



The Science of Storytelling

Perspectives from Cognitive Science, Neuroscience, and the Humanities

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Abstract: This article at once celebrates and puts at cautionary arm's length the tremendous advances made in the cognitive and neurosciences as research that can deepen our understanding of creating and consuming of literature, films, comic books. After providing an overview of recent insights by scholars with one foot in the humanities and the other in the cognitive and neurosciences, the article reflects on some key precepts that might be useful in our continued shaping of a humanities and cognitive based research program. For instance, the article explores the way authors, film directors, and artists generally not only construct artifacts that elicit positive emotions but also negative emotions. It also proposes a model for understanding how the “aesthetic” is a relation and not a property nor an essence of the object (a film) nor something to be found in the subject (us viewing the film).

Keywords: aesthetics, cognitive science, creativity, emotion, imagination, neurobiology, mental mechanisms, mind/body problem, structures of fiction

It is easy to get swept into all the brain hype. News articles splash headlines about how brain images show that reading Jane Austen makes you smarter. How playing brain games at sites like Luminosity will hold at bay Alzheimer's. How we have a moral module. How tweaking a neurotransmitter might cure cancer. Publishers are lining up to sell books about the moral brain, the mommy brain, the daddy brain, the doggy brain—your brain on comic books, even.

The 1990s were pronounced the “Decade of the Brain,” followed by hundreds of millions of dollars being funneled into research programs on the brain that seek to map, to computer simulate, and to develop new brain technology. I refer here not only to Europe's The Human Brain Project but also the United States's Brain Initiative that aims to discover and develop state-of-the-art brain tools (optogenetics, for instance) that aim to control and repair neurons for healthy functioning brains.

Don't get me wrong. I'm as excited as the next person. We are living in an exciting time where advances in the research taking place the neurosciences



has deepened significantly our understanding not just of other related areas of inquiry such as the cognitive sciences, but also the humanities writ large. Scholars like myself and others who have a foot in the cognitive sciences and the other in the humanities are reaping great rewards. The research enriches our scholarship as well as our teaching of all sorts, including literature, film, and comic books.

Indeed, to share this exciting interface of knowledge growing from the cognitive and neurosciences, led my colleague Zhong-Lin Lu and me to establish the Humanities & Cognitive Sciences High School Summer Institute. During this week-long series of lectures and activities a racially and socioeconomically diverse range of rising ninth to twelfth graders join world renown professors to develop research skills and deepen their understanding of their everyday activities—from playing video games like *Call of Duty* to reading Kafka's *The Metamorphosis* to catching the latest Marvel film blockbuster recreation.

Questions I like to explore in my teaching and my work on film (and comics, short stories, video games, and art generally) include: What is the role of imagination in human cognition? Why do we create stories and how does this ability develop in childhood? Why are we attracted to some stories and not others? How do our causal, counterfactual, and probabilistic learning mechanisms inform the way we create and consume stories? How does our theory of mind (and its related emotion and empathy dimensions), theory of recursion, theory of relevance along with mental mechanisms and operation such as event and spatial perception, gap filling, and memory operate when we create and consume film, comics, short stories, video games, and art generally?

Particularly useful in helping me find answers to such questions has been the exciting insights found in the work of scholars such as Alison Gopnik, Suzanne Keen, Anjan Chatterjee, Keith Oatley, G. Gabrielle Starr, Jean-Pierre Changeux, Stanislas Dehaene, Irving Massey, Paul B. Armstrong, Noel Carroll and John Gibson, Raymond Mar, Lisa Zunshine, Joshua Landy, Sue Kim, Semir Zeki, V.S. Ramachandran, Tamar Gendler, Herbert Lindenberger, and Patrick Colm Hogan (coeditor with me on the Cognitive Approaches to Culture book series), to name a few. I first share some recent insights by a handful of these scholars. I then reflect on some key precepts that might be useful in our continued (collective) shaping of a humanities & cognitive based research program.

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What is the role of imagination in human cognition?

