigation, with shifting morphologies themselves constituting arresting displays. Many of the individual features of Figaro -- the melodies and harmonies, the lyrics, the characterizations, the scenery, the gestures, even the revealing pauses-- are also presented in an artistic way.

When it comes to the relationship between the Holocaust and artistry, one must tread carefully. I suggest two points. First, the designers of the death camps saw themselves as fashioning a system with its own form. From the deceptive legend above the entrance ("Work makes freedom") to the passage of individuals through the camps, to the way in which the gas was released, to the disposal of the charred bones and the preservation of the gold teeth, the architects sought to satisfy certain design criteria. Indeed, Heydrich and Himmler were driven to the creation of death camps precisely because the earlier forms of killing and burial were considered too harsh on the sensibilities of the murderers; the death camps allowed individuals to participate in a relatively "sanitized" and distanced process.

Second, the Holocaust raises in most unflinching form the question of the relationship of art to issues of life and death. As British critic George Steiner (among others) has reminded us, we must understand how SS men could preside over the acts of the greatest brutality and then return home to their families, listening to Mozart on the gramophone or performing at night in string quartets. One must take note not only of the many artists whose works were burned by the Nazis but also those, like composer Richard Wagner, who were placed on a pedestal, and those

like conductor Herbert von Karajan, singer Elizabeth Schwarzkopf, or filmmaker Leni Riefenstahl, who hitched their professional destinies to the Nazi star. And finally, one cannot forget that Hitler was once an aspiring artist, that he treated his architect Albert Speer as if he were a son, and that he thought of his speeches and his architectural creations as contributions to German culture.

"Hands-On" Points of Entry Young individuals, in particular, are stimulated by the opportunity to work with physical materials in a dynamic, interactive way. Since the processes of evolution ordinarily occur much too gradually to be observed, it is necessary to take a more aggressive or imaginative approach. The opportunity to breed *Drosophila* (fruitflies) has long been exploited in biology classes. Precisely because the species is in many ways a simple one and its life cycle is brief, it is possible to monitor the changing of traits and the way that these changes affect the life course and morbidity of different strains. Computer and "virtual reality" simulations also provide, for the first time ever, the chance for students to experiment in an active way with the factors that control evolution: for example, the struggle among species, or the gradual isolation of variations until separate (reproductively exclusive) species have emerged.

Those with means can explore other manifestations of evolution directly. Every year, many tourists and study groups visit the Galapagos chain to view firsthand the biological diversity that struck Darwin and his shipmates. And it is also possible to confront other aspects of evolution by visiting the rain forest, probing streams that have been polluted, or examining those experimentally "denuded" islands where attempts have been made to simulate evolutionary processes.

Works of art provide the readiest forms of hands-on (or mouths-on) involvement. Anyone can listen to or sing along with parts of Figaro. And particularly since the advent of computer music, one can perform parts of the score using different instrumentation and also conduct experiments with contrived endings and combinations of themes. There are also numerous roles that one can assume in the production of a complex work like Figaro--not only those of individual singers, but also instrumentalists, conductors, dancers, members of the chorus, lighting crew, scene designers, program creators, prompter, and even censor.

Again, the issue of hands-on involvement with the Holocaust must be approached carefully, especially with young individuals. In some Holocaust exhibits designed for young persons, each visiting child receives upon entry the name and photo of a specific Jewish child. At the end of the exhibition, the visitor learns the fate of that child. Certainly this form of temporary "identification" constitutes a powerful, if unsettling experience.

For older individuals, it is instructive to learn about, and perhaps participate in a recreation of the classical "obedience to authority" study. In this psychological manipulation, devised in the 1960s by social psychologist Stanley Milgram, an unwitting subject (A) is instructed by an experimenter clad in a white coat to deliver a continuing series of electric shocks to another subject (B). Unbeknownst to subject A, subject B is actually a confederate of the experimenter and is not experiencing shocks. Despite the simulated cries of the confederate, and evidence from the instrument panel that the shocks had reached the danger level, most Americans who served as subjects continued to deliver the shocks. Residents of other countries showed similar profiles.

