In Search of Texture

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The fundamental question proposed by the committee—does a fundamental relation exists between neurophysical and neurochemical processes on the one hand and aesthetic judgment (or preference) on the other?—hinges on an approach of time (or, for that matter, evolution) as a constitutive rather than as a purely descriptive device that may be arbitrarily sliced without major consequences. If one is to take evolution seriously, it should not be confined to arbitrary time slices that have more to do with an essentially anthropocentric stand and with the history of our understanding of reality than with reality as a whole.

Also, if we confine aesthetic experience and aesthetic judgment to art, we are faced with rather difficult questions about what art is all about. Eventually, we might end up begging the question, defining art in function of the absence or presence of an aesthetic experience.

Without having to turn to institutional and other (primarily sociological) theories that make art and aesthetics subject to the whims of fashion, and without stretching the realm of aesthetic experience to include about every single everyday experience that

comes to mind, we may avoid the impasse by dramatically increasing the realm in which art and aesthetics are operative.

Obviously, this is a much stronger contention than the claim that a biological layer is required for our aesthetic judgment (or any other human feature or even humanity itself) to exist. The latter (weaker) claim is at the heart of Searle's rejection of artificial intelligence on the basis that life—in a biological sense—is a prerequisite for intelligence, even if we accept, as he most certainly does, that life itself is just a specific organization of lower level elements. I believe Searle is basically right. But at the same time, this very argument seems to indicate that some "new" life—or "artificial life," if that is how it should be called—is not in principle impossible so that, even if "life" is a prerequisite for intelligence, "artificial intelligence" should not be in principle excluded—albeit, perhaps, based on "artificial life". Evolution does not follow a single path from an absolute origin in the past to an absolute objective somewhere in the future. On the biological level too, different species have evolved simultaneously and parallel to each other, leading to similar but nevertheless distinct features. If the notion of evolution is extended beyond the realm of biology and if the notion of evolution is itself subject to evolutionary changes due to the reflexivity of the process, then there is no reason why we should not acknowledge at least the possibility of similar parallel developments within non-biological systems.

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When looking at possible predecessors of our human aesthetic judgment throughout the history of the universe, we look at human aesthetic judgment as part of a tradition—as old as reality itself but perhaps "older" than time—of non-deterministic decision procedures.

The necessary conditions for human art and human aesthetic judgment not only to function but merely to exist are the very conditions for non-trivial existence as such. Neither in a reality that is completely deterministic, nor in a reality that is completely arbitrary, there is room for art or for aesthetics.

1) In a reality that is totally deterministic—in which everything that exists follows with necessity from an initial formula—there is no room for aesthetic judgment. In fact, in such a world, no judgment whatsoever would be called for. Judgment would at best be an illusion. But we can rest assured: We know that indeterminacy is an essential feature of reality. 2) On the other hand, in a reality that is completely arbitrary or random, there is no room for aesthetic judgment either. In such a reality, we would not be able to make a cognitively or ontologically meaningful distinction between "normal" and "aesthetic" judgment. In such a world, the notion of judgment would be completely trivial. But this time also, we don't need to panic: Some phenomena are obviously pretty stable (Cissors are dangerous).

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A good place to start a reflection on the biological foundations of aesthetics is Darwin's distinction between sexual and natural selection, the former being "the

struggle between the males for the possession of the females," resulting not in "death to the unsuccessful competitor but few or no offspring" (Darwin 1859, p.136); the latter the "preservation of favourable variations and the rejection of injurious variations" (Darwin 1859, p.131). In the same breath, Darwin excludes from the impact of natural selection those variations that are neither useful nor injurious—variations that he calls fluctuating elements. This restriction immediately seems to open a field of options for selections without great importance (at least not from an evolutionary biological perspective), the kind of disinterested choices and judgments that one finds in notions such as *art for art's sake* or *beauty for beauty's sake*—philosophically founded by Immanuel Kant in the 18th century but with traces as far back as the Hellenistic period. Do these fluctuating elements perhaps constitute the domain in which aesthetic choices are operative? Could we possibly define the cultural level as rooted in these fluctuating elements?

A specific interpretation of sexual selection bears on the notion of *good taste choice* as opposed to *good sense choice*. It implies taste as a driving force behind selective advantages. Darwin himself insisted on calling good taste *aesthetic*, which he construes as a choice of beauty for beauty's sake (Darwin 1959, p.371). Until late in this century, this embarrassed many Darwinians, many of whom either stressed the importance of natural over sexual selection or refuted sexual selection altogether.