A Map of a Contemporary Terrain

The essays that make up Noël Carroll and John Gibson's edited collection, *Narrative, Emotion, and Insight* (2011) offer a primer of sorts on the main philosophical debates and explorations concerning story—in its most expansive

sense as narrative. The essays variously answer and give shape to the request (by Carroll and Gibson) to consider not just how it is that “we emote over or learn from objects we know do not exist?” but how it is that we can do the same regarding narratives in general (fictional and sometimes nonfictional). Gravitating around various explorations of film, poetry, music, and art generally, these philosophically minded scholars use insights from cognitive and affect theory to enrich our understanding of what cognitive benefit does one gain in our emotional responses to narratives of all sorts: from film to literature to art. For instance, in Berys Gaut and Noël Carroll’s respective essays on the narrative of film we learn how the film experience can lead to insights into mental and perceptual functions. They also provide us with emotive and thought experiment forums that can lead to critical self-reflection and metaphysical insight. Taken as a whole, the essays aim to open up “new possibilities for addressing fundamental issues concerning the emotional, ethical, educative, and cognitive value of art” (Carroll and Gibson 2011: 2). They seek to uncover just how narrative in its many sartorial forms can enhance our ability to exist more meaningfully.

In Patrick Colm Hogan’s 2011 published *Affective Narratology* we land more firmly and squarely in the area of affective literary study. Hogan seeks to further sharpen our understanding of how the emotion system grows universal narrative structures (romantic, heroic, tragic, sacrificial). Building on his earlier deep excavation of the central role played by the mind and its stories (the title of one of his seminal books in this area of investigation) here Hogan develops a formulation of how the emotion system operates in relation to elements of stories, especially narrative events and incidents. To do so, he carefully maps out the way our emotion system works in everyday life: from situations that activate emotions and lead to expressive outcomes and actional responses to how our empathic social mappings guide how we should fear and what should make us happy. He also lucidly explains how emotion contagion and emotional memories operate generally in life and specifically in fiction.

With Keith Oatley’s 2012 published *The Passionate Muse* we step even more deeply into this space where emotion and fiction intersect. Building on then complicating the premise that fiction is like childhood play (and grows out of this play) in that it is done for its own sake and is centrally about emotions and relations with others, Oatley focuses on the later position, focusing on how our reading of fiction (or watching of films, etc.) centrally involves the constant consideration of mental and physical actions of others—and that this has consequences for our emotion system. Oatley carefully outlines how our emotion system operates in our engagement with fiction, including a long short story of his included in the book. Like Hogan, however, he is careful not to conflate our emotion responses directly with those of the characters we read about. Rather, when we read about a character “we feel something that is perhaps similar to those emotions, but they are not the character’s. They

are our own. That's how empathy and identification work in fiction" (Oatley 2012: 29). For Oatley, when we read or view a fictional narrative we know it is not real, yet we still experience it as if it were real. This stimulatory approach is what allows Oatley to determine that fiction provides a place to experience emotions within a safe space. This can and does have an ameliorative effect: it helps us "improve our mental models of others and ourselves" (Oatley 2012: 19). We watch a film (he gives the example of *Casablanca*) or read a story such as Oatley's and we experience fleeting emotions and insights that leave residues that can over time change "our selfhood."

In Arthur Shimamura's *Experiencing Art: In the Brain of the Beholder* (2013), the scholarly focus turns to the visual arts. Extending and expanding on the work of other so-called neuroaesthetic scholars (Massey, Zeki, Chatterjee, and Ramachandran), Shimamura uses research in the neurosciences to put to test several of the main theoretical threads that have attempted to describe our experience of art. They include: the mimetic where the "beholder interprets an artwork as a window to the world"; the expressionist where the "beholder seeks an emotional experience, such as beauty or the sublime"; the formalist where one attunes to formal features that give shape to the artwork, including "colors, lines, and abstract shapes"; and the conceptual that attends to the "thought or story behind an artwork" (Shimamura 2013: 14). Because the mental mechanisms used in our everyday activities are "co-opted" (his words) in the creation and apprehension of art, the more we know about how perception, cognition, and emotion work, the more enriched will be our encounter with art objects. While the same cognitive and emotive mechanism might be involved, Shimamura is careful to remind us that the artist intends to create an object with the purpose of stirring "our feelings, thoughts" and everyday natural phenomena does not have this same willful intent. For Shimamura, this intentionality in art to stir specifically directed emotions and thoughts does not mean going to biographies of artists for insights into our experience of the art. Rather, the artist entity is an integral part of the work itself. Shimamura importantly reminds us that the experience of art is a "whole brain phenomenon." While we might study particular areas of the brain (perception, memory, emotion and so on) in our encounters with art, in the end there "is no art center in the brain" (2013: 257, 258).