Only after the conclusion of the experiment did subjects learn that the shocks were simulated. They had actually been involved in a provocative experiment: a study designed to explain why so many inhabitants of Germany had followed orders which at some level they sensed were wrong. The Milgram studies revealed that subjects were not happy about what they were doing but that many felt they had no choice once the experiment had begun. They lacked a procedure for "opting out." Interestingly, most behavioral scientists had predicted that only psychopaths would continue to deliver shocks; this single set of experiments has revised many persons' views of how (a)typical was the behavior of Germans who became "willing executioners" in the Holocaust.

Interpersonal Points of Entry \_ So far, the entry points reviewed have been ones that touch the individual learner. Some students, however, crave interpersonal contexts-- they want to learn in the company of fellow human beings. Some like to cooperate with peers; others like to debate, argue, present conflicting agendas, occupy various roles.

Projects prove to be excellent vehicles for interpersonal entries. Through participation in projects that are engaging and that take place over days or weeks, students have the opportunity to interact with others, learn from one another's words and actions, to exploit their own personal reactions to a topic, to make their own idiosyncratic contributions to a group effort. When projects feature drama, students have the opportunity to assume different roles and to discern how a situation looks and feels to other participants.

Earlier illustrations can be readily reconfigured to involve groups. For example, students can collaborate on works of graphic art that treat a powerful phenomenon, create a drama that fleshes out various narrative lines, debate existential questions or logical conundra, or carry out a biological or social psychological experiment.

Let's return to our three themes. In the case of evolution, individual students could recreate debates that followed publication of Darwin's theory; fabricate a new ecology, and enact the ways in which different species fare under these contrived conditions; or plan an expedition to the Galapagos, complete with a survey of the current distribution of finches, tortoises, and iguanas.

In the case of Mozart, students could create an ensemble that enacted a scene from Figaro; or, more ambitiously, they could compose and perform an operetta about the clash between social classes or generations. They might try to re-enact the "trio of colliding agendas" with different performers, varied readings of the scores, contrasting interpretations of the motivations and goals of each of the protagonists; or even a new three-note motif.

The Holocaust provides many opportunities for role play. Students could enact plays based on the Holocaust (e.g. Hochhuth's The Deputy, or The Diary of Anne Frank). They could recreate dramatic scenes from the Holocaust, such as the defense of the Warsaw ghetto; or debates within families about what to do when they were about to be separated from one another; or the reactions among members of a unit when a solitary soldier refused to join in the massacre of Jews. Returning to our central example, they could re-enact the planning for Wannsee, the actual

conduct of the meeting, or Eichmann's subsequent recounting to the Israeli court that tried him in the 1960s; or they could anticipate the reactions of others had one of the participants at Wannsee objected strenuously to genocidal orders from "on high" in the German command.

Once again, there is no formula for generating promising entry points: one must draw on judicious blends of analysis and imagination, followed by mindful experimentation. Nor is there any obligation to use all entry points. The advantage of "multiple entry points" is simply stated: what works for one student with one topic is likely to be different from what works with another student on another topic or another day. Such a variegated approach greatly increases the likelihood that one will engage a variety of students and that they will "sign on" for the longer run and move toward performances of understanding.

Powerful Analogies and Metaphors Once interest has been engaged, it is time to raise the ante: to bring students into full contact with the principal content of rich topics. This deeper penetration can be effected in two ways: through powerful comparisons (described in this section) and through complementary attempts to represent the core aspects of the concept (the focus in the section that follows).

Stripped down, analogies are simply examples drawn from another realm of experience, a realm that is presumably more familiar to the students than the topic at hand. Metaphors (and similes) are figures of speech that, again, illuminate the less familiar topic in terms of the more familiar vehicle.

Recall that Darwin himself was guided toward his discovery by his reading of the economist Malthus. Darwin came to appreciate that the struggle historically (and prehistorically) among diverse biological individuals and species paralleled the situation described by Malthus with respect to a rapidly growing human population in the face of limited resources. Thereafter, Darwin explicitly used this analogy in his writing.

It did not take many years after Darwin's contribution for scholars and laypersons to discover evolution at work in many aspects of life. Particularly when it came to contemporary society, observers described the market economy as a struggle among participant individuals and corporations. This view is often called Darwinian because of its embracing of the metaphor of the "survival of the fittest". However, any struggle involving conscious human beings in a historical moment also differs from Darwinian evolution. Biological evolution occurs as a result of the struggle among individuals (and species) with different genetic constitutions over many generations, without any conscious knowledge or choice among the participants in the struggle.