However, as Helena Cronin points out, looking at Darwinian theory as primarily dealing with the replication of genes dissolves the distinction between "adaptive" natural selection and "non-adaptive" sexual selection. "Adaptations," she contents,

"are for the benefit of genes of which those adaptations are the phenotypic effects. Adaptations may not be prosaic or worthy; genes can further their destiny as much by apparent ostentation as by strict austerity. And they may not be of benefit to their bearers, let alone to the species as a whole." (Cronin 1992, p.292)

What this means is that at least the kind of aesthetic elements that are implied by Darwin, appear as novel elements in their own right on the level of organization or the level of complexity of the species. On previous levels, e.g. the level of the genes, aesthetic elements disappear in the pool of elements and principles operative at those levels.

The obvious result of this approach is that it ultimately incorporates the aesthetic in the utilitarian and economical views on adaptation that are at the core of standard Darwinian thought on the subject.

As such, if one accepts the strictly utilitarian agenda of evolution, there is nothing against a utilitarian view on aesthetics. The question is whether we should accept that agenda. Even stronger: *can* we accept that agenda as the single driving force behind evolution and if we do, how are we to understand it in the light of the conditions for non-trivial existence indicated above?

Ultimately, the utilitarian agenda must be specified as being underdetermined: there is no way that we—or evolution—can know for sure that a specific change will indeed, on some time scale, be a better solution to a problem. Problem, in this context, refers

to a situation in which some action is required—the sanction being the violation of the conditions for existence—but in which no guaranteed solution can be formulated.

The hidden teleology behind the utilitarian evolutionary program—in biology as well as on the other levels of complexity but also, and perhaps even more important, in the evolution from one level of complexity to the next—is a negative one, perhaps better referred to as a drive to avoid certain states—later in this paper I will specify those as paradoxical—than as a drive to reach certain goals.

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The investigation of the biological and evolutionary foundation for aesthetic judgment, while most certainly meaningful in its own right, gains it full significance against a more comprehensive background of questions related to the interaction among levels of complexity in general. This works both ways. On the one hand, the concept of evolution is no longer confined to biology. It has penetrated all the sciences as well as the arts. On the other hand, the neurobiological processes involved in the aesthetics of vision turn out to be perfect metaphors for the relations among levels of complexity in general. To quote R.L.Gregory, "'I see what you what you mean' is not a puerile pun, but indicates a connection which is very real."

In this paper, I will focus on *texture* as a core metaphor. In a sense, the texture metaphor embraces but also supersedes the hierarchy metaphor that became since the end of the 19th century one of the most powerful research paradigms. The hierarchy metaphor, in order to be sufficiently sophisticated, required further specification in

terms of the simultaneity of bottom-up and top-down processes. In the case of the mind-body problem, this leads to the need to integrate such apparently extremely dissimilar disciplines or programs as Freudian psychoanalysis and neurologic microgenesis—to integrate the language of id, ego, and superego with the language of limbic processes .

In a sense, the texture metaphor gets back to the surface-oriented models that the hierarchy-based approach tried to move away from. In its topological aspects, however, it preserves the dynamical aspects of hierarchies. The city no longer simply rules its surroundings but becomes part of the landscape.

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I will argue that aesthetic judgment functions at the boundaries between what is stable and what leads to change. Aesthetic judgment must thus be considered as an important element in planning ahead on the topological map that is used to integrate past experience, present experience, and to decide on paths to be followed in the future.

These three elements are essential in all planning, regardless of whom or what the planning is for, and in the anticipation of both foreseen and unforseeable events. (MacLean, 1991). They are therefore also important in our teleological project, however underdetermined it may be—or precisely because it is underdetermined.

Our topological map of the past is highly selective. It is estimated that of all the information available to our consciousness (by itself a small fraction of all the sensory input) no more than 1% is stored in long term memory. And of that small section, large

parts are later forgotten or are at least no longer available for conscious retrieval. At the other end of the series of steps in memorization, our sensory memory can hold its enormous content for no longer than fractions of a second. The product of time and amount of information appears as relatively constant.