Several other recently published titles need mention here. In *How Literature Plays with the Brain* (2013) Paul B. Armstrong's purpose is twofold: He wants to see what neuroscience can tell us about how "art changes human experience as it reorders our perceptions and engages our emotions" (28). And he wants to see how work in the humanities can guide research in the neurosciences. This guidance consists of: 1) informing neuroscience what to look for to more fully understand the aesthetic experience; 2) helping neuroscience make sense of the aesthetic experience in the terms of neurobiology itself.

For Armstrong, art does not merely represent reality; it distorts, enhances, and transcends reality—and this with the use of techniques that might lead to the triggering of neural mechanisms that lead to harmonious or disjunctive emotive responses. In the sense that Armstrong is interested in understanding art that discomforts and art that comforts, he proposes the bringing together a phenomenological approach (Husserl, Heidegger, and Merleau-Ponty mostly) with insights from the neurosciences. Among the many avenues he chooses to explore, he introduces the hard problem of how consciousness and lived experience (the qualia) emerge from chemical and electrical processes at the cellular level in the apprehension of art.

We also see a turn to the neurosciences to explore different states of emotion in the artful encounter in G. Gabrielle Starr's *Feeling Beauty* (2013). Starr is less interested in identifying the qualities of an object that create the aesthetic experience, and more in mapping the architecture of the brain's responses to these objects. She does so by identifying the perceptual mechanisms and neural networks at work in the aesthetic responses to art that's experienced as dull and to art that moves her human subjects emotionally. She formulates an aesthetic theory built on the research conducted with neuroscientists Edward Vessel and Nava Rubin that sought to measure intense aesthetic responses to works of art that trigger our "default mode network." The default mode network is suppressed in activities when we attend to external stimuli and active in within the mind/brain during interoceptive states such as during daydreaming and wakeful rest states, for instance. While Starr considers the importance of the artist, she considers their efforts more of a trial-and-error strategy (and not willfully intended) to design and create objects that create perceptual, emotional, and aesthetic effects in the respective audience. It is this aesthetic in readers, listeners, and audiences of literature, music, and art that impacts our sense of self and reveals why the arts are so important to human beings.

A Necessary Pause for Critical Reflection

Given my own scholarly proclivities, I can say that these scholars are moving in the right direction and that they have much to teach us. While one might not agree with certain particulars of their respective positions and formulations, at least we know what we are disagreeing with. They all write in a wonderfully lucid style and present crystal clear arguments and positions.

Here I want to offer a few of my own reflections on our growing of a research program in the humanities that invites to the table the insights from the cognitive and neurosciences.

1) Emotion is a defining ingredient in narrative fiction. If we don't experience emotion we are less involved in the story; we attend less to the story, or reject

it altogether. That is, authors and artists build into the design and execution of the artifacts—elements that trigger all the subsystems that make up our emotion system. Continued research in this area is paramount, especially focused on how it works in a particularly willful way when designing then creating narrative fictions—and in our consuming of these narrative fictions.

This said, it is not always true that the seeking and experiencing of emotions—and knowledge of emotions—in our encounter with literature is a goal that is systematically sought. We often see novels, films, comic books and the like created in ways that seek to diminish our emotional reactions.

So while emotion is centrally involved in the making and consuming of plot structures in fictions there are many instances when these seek to create either negative emotions or even absent entirely our emotion responses. I think of the distancing or estrangement effect sought by Bertolt Brecht in his “epic theatre” or of certain novels in the “behavioristic” mode, such as Albert Camus’s *The Stranger* or Alain Robbe-Grillet’s *La Jalousie* as well as of Nathalie Sarraute’s *Portrait of a Man Unknown* and other works in the tradition of the so-called nouveau roman. In this respect, we can also include several films by Lars Von Trier and Jean-Luc Godard rejecting Hollywood realism. In quite a few of Godard’s films, for instance, actors talk straight to the camera and thus break the rhythm of the narration at the same time that they call attention to its artificiality. This distancing effect and deliberate rupture of the “fictional pact” is sometimes underlined by Godard when he does not allow the soundtrack to operate in unison with the image. These and other procedures undercut the emotions that the narrative could have generated.