Individuals are particularly vigilant to changes that occur in domains of interest to them. Youngsters, for example, observe the changing fashions in dress and hair style. Listeners observe the way in which particular themes evolve in a piece of music, as well as the ways in which "beats" or "vocal styles" characterize one decade as compared to the next. Fans of literature note the changes in genres and character types in novels, which nowadays often reflect what is appearing on the movie or television screen. Sometimes these changes will be so gradual that they are scarcely apprehended; at other times, they will be swift and dramatic.

Each of these examples can be thought of in Darwinian terms. Indeed, the contrast between gradual and rapid cultural evolution bears a rough analogy to the current debate between evolutionists who favor a gradualist explanation and those sympathetic to a more punctuated or chaotic view of evolutionary change. But because any comparison will be inexact, it is equally important to call attention to those aspects that are potentially misleading. For instance, evolution is often seen as a ladder--which deceptively implies that those species at the top are the "highest" on some dimension.

The case of Mozart suggests many interesting analogies. Starting at a very early age, Mozart's career was like that of a meteor: a very rapid rise, followed by a disappearance into space--one that, in my view, ultimately led to Heaven. His productivity, on the other hand, was very steady: like a bird carefully building each new nest or a squirrel burying each new nut, he proceeded from one composition to another in workmanlike fashion, seemingly oblivious to the turbulence in his personal life.

Mounting an operatic presentation resembles many highly complex tasks. One can compare it to the design and construction of a building, the creating of a new weapon, the launching of a business. There are many separable roles that can be assumed by the same or by different individuals; and each artistic decision affects the the whole work.

Finally, a particular work like Figaro also lends itself to comparisons. The imbroglios in this 18th century social tableau are reminiscent of other complex plots, for example, the Los Angeles-based movie plots of The Big Sleep or Chinatown. The relation among scenes and acts resemble the

courses of a long meal: major courses, interspersed with shorter taste quenchers as well as periods for conversation or dancing. And pieces like the trio recall particular events in life. There are times when rumors lack proof and yet have the aura of truth. There are times when several acquaintances are each playing with the same basic elements (say, ideas, rather than notes) and yet are never cognizant of that fact.

Debate about the uniqueness of the Holocaust raises the question of the appropriateness of analogies. Since analogies always involve differences as well as similarities, I see no problem in searching for revealing comparisons.

Hitler's desire to eradicate the Jewish people resembles other efforts to annihilate all traces of an unwanted body: whether it be the destruction of a work of art or science, the disposal of a corpse, the killing of all cancer cells, or even the removal of the final traces of an old civilization, as happens when ruins are decimated and distributed. The actual devising of concentration and death camps proceeded much in the style of trial-and-error experimentation; the designers tried out various patterns until they found one that satisfied the most crucial requirements. The analogy between work and death was drawn out deliberately; the Nazis sought to apply the principles of factory production to the packaging of death. And the experiences of inmates resembled a nightmare that never ended, or one that ended not by waking up to a bright day, but only by a brutal death.

If Aristotle was correct and metaphor is a sign of genius, no wonder that it is challenging to discover the most apt comparisons. Certainly, skilled teachers and researchers struggle to

discover fruitful apt analogies and metaphors. Awareness that each comparison has its limitations is important. Once students enter more deeply into the topic, they should be encouraged to come up with their own analogies and metaphors. Not only are these likely to work with the particular individual; but the discussions among students, about the virtues and limits of particular comparisons, can prove enlightening in themselves.

Multiple Representations of the Core Ideas: Introducing the "Model Language": We are now at the pivotal point where interest has been gripped by compelling entry points, and where the key ideas have been broached through various comparisons, analogies, and metaphors. Yet the most demanding task remains: How best to convey the definitive features of a concept, theme, idea or phenomenon?