The same applies to our maps of the future. We foresee events on different timescales. In the immediate future, we foresee the path of a basketball as well as the path of our own body as we jump up to pluck the ball out of the air. This is quite an astonishing accomplishment, especially as we compare it to a frog that snaps directly at a fly without any kind of calculation. The cerebellar nuclei—not very developed in the case of the frog—appear essential in the corrective controls involved in these processes. (Maclean, 1991).

On the long-term, we plan tomorrow's lunch, our next holiday, and perhaps even our retirement. In these cases, the neurophysiological elements involved are less clearly defined. This may be a simple case of still incomplete knowledge but it may also be that this mimics the situation at hand. The planning itself takes much longer to carry out. Details escape from our attention. Furthermore, our very plans feed back into our current situation. Either way, dreams may come true or never materialize, precisely because we had them in the first place.

The picture that emerges is the following: Around the present, a region of dense information exists, as well in terms of our recall of the recent past as in terms of the near future and as in terms of not all that different alternatives for our present position.

The farther we move from the present, the less detail we can provide about our experienced past and our projected future. Clusters of increased detail may exist, but it is reasonable to assume that they will not constantly be in the center of our attention.

The emerging picture, in short, is one of great depth. Its horizon presents itself as what Kant has indicated as the *horizon of knowledge*—"die Beurteilung und Bestimmung dessen, was der Mensch wissen kann, was er wissen darf, und was er wissen soll": the investigation and determination of what we can know, what we may know, and what we should know. (Kant Logik:A54)

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Contrary to popular belief, the perception of depth is not contingent upon stereoscopic vision. Monocular devices to perceive depth include *relative size, interposition, linear perspective* and *focal depth*. Binocular depth-perception relies on the convergence of the optical axes that result from the disjunctive eyemovements. The closer an object, the greater the disparity between the two retinal images.

Based on research with random dots stereograms, it was established that stereoscopic depth perception is independent from the recognition of objects. The computational task at hand is enormous. Basically, every point in the left eye-matrix is scanned and compared with the corresponding point in the right eye-matrix.

However, recognition facilitates stereoscopic perception, not by speeding up the scanning process as such but by indicating places where disparity may be relevant. This puts the emphasis on the role of local processes in the computation of global

characteristics. Especially the problem of segmentation—the process of marking pixels with labels shared with neighboring pixels—is crucial.

In analyzing images, there is a high probability that regions of uniform texture indicate meaningful segments. In this respect, the importance of color vision should be noted.

The perception of texture—classified as either deterministic or stochastic—involves a hierarchy of resolutions, embedded characteristics, virtual visual elements, and parallel processing governed by a restricted set of rules.

Identifying objects as significant units is equally a segmentation problem, even if it can be argued that the low level detection of boundaries based on perception of texture is at least at first sight less complex than the high level perception or the recognition of objects. The computational complexity of recognizing objects (function of 1-, 2-, 2.5-, 3- or 4-dimensionality) depends on the constraints imposed by the context or scene. In most contexts, for example, a 1-D analysis (based solely on length as a discriminating feature between objects) will be insufficient, if not but because of the sensitivity of perception to angular alignment of objects. More sophisticated tools seem required.

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The problem of segmentation is crucial not only in the context of visual perception but also in verbal language. The tools used to recognize meaningful segments—including punctuation, capitalization, visual or auditory blanks, intonation, and morphemes—are rather obvious and require only relatively simple computational tasks.

The *production* of meaningful segments is quite another matter. First of all, because at the neurophysiological level the neurons involved in the production of language are different from the neurons involved in the comprehension of language, even if we are finding out that the situation is somewhat more complex than a simple division of labor between Broca's area and Wernicke's area. But the production of meaningful segments is especially crucial in those cases where "business as usual" no longer applies and novel elements must be introduced to maintain the stability of the system. Particularly interesting is the case were language becomes paradoxical because of self-reference. Such paradoxes (e.g. *This sentence is false*) may be solved using Tarski's notion of meta-levels. To replace *This sentence* by *"This sentence"* is to eliminate the self-reference and to replace it by a reference made from the level of the quotation marks.