The possibility of the elicitation of emotions and of their absence has to be seen also in the light of their positive or negative valence. Often, emotions are contextual. In a certain context an emotion may have a positive valence and in another a negative one. Also, there can be an affect system corresponding to characters and another one corresponding to audiences or readers. So, for example, in the affect system corresponding to a character an emotion may have a positive valence and in the one corresponding to the audience or reader that same emotion may have a negative valence. Thus, we see many films where a character derives great pleasure from being sadistic, cruel, and perverse and yet where this is a source of deep distress and repulsion for audiences. Recall, too, how Buster Keaton’s trademark as an actor was his impassive face and perfunctory behavior. Throughout his films he would make no manifestation of emotion, feeling or concern. The contrast between Keaton’s apparent lack of emotions and the chaos surrounding him is what triggered belly aches of laughter in the audience.

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I think of Denis Diderot's position: that characters need not and should not experience any of the emotions assigned by playwrights to their characters. Acting should be considered literally as performance and objective presentation: not a true embodiment and true subjective experience of emotions by actors but representational adscription of real-life affects to fictional characters. I think of this in contrast with the Konstantin Stanislavski's approach developed in the Soviet Union and with some later variations introduced by the method acting technique created by Lee Strasberg and others in the United States. According to this approach, the actor must immerse herself in the affective universe of the portrayed character and identify as completely as possible with the character's emotions, to the point of actually living them. The rationale of this procedure is that being true to the character's emotions brings truth in performance and thus believability in the eyes of the audience.

The Diderot approach and the Buster Keaton or Luc Godard films may remind audiences that they are experiencing a fiction and that in the process they are using their frontal cortex to reflect on the film's content and form as fiction. In such cases the epistemic or cognitive system overrides the limbic system.

Characters may elicit or not elicit emotions. The same applies to actors playing the characters. And of course to the audience watching the play or the film.

We can have the Brechtian distancing effect or its opposite, the Stanislavskian immersion. The Diderotian or Brechtian ideal viewer would then be the one who agrees to minimize the use of his/her emotion system and to give a much larger place to the use of the rational system. This means that the audience experiences a duality, together with characters as created fictions, and actors as vehicles or representations of those characters: they are either more emotionally involved or more rationally involved, according to the greater or smaller distance they establish with the limbic system and the rational or cognitive system.

That is, there exists a duality within the character, within the actor and within the audience, but not necessarily a coincidence among the dual opposites. Keaton can keep his expressionless face from beginning to end, maintaining a kind of patent Diderotian or Brechtian distance throughout the film, yet the audience can be emoting and experiencing all variety of affects. As this example shows, no relations is necessary between emotions felt and expressed by characters as embodied by actors and the emotional reactions of audiences. This is the beauty (and a result) of the relational nature of art. Buster Keaton's characters are an invention, an artistic creation, and they generate many responses audiences precisely because they exploit this lack of a one to one correspondence between the fictional character emotion system and the real-life audience emotion system.

We might also consider learning more from research on negative emotions, as well as from readers that are not interested in fictions for their emotion ingredients, but rather for their puzzle solving elements such as evinced in certain detective novels and films. Autism and fiction is a field also to be further explored.

The absence of certain emotions in humans, as observed in the behavior of sociopaths (characterized among other things by greatly diminished empathy and remorse), may teach us many lessons in aesthetic production and aesthetic reception.

Of course, while we separate the emotion system from the cognitive system to understand better the former's role in our making and consuming of narrative fiction, we know that in actual practice, both systems are inseparable. It is an established fact that all or most cognitive activity is usually accompanied by emotional activity. Emotions propel, guide, and focus our cognitive systems in our goal seeking activities—among many others. Without our emotion system in full operation, our cognitive system becomes paralyzed entirely or to a large extent. One interesting condition—that of catalepsy—has been largely exploited in literature by authors such as Poe and Dickens, and could perhaps shed some light on this issue. The same can be said of the particular state of stupor known as catatonia. Many medical conditions could be relevant to the study of the interrelations between the emotion system and the cognitive system, and therefore may give us precious information to develop our own understanding of narrative fiction, and all art more generally.