For discussion purposes, I can lay out the most important ideas connected with each of our "iceberg" topics. In the case of evolution: variation, struggle among organisms, natural selection of those that survive until reproduction, and the best long-term fit to a particular environment. In the case of Mozart's music: appreciation of the major contours of the plot, sensitivity to motivation and goals of the characters, grasp of the principal musical means available to the composer; appreciation of, and pleasure in, the ways in which music conveys pivotal actions and feelings. In the case of the Holocaust: the anti-Semitic program of the Nazis, the weak position of the Jews, particularly once war had commenced; the failure of various provisional "solutions" to the Jewish question; the decision to pursue systematic genocide; the means designed to achieve that goal; the actual operation of the death camps; judgment about culpability.

Deviating from established wisdom, I do not believe that there is a privileged representation for any core idea or set of ideas. Appearances of a privileged representation are illusory; they usually derive from a particular history of contact with a concept-- how the teacher has first encountered that concept, or how it was initially presented or written about. For example, if one has seen evolution represented as a branching tree, or photographs of liberated inmates at Auschwitz, or a memorable performance of Figaro at New York City's Metropolitan Opera, then one may harbor the belief that this "mental representation" offers the optimal way to convey that particular topic. In contrast, I argue that the best representations are multiple. And so our search should be for that family of representations that can convey the core ideas in a multiplicity of ways that are at once accurate and complementary.

The "multiple representations" perspective balances the "analogy and metaphor" tack. In the cases of analogies, one chooses a vivid element from a deliberately different or distant sphere of reference. In the case of multiple representations, one chooses elements from spheres of reference that apply readily to the topic at hand.

Here I introduce the construct of a model language. In scholarship, models are abstractions from the topic or discipline at hand; there can be models of the atom, of historical revolutions, of classical tragedies. Models may occur in ordinary language (of the sort used in books like this) or in any other publicly-assessed symbolic form. In science, models are often presented in graphic or numerical or logical form; in the humanities, models are more likely to be presented in literal or figurative language, though other symbol systems are sometimes used; in the arts, models typically appear in the garb of the particular artistic symbol system. Thus, a model of a

painting, or of school of painting, would appear in graphic form; a model of a work or genre of music would be expressed in a musical score (or, less commonly, in some kind of a graphic format that--like a weather map-- portrays different forces, directions, and motifs).

Let us turn, then, to "model languages" that can capture and convey core aspects of our three specimen cases. As an instance of scientific scholarship, evolution lends itself to expression in terms of a set of propositions. The syllogistic statements introduced earlier represent one secure way of capturing the central idea of evolution.

But key facets of evolution can also be captured in natural language, as Darwin first did. These facets can be conveyed as well in pictorial language. One common tack is to present the branching model of evolution, with a single "ur" species giving rise over time and geographical space to a number of secondary branches. Some of these branches thrive and proliferate; others remain relatively isolated and endure; a larger number do not survive in their particular niche.

#### DARWIN'S SKETCH OF THE BRANCHING TREE ??

Readers of Darwin tend to think of the branching tree in the static form which he himself employed. Filmic, video, and more dynamic forms of computer simulation can also indicate the ways in which species arise, evolve, and ultimately proliferate or disappear. As for other facets of the evolutionary process, ranging from the incidence of certain traits (like the beaks of various finches), to the laws governing transformations of shape, to the changing ratio of different species in a fixed ecology, various kinds of algebraic, geometric, and calculus languages can be employed as well.

To underscore the central point: None of these model languages constitutes the last or ultimate word on evolution. All contribute. And so, it is that individual-- initially the expert, then the teacher, then the student-- able to move comfortably among the multiple representations, drawing on them when appropriate, who can be said to have a full understanding of the concept.

Different model languages will not capture identical aspects of the concept. Geometry will capture shape, film will capture motion, while logic will isolate causative factors. Indeed, each of the model languages has its own genius; each is privileged for certain purposes, while less useful or relevant or exact for others. The individual who can appreciate these individuating features, and piece them together, ends up with the most versatile, flexible, and desirable understanding.

Just how do these models and model languages come together? This question is difficult to answer, both in terms of psychological modelling and in terms of actual pedagogy. It is certainly easier to have available an ensemble of model languages than it is to tie them together into a meaningful synthesis. My own view--admittedly not a sufficient answer-- is that there is no privileged approach toward creating "interlingual fluency." Rather, the more time and effort one devotes to understanding each of the several model languages, the more likely it is that appropriate connections (as well as relevant separations and dissociations) will be effected among them. One "settles" into increasingly comprehensive models of the topic at hand; but promising new model languages can "unsettle" one's representation and ultimately hone a fresh representation that is even more powerful.