The reason why these levels are so important is because they turn the potentially lethal self-reference of a system into a constructive rather than a destructive quality (DePryck 1993). The interaction between Gödel's theorem—the argumentation of which is quite technical but which basically states that consistent systems contain true statements that cannot be proven by the system—and paradoxality caused by self-reference is "responsible" for the relative uniqueness and independence of each of the levels of reality. When a system creates a next higher level to regain the consistency that it lost when one of its levels ran into semantic paradoxes, then from Gödel's work it follows that the newly created next higher level will contain a "true sentence" which cannot be derived from the lower levels. Biology is more than just chemistry. It contains a true expression, "life", that cannot be reduced to the level of chemistry. As a result, the

levels of reality indeed cannot be reduced to one another without losing the consistency gained when new levels of complexity are introduced. If it were at all possible to specify a unique formula from which all the others can be generated or derived without adding something new, then such a formula would necessarily contain or lead to paradoxes. These paradoxes, then, could in principle not be avoided, because solving paradoxes is only possible by introducing novelty, by creating new levels of reality which in turn will necessitate further levels of complexity.

New levels of complexity is constructed based on a selection of elements pertaining to the level on which the paradox occurred. As such, it is not necessary to use quotation marks to indicate the new level: The increased complexity of the relations among the elements that constitute the new level provides an admittedly fuzzy, but nevertheless sufficient indication. This increased complexity, I suggest, can be indicated as increased texture.

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Looking at *"This sentence" is false* it is easy enough to recognize that the specific selection that was made indeed provides an adequate solution to the problem. However, it is less clear *how* that selection was made. Not every possible selection will qualify as a solution to the paradox. In fact, most selections will have destructive qualities at least equal to those of the initial problem.

This remark is at the core of the problems of a more traditionally hierarchical approach of the bottom-up type. In the case of the biological foundations of cultural

phenomena—perhaps best signified by the mind-brain problem—this translates into questions concerning which selections and which types of combinations of basic biological material will indeed permit the jump to the cultural level. In other words: How are we to account for the uncanny accuracy of evolution without having to turn to a determinism that would violate the very conditions of our existence?

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Caglioti uses *ambiguity* to refer to the coexistence, at a critical point, of two mutually incompatible aspects of the same reality (Caglioti 1992). Implied in his use the term, therefore, is obviously what I implied by *paradoxes* in my own work. (DePryck 1993) From Caglioti's point of view, ambiguity assumes the existence of a symmetry, which he defines as *invariance* as the result of a transformation or as *indiscernibility* of the change produced by a transformation.

The symmetry, however, may be broken by an external action whereby a control parameter increases its values. The control parameter measures how far a system is from the critical point of a phase transition or the bifurcation that leads to dynamic instability. The parameter may be associated both to phase transitions between states of (thermodynamical) equilibrium in a system, and to dynamic instabilities between a state of equilibrium and a dissipative structure according to which a system may organize itself when it is removed from equilibrium. When the symmetry is broken, correlations are established and therefore order is introduced, between structural moduli that

previously were indifferent to each other. This is equivalent to the production of information and therefore of the decrease of entropy.

In a sense, this is similar to the perception of ambiguous figures which typically alternate object and ground or position in depth. Well-known examples of such ambiguous figures are respectively the urn-faces and the Necker cube.

Our perception never changes the material object—the ink on paper. However, at the point of recognition—a neurophysiological event in the observer—the symmetry between the two object is broken and information is produced: The two figures are no longer indifferent to each other but now mutually exclude on another *at the semantic level* while obviously still coexisting at the level of the material object and even at the level of the retinal image.

This semantic process is quite similar to the formal process of *graphic condensation* described by Caglioti using an example by Grignany. (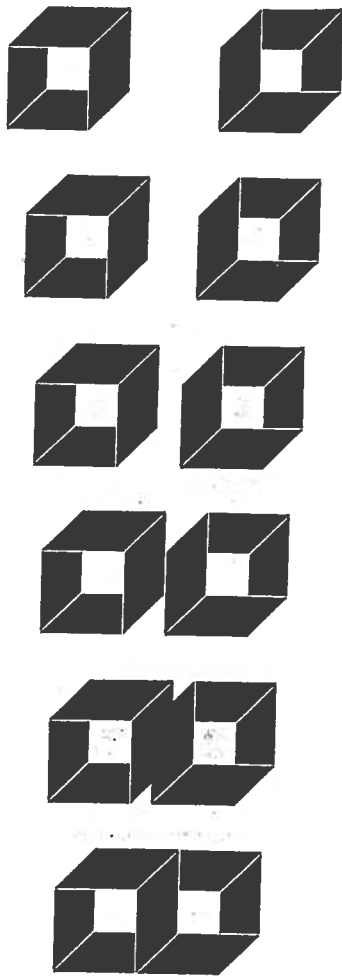See Figure 1.) In this example, two images converge as the result of the inversion center symmetry operation, after which a reversal of all the elements in the image with reference to the inversion center would not be noticeable. The center pane can now be seen as either the inner wall of the left module or as the inner wall of the right module, but not as both simultaneously. As Caglioti points out, one bit is all that is needed to lift the uncertainty between the two possibilities.