This much we know: the executive brain cannot fulfill its functions properly unless it is propelled by emotions. Without emotions, the executive brain can become paralyzed. Emotions and cognition cannot be separated when we study how human transformation of the natural environment transforms culture. The education of the executive brain—the learning of mathematics, the learning of the days of the week, the learning of a new language—follows a series of formal steps. This is the characteristic way of functioning of the so-called executive brain, which is to be systematic and, in a loose sense of the term, to be algorithmic. At the same time that we educate the brain to perform certain algorithmic functions, we have to educate the brain to successfully apply the emotion system driving the executive brain. The ways one educates the executive brain will vary according to the changes produced in culture, which of course are man-made. Hence the loop between emotion and cognition, and between education and culture.

Creativity is the product of the simultaneous action or use of the cognitive system of the brain and the affective/emotion system of the brain, in ways that allow the brain as a whole to link disparate phenomena. It stands to reason not only as a deduction but as an empirical observation that constantly in our lives we are having the experience of obtaining results—of working and of

feeling good about our work; this combination of knowledge, work and feeling good leads to a very constant (frequent) state of creativity. The ancient Greeks called this *poiesis*: deliberately bringing into the world something new by giving new shape to existing ingredients of the universe, and by establishing new relations between ideas or concepts, thus creating new hypothesis, new theories, and new metaphors, for instance.

2) Narrative is a huge territory that encompasses numerous phenomena. There is narrative in that iPhone-shot film of the young Palestinian boys murdered on the beach by a bomb dropped by a drone. There's narrative in all the newspaper and Internet testimonies telling of what's going on in Gaza today. There are narratives in scientific books that tell us about emotion responses to objects. However, by talking about narrative in this large, all encompassing way we gloss over the difference between narratives that are made with a will to style, that is, that are given shape with artistic aims—and that therefore ask that we take into consideration the deliberateness and goal seeking activities involved in the creation of art—and those that simply seek to convey information with a minimum of aesthetic intent.

3) Art, if it is to be art, has to be a goal directed activity. The first of our ancestors who chipped away at a rock to create an arrowhead wanted to obtain a result: a tool for killing animals. However, at a certain point this ancestor began to observe this object as something that could produce a certain amount of joy—pride in succeeding in creating the arrowhead. This ancestor could now see beyond the tool's practical application, could ascribe to it a value much later conceptualized as beauty, and could rejoice differently both in his work and in his skill. Thus grows an aesthetic attitude toward the work accomplished—one that could be shared by linguistic means and a contagious pride. The arrowhead has not changed, nor the specific work involved in producing it. What changes is the relation of the producer to the product. The arrowhead is still a practical object, but it is also a source of joy and pride as a work well done. These emotions are shared by others. The arrowhead elicits an incipient aesthetic experience. But we must be clear about the nature of this experience.

The “aesthetic” is a relation, not a property or an essence. It is to be found in the relation between the object and the subject, and the other way around.

The emotion system of the human brain works in tandem with the cognitive or reasoning system to produce an object that has a specific use as an arrowhead. Now, as I have posited, at a certain moment these two systems become involved not in the process of production but in the process of perception or observation of the produced object while attaching to it a value distanced from utility and proximate to delighted contemplation, eliciting intense pleasure and deep satisfaction. This specific kind of enjoyment is what is termed “the aesthetic experience.” As this example shows,

the “aesthetic” is not contained in the object, and it is not a property of the subject. The “aesthetic” is a relation, not a property or an essence. It is to be found in the relation between the object and the subject, and the other way around.

Imagining, planning, and realizing are the executive cortex functions propelled by the limbic system that lead to the production of the arrowhead. In this confluence of cognitive know-how and emotions the resulting product gives rise to specific affects caused by the specific awareness of the specific success in the making of the specific arrowhead. Producer and contemplating neighbors acknowledge that knowledge and skill have been properly applied. The arrowhead preserves its utility, which is now accompanied by “the aesthetic experience.” The more this experience repeats itself and expands, the more it detaches itself completely from “utility” and the more it becomes a special form of relation between certain objects (products) and certain subjects (audiences, readers, and the like). Thus the aesthetic experience ends up becoming a purely relational phenomenon, and arrowheads become poems become music become painting become novels become comic books become films.