Model languages work differently with respect to different cases. The life of Mozart, and the plot of Figaro possess features that are readily covered in natural language, in logical analysis, and in graphic form. And what of the distinctly musical features of a long and complex work like Figaro? To be sure, musical scoring provides a convenient way to express motifs, "responding" counter-motifs, and the shifting uses of themes, keys, registers, instruments, and soloists. (Note: there are now many rival musical notational systems.) However, other languages can contribute, even decisively. There are many books about music, including some that contain very few scores or score fragments. The course of motifs can be well-conveyed by graphic figures, either ones presented in geometric form or ones couched in some more informally-sketched field forces--for example, renderings that resemble the "artful scribbles" of abstract expressionists like Jackson Pollock or Franz Kline or the more diagrammatic languages of Piet Mondrian or Sol Lewitt. And should aspects of Figaro be converted to movement or dance, various dance notations can bring out important features of the score.

Indeed, if one were faced with the task of conveying what Figaro (or even one trio) is like to a naive listener, it would make little sense to hand him or her a score. Much more powerful would be the devising of a simpler symbol system-- one which denoted only the principal characters, actions, musical motifs and forms. Such a representation can be done in a few pages and can provide a very powerful characterization. And, not incidentally, such a summary representation created by the student would serve as a pertinent "performance of understanding" at the conclusion of a unit--provided, of course, that the representation was accompanied by a good legend or key.

Since the Holocaust occurred within living memory, many kinds of representations can be readily identified. The testimony of witnesses, in their fullness, remains the most potent kind of "live" representation of this horrendous chapter in human history. Photographs and films-- documentary as well as dramatized-- provide other powerful ways of presenting and contrasting key ideas.

More abstract forms of representation can be used as well. Key factors can be analyzed in logical or numerical form, and graphic representations can be made of the identity and interactions among key players in the situation. Indeed, there are maps and diagrams of the concentration camps, lines of supply, relation to battle routes, and the like. These, too, can be presented in static or in dynamic form.

Even our target example of the Wannsee Conference allows itself to be captured in diverse model languages. One can give a straight narrative account; a dramatic reenactment; an analysis of the different logics that gave rise to decisions as well as a numerical and logistic examination of the steps needed to realize the final solution. And the emotional reactions (or lack of reactions) of different attendees over time provides an entirely different kind of "mental map" of the Holocaust.

It may be feared that these various forms of representation could in some sense reduce the Holocaust to a set of formulas and thereby trivialize it. I suppose that this is a risk, and one that should be guarded against. But it is probably less of a risk than occurs when an individual has but

a single representation which is limited or misleading in various ways.

All three of our examples lend themselves readily to capture in contemporary vehicles such as CD-ROMS, videodisks, hypertext, and other interactive multi-media representations. Often these appeal to the student. Warning: these presentations can be too rich--one can draw too many inferences and construct too many mental representations from them. Often more useful are those representations that are attenuated or uncluttered: that sacrifice richness, so that the learner can focus more readily on features that are truly central to the concept under investigation.

### Remaining Issues

I have suggested the multifarious ways in which topic of importance can be approached, presented in analogic form, and crystallized in a series of discrete and complementary forms of representation. I believe that such an approach is most likely to result in learning that is deep, genuine, and enduring-- learning that will reach a variety of students in ways that are meaningful to them, and in ways which allow them to build on their understandings, to perform them publicly, and to stretch them in new and appropriate directions. There is no need for all students to begin or end with the same representation as do others; at a premium is an increasingly rich representation that is meaningful to each student and that can be communicated to others.

It will not have escaped the reader's attention that my account has been presented in words. I am comfortable in that medium and it is also the medium in which books are written. I hope that I

have used words in a way that is sufficiently evocative to suggest the power of non-linguistic symbolic systems as well.

We are left, however, with several outstanding issues:

1. How does one orchestrate among these three approaches to important ideas?
2. How does one spread this orientation to the rest of the curriculum-- and what might the limitations be?
3. How does one assess the success of such an approach?
4. How might this approach be misunderstood?
5. In the end, what is the status of the true, the beautiful, the good and their possible interconnections?