In this example, it is difficult to speak about aesthetic judgment or an aesthetic preference for one solution over another. In fact, the resonance between the two possibilities speaks against a choice in favor of one and against the other.

Figure 1. F.Grigani, *Graphic Condensation*. In: Caglioti 1992

In general, however, definite choices are made. Even in the case of symmetrical equations the outcome may possess asymmetrical properties, dictated by the starting conditions of the changes and not by the equations predicting or describing the changes over time. In fact, as Barrow and Silk point out, the symmetry of the initial state is completely

hidden to an observer who looks only at the changes as they occur. (Barrow and Silk 1995). They illustrate this with an example about a dinner where guests are sitting around a circular table, each with a wineglass to their left and to their right. Once the first diner picks up his glass, the symmetry is broken: The party becomes either left-handed or right-handed.

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As Morrison points out, modeling and forecasting require that parameters and initial conditions be optimized, which may be difficult or impossible for some systems of nonlinear equations. (Morrison 1991) It is my contention that, except for in the most straightforward and discursive cases, aesthetic judgment is at the core of the segmentation problem.

Segments—the initial condition in the texture paradigm—are selected based on aesthetic criteria. In the simple but paradoxical sentence *This sentence is false*, without taking into account the grammatical and semantic constraints, 15 (namely 4 + 6 + 4 + 1) possible selections can be made. Only 1, *"This sentence" is false*, solves the paradox in a way that is consistent with the semantic and syntactic constraints of the language. In other words, solving the paradox involves an entropy of $\log_2 15 = 3.90$. This seems a small price to pay compared to the alternative where we get stuck with a paradoxical language in which we can no longer maintain a sufficiently stable truth-notion and wherein we can "prove" both A and ¬A, and thus nothing whatsoever.

Only after a selection is made can its potential be examined: The selection feeds into a non-linear dynamical system that is highly sensitive to initial conditions—i.c. the aesthetic choice.

Aesthetic choice, in this context, is a choice favoring increased texture. Recent (admittedly still controversial) research indicates that noncoding or junk DNA displays long term correlations, meaning that the placement of one nucleotide depends to some extent on the placement of others. The fractallike pattern that emerges ($1/f$ noise) is consistent with the one found in many evolving physical systems. I suggest that the distinction between coding and noncoding DNA may be an aesthetic call.

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In this paper, it turns out, I have reversed the expected causal order of the relation between biology and aesthetics. What emerged was not the biological foundation for aesthetics but rather the aesthetic foundation of biology.

The underlying hypotheses is that aesthetics is older than biology, perhaps even as old as the universe itself. This hypothesis is part of a research project that attempts to found the functioning and the necessity of aesthetic judgment in a larger onto-epistemic frame. In order to do so, I try to indicate the conditions under which human aesthetic judgment may function while simultaneously, from the bottom up, I look at the role of aesthetic judgment within the context of an underdetermined, dynamical (evolutionary) reality. This is what I have referred to as the tradition on nonlinear, dynamical decision-procedures—a tradition that is necessary in a reality that is neither totally

deterministic nor totally arbitrary. The decisions involve problematic actions or events that show a certain pregnancy—they must be acted upon—without an absolute or necessary criterion for decisions.

I propose that aesthetic judgment is a universal, non-deterministic device to make (or to help make) those decisions that must be made in order to avoid the standstill of an evolving system (for example because of incoherence or because of internal paradoxes) but that can not be made on the basis of deterministic, established criteria. Aesthetic judgment, as I have suggested in this paper, is especially functional at the level of segmentation—the selection of elements that will or could function as the building blocks of the next higher level of complexity.

In the context of this approach, the question about the evolution of aesthetic judgment must be asked—an evolution as a function of the specificity of the different levels of complexity that constitute the totality of reality. We might ask, for instance, if moral judgment is not a specific kind of aesthetic judgment, namely a form adequate to at least part of our human actions. Or is moral judgment perhaps an alternative (an evolutionary variation?) for aesthetic judgment—hence a possible conflict between the good and the beautiful.

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