4) Just as creating the arrowhead requires the hitting of a rock at a certain angle with a certain strength to obtain a specific shape, so too do we apply our cognitive faculties in a certain way to give all our other creations shape. When my eight-year-old dances in a certain way, she’s giving her body movement a particular shape. In narrative fiction, authors use different devices and tools to give particular shape to their works. Elsewhere I have called this the generative operator of the discourse. (See Aldama’s and Hogan’s *Conversations on Cognitive Cultural Studies*.) While stories are finite, the way they are given shape is imaginably infinite. I also identify what I call the will to style to identify the teleological will of a given author, director, comic book creator. It is the teleological activity and attitude involved in giving shape to new objects that can and do transform the world—one supplied continually with an abundance of freshly created aesthetic relations.

If analysis and interpretation are based on a difference that makes a difference, the element that singly makes the difference in my study of narrative fiction phenomena is shape; the shape giving activity of human beings and shape as the goal and result of that activity.

5) While we separate the brain into areas of study, in the end we need to think of it and us as a whole. Not only the brain as a whole, but the nervous system as a whole and all that comes with the body, including centrally our sense of sight, taste, sound, touch, balance, for instance. For only thus can we begin to set the foundations of a scientific, relational aesthetics.

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Curiously enough, the pervasive view on humans has been the dualist one typical of Western religions. They posit a dualism of body and soul, or mind and matter. Then, they give different explanations on how these two different substances or entities hang together until the person's death, while the immaterial one survives and goes on to inhabit a supernatural world. But this religious view and similar ones set forth in the work of many philosophers now meet the powerful challenge of empirical facts and findings amassed in the last 15 years or so by cognitive science and neurobiology. Bertrand Russell used to say that philosophy and science begin when someone asks a general question, and that both philosophy and science as we know them, are Greek inventions. But for many centuries knowledge was accumulated mainly by philosophy. So as each branch of philosophy gained ground in terms of empirical findings and methods, it grew into a separate, independent science (physics, chemistry, astronomy, biology, psychology, human anatomy, physiology, and so on). In what can seem a boutade, but clearly isn't, Russell defined science as that which we know, and philosophy as that which we ignore. That is why there is a constant movement of themes and subjects from philosophy to science, as knowledge develops and becomes more solid. Philosophy is important because, among other things, it's a kind of speculative exploration of the unknown. In his book *Wisdom of the West* Russell shows how "the various fields of science all started as philosophical exploration in this sense. Once a science becomes solidly grounded, it proceeds more or less independently, except for borderline problems and questions of method." The exploratory process as such, began in the sphere of philosophy, "goes on and finds new employment" in the domain of science (Russell 1959: 6).

Psychology ceased being a branch of philosophy toward the end of the nineteenth century, and a short time later neurology was established as a science thanks to the work, among others, of the Spanish histologist and neuroscientist Santiago Ramón y Cajal. Present advances in neurobiology are based on an ever more accurate knowledge of the anatomy and physiology of the brain and have empirically dissolved the so-called mind/body problem in favor of a monist (or materialist) approach. The brain is a very specialized organ of the body that reacts to stimuli from the body itself (internal stimuli)

and from the outside world (external stimuli), and this material reaction, according to its specific origin and outcome, is termed emotion, thought, intention, planning, etc.

The dualist position is losing ground day by day because the more we know about the physiology and anatomy of the brain the more we can establish with certainty that all brain processes and their effects (including qualia) are of a chemical or electrical nature

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(and a combination of the two). This is why fMRI and CAT scans, for instance, allow us to explore what is going on in the brain.