#### Orchestrating among the three approaches

My mode of presentation implies a distinct order: begin with entry points, then offer analogies, then converge upon multiple representations of the core idea. As a schematic, there is much to recommend this rough itinerary.

The art of teaching, however, consists precisely in resisting formulas. It is important to underscore that these three perspectives are not completely distinct: multiple representations use analogies, entry points can also convey key constructs, and the like. The teacher's job resembles that of a master orchestrator, who keeps the whole score in mind and yet can hone in on the specific players. He or she should come up with questions, units, performances of understanding that fit together comfortably, that engage the students, and, ultimately, that aid the vast majority of students to achieve deeper understandings of the topic. Within that broad prospect, the teacher can and should be encouraged to be as versatile as possible.

The rest of the curriculum: Possibilities and limits

Even in a curriculum that focuses on understanding, there will continually be pressures to cover more topics, or to cover the existing topics in different ways. Compromise has to be the order of the day.

That said, I feel that the general approach outlined here can be applied to a wide variety of topics in the arts, the sciences, and the humanities. Indeed, my three examples have been chosen precisely because they can stand for many others: evolution for a range of theories and concepts in science; Figaro for innumerable artists and works of art; the Holocaust for a range of historical events and forces.

But while understanding should be a universal goal of education, it requires a stretch to apply these methods equally across the curriculum. Certain aspects of mathematics are algorithmic; certain segments of foreign language study simply involve drill and memorization; much of arts

education involves steady practice of component skills and gradual success in integrating them.

However, even in these apparently less flexible areas of the curriculum, the current "model", if you will, has utility. New concepts proliferate across subject matters. Whether one is studying infinity, zero, differentiation, or proof in mathematics, the approach should prove useful. By the same token, such unfamiliar concepts in foreign languages as the subjunctive, the preterit tense, case markings of nouns, or the ergative case can be judiciously introduced to speakers of English by the set of perspectives sketched here.

Measures of Success If one's goal is understanding of key concepts, then there is only one path to gauging success: students must be given many opportunities to perform their understandings, under varying conditions, and to receive regular, useful feedback as well. Initially, these performances are likely to be prescribed in terms of what students are supposed to do and the criteria by which they are to be judged. With time, several trends ought to emerge: more facets of the assessment undertaken by students themselves; more opportunity to join together various concepts, themes, and ideas; a greater variety of ways in which one shows what one has learned; and, most important, occasions to stretch one's understandings, to see how they apply (and do not apply) to various new instances.

It would take many pages to indicate the ways in which one can probe understanding of each of my three icebergs, let alone a number of different icebergs, let alone the relationships among them. Still, I have made a start in the above discussions. Nearly every example of an entry point, analogy, or model language suggests a possible form of assessment; and taken together, one has a

sizeable ensemble for measuring students' understanding of these and comparable topics.

Let me suggest just two possible assessments of understanding for each of our topics. One could assess understanding of Darwin's finches by creating a hypothetical chain of islands, each with its own ecology, and ask students to predict what would happen, over time, to a small set of insects transported to each of those islands. Or students could be given data from a recent visit to the Galapagos and asked how Darwin would have made sense of the current distribution of flora and fauna.

Turning to the Mozart trio, one could take a duet from a different kind of opera-- say, Puccini's tragedy Tosca. One such composition features a struggle between the passionate singer Tosca, who is in love with the painter Cavaradossi and the tough and lustful Chief of Police Scarpia, who covets Tosca. The student could be provided with necessary background material and asked to analyze the events in the duet, in terms of both plot and use of musical materials. Or students could be asked to create their own duet featuring two contrasting personages.

Finally, in the case of the Holocaust, one could describe what happened to Armenians in the early decades of this century. The Turkish government, for its own purposes, ordered the annihilation of the Armenian minority and largely succeeded in its goal, using many of the same techniques that the Nazis later "perfected." Students can debate the similarities and differences between the two attempts at genocide; or create works of art that commemorated these events in an appropriate way.

Possible Misunderstandings of the Approach Inasmuch as new ideas are typically misunderstood, it is well to be on the lookout for possible misapplications of the approach described here. It would be a complete caricature of the approach to take any topic, and attempt to lay out 7 (or 10) entry points, 7 (or 3) metaphors or analogies, 7 (or 22) model languages or multiple representations. Just as my three topics are meant only as illustrations, so, too, the lists developed here are only exemplary.