Take the case of language. Some scholars consider that it is one of the most pure and intangible manifestations of culture. But we know this is not so. We know language is an admixture of neurobiology and culture, where neurobiology is the essential material basis. We know which parts of the brain are involved in the existence of the language faculty. As Noam Chomsky has remarked, our language faculty is a biological faculty, an “organ” functioning within the brain. (See my discussion of Chomsky in *Conversations on Cognitive Cultural Studies* [Aldama and Hogan 2014].) When exposed to certain stimuli, it generates the knowledge of what we call French or English or Spanish or Chinese, for instance. That is, our knowledge of one or several specific languages results from the existence and operation of the human universal language faculty. When the individual is in an environment where French, English, Spanish or Chinese are spoken, the corresponding stimuli trigger the acquisition (or “growth”) of the corresponding language(s). This is to say that while French, Spanish, or English are not physical objects—we can’t touch them the way I can touch my car—yet they are so physical that we can study in a very precise, detailed and material way their logical form, their syntax and their acoustic physicality. More and more the monist or materialist view of the so-called mind/body problem has been vindicated by contemporary scientific discoveries, particularly those made in the past 15 or 20 years.

6) By considering the human being as a whole, neuroscience can tell us a lot about how the material (organic, chemical and electrical) activity of this whole can lead to the inventing of new iPhone Apps or to the making of a painting à la Jackson Pollock or the creating of a shaping device like that of the interior monologue used in *Ulysses*. Knowledge of the universal aspects of creativity or inventiveness can tell us interesting things about the aesthetic experience. What neurobiology confirms is that the aesthetic experience does not reside in the subject nor is it inherent in the object, but lies in the relation between one and the other. The aesthetic object results from the conjoint activity of the affective and cognitive systems. Feedbacks and loops with these two components and with our capacity for recursion (the ability to embed our thoughts within other thoughts) allow us furnish the universe with entirely new entities. And these entities are deemed aesthetic to the extent that we establish this special relation with them we call the aesthetic relation. Our creative faculties bring about new objects and new relations. *Poiesis* is thus a relational activity between subject and object.

What neurobiology confirms is that the aesthetic experience does not reside in the subject nor is it inherent in the object, but lies in the relation between one and the other.

That narrative fiction adds to reality, and is patently different from reality in that it distills and organizes and recreates it.

7) We can make advances in our understanding of narrative fiction if we keep clear important distinctions. That narrative fiction adds to reality, and is patently different from reality in that it distills and organizes and recreates it.

Reality in narrative fiction (as in all art forms) is *shaped* reality. That neurobiology as a science deals with the general and the universal and as such can only begin dealing with the particular and the individual through applications in technology. That is, neurobiology will never be able to tell us how to read more effectively *Ulysses* nor how to understand this novel or any other text. But neurobiology, concerned with that which is general in the human species knows and learns and teaches us many things about us as a biological entity. It can thus tell us much about creativity and how we transform reality through our work (*poiesis*) and how the process of transformation and the products of transformation can acquire the quality of being an aesthetic experience.

8) Aesthetics is a branch of philosophy that is being explored increasingly by science, in particular psychology and neurobiology. This means that aesthetics can no longer limit itself to hypotheses and conjectures about the individual and the particular, since science deals with the general and the universal. The task at hand then is to build bridges between the scientific (neurobiological) domain and the study of aesthetic experience—bridges possible to build because both domains concern the human being as a whole and as a species. Through such an approach, one could eventually explain on a scientific basis why the aesthetic experience may extend over a territory as wide as the encounters with an Italian tea pot, a Macbook Air computer, a Jaguar XK-E, a view of the Amalfi coast near Naples, watching a sunset in the San Francisco area, listening to Beethoven's String Quartets, or reading Kafka's *The Metamorphosis*. We can explain what it is that joins all these very different kinds of aesthetic experience and why in order to have an accurate view of this aesthetic experience we should not limit our studies to just the plastic arts or music or literature—or certain kinds of literature.

9) We all have the same biology in the sense that we all belong to the human race. Young and old, ill and healthy, tall and short, brown and white, male and female, whatever our differences, we all share the same genetic material of the species, the same genome. Whatever the myriad of variations, we all belong to one species, the human species.

With this centrally in mind, we can consider how a central feature of our common biology is our creativity. All culture, as defined in anthropology, is the outcome of creativity, and two of its most general provinces are science and art. Within science all human creativity is focused on obtaining the most accurate possible knowledge of reality and on the creation of the most efficient

tools based on this knowledge. We apply our creative ability also to the production of ontologically new entities that are added to reality, added to the world. Here human creativity does not discover but invents and gives shape. Its products are art in all its forms and manifestations. The theory concerning this specific kind of creativity is scientific aesthetics or what could also be called the unified theory of aesthetics.

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