In each case, the ultimate selection of entry points, analogies, and model languages must proceed in an intuitive, indeed, artistic manner. There needs to be a constant dialectic among the ideas to be stressed, the modes of instruction that are comfortable for the teacher, and the identified interests and needs of the students. It is perhaps understandable that teachers might begin by looking for a few entry points, analogies, and model languages, suited for the topics to be probed. However, as teachers become more expert, they are likely to arrive at quite "personalized" approaches for every topic.

It would also be a misunderstanding to assume that every entry point, analogy, or model language is equally appropriate for a particular concept. Just as disciplines constitute different lenses, highlighting separate aspects of a topic, so, too, various entry points, analogies, and model languages each call attention to certain features, while minimizing others. Indeed this accentuation constitutes one of the most powerful arguments for several approaches to a topic. One cannot infer that a particular approach will convey all facets of a topic equally well; each will necessarily reveal its own biases in how it is presented and interpreted.

Finally, it is important to say a word about the relationship between the theory of multiple intelligences and the pedagogical approach put forth here. I would like to think that the theory of multiple intelligences has created an intellectual atmosphere where it is natural and productive to speak of different entry points, analogies, metaphors, multiple representations and model languages. Variety is the message of the day. Yet, it is a distortion to relate specific entry points, analogies, or model languages directly to specific intelligences. The links are at best suggestive. For example, while narration has ties to linguistic intelligence, it has powerful links as well to logical, personal, and existential intelligences; and, by the same token, while spatial intelligence suggests visual representations, these can range from graphs to photos to films to hypermedia presentations.

No doubt, at some level, the intelligences of which we are capable determine how we make sense of the world. It would be fascinating to detail the relationships among the structures of the mind/brain, the physical properties of our world, the perspectives of different cultures, and the particular symbol systems and disciplines that have developed over time. I am quite sure that there are some relationships and that these bear both striking similarities and revealing differences across individuals. But, alas, this book is not the place to trace these connections or differences. The most that I can say here is that a plurality of minds begets a plurality of ways of making sense of various worlds.

Once more: The true, the beautiful and the good, I initially introduced our three cases as prototypical examples of the classic domains of truth/falsity, beauty/ugliness, and goodness/evil.

As one enters into the details of each case, it is perhaps inevitable (and not inappropriate) that

these broad organizing labels will be obscured or even forgotten. But here, as my discussion of pedagogy draws to a close, it is apposite to revisit these enveloping virtues.

Cultures evolve notions of what is important; they find it imperative to pass on that lore to their young. To be sure, the ways in which these topics are construed and described will change over time; and, in particular, concepts like truth, beauty, and goodness now exhibit an old-fashioned wooden varnish in our largely plastic culture. Nonetheless, unless we are to make them at random, our choices reflect our values; and no culture can endure unless it attains some success in passing on its chosen verities, beauties, and desired modes of behavior.

If one comes to understand evolution, one will have achieved purchase on an important truth about the origins and fate of our species; and one will see the weaknesses in rival Lamarckian theory, and, perhaps as well, in fundamentalist religious accounts.

If one comes to understand the music of Mozart, one will have encountered an unambiguous and powerful instance of beauty in the Western canon; and one will appreciate as well the limitations of lesser Western composers like Ditters von Dittersdorf, or of less ambitious genres and works, such as those from the "pop charts" of American (or other national) music. For those who doubt my characterization, I am happy to wager on which works are likely to be listened to with pleasure and enlightenment a century from now. (Our "post-post modern" descendants will have to "cash in" our respective debts or credits.)

Finally, if one comes to understand the Holocaust, one will have a better purchase on the nature

and dimensions of human evil; its sources, its extent, and the measures that one might initiate to combat these human potentials, in others and in oneself. And within this bleak picture, one will have descried rays of hope, in the exemplary behaviors of certain soldiers, civilians, political and religious leaders.

Ultimately, society's answers to questions about truth, beauty, and goodness are important, but our personal answers are more important. Connections and reverberations among the true, the beautiful and the good, are as important as their distinctive features. The issue of how one might set up programs that facilitate such understandings--cultural and personal-- assumes center stage in the pages that follow.