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# AESTHETIC EVOLUTION

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After reviewing theories of art history, a psychological approach patterned upon the lines of the Darwinian theory of evolution is described. It is argued that the basic trends in the history of an art form arise from artists' continual necessity to produce novel works in order to counter the effects of boredom or habituation. This pressure leads to a monotonic increase across time in the novelty, unpredictability, and complexity of works of art. On the other hand, it leads to oscillations in content indicative of primary process (autistic, dreamlike) cognition: Within a style, primary process content increases; however, it declines with the introduction of a new style. Quantitative studies of the history of poetry, painting, and music supportive of the evolutionary study are briefly described.

## 1. Introduction

As Dobzhansky (1973: 125) has aptly remarked, 'Nothing in biology makes sense except in the light of evolution'. It could just as well be said that nothing in art or literature makes sense except in the light of evolution. Literature and the arts show such profound historical changes that it is often difficult to find any common features shared by works in the same medium produced during different eras. What, if anything, does a Bach fugue have in common with John Cage's 4′33″? Because the latter consists of 4 minutes and 33 seconds of complete silence, the two works do not even share the feature of being composed of a series of sounds. The only obvious common feature is that both are labelled as 'music'. However, if we trace the history of music from Bach to Cage, we find that it has changed in a series of small steps from Bach's style toward Cage's style. Only if we are aware of this history does Cage's composition make any sense. I shall argue below that we can explain or understand this historical progression with a theory that is altogether analogous to Darwin's theory of biological evolution. Only within the context of such a theory can we understand *either* Bach's or Cage's work. Each evolved in a lawful way from prior composers' works.

Change is equally extreme in all of the arts. Compare, for example a painting by Poussin with one by Picasso. What attributes does Swift's *Gulliver's*

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*Travels* share with Samuel Beckett's *The Unnameable*? The latter novel does have a hero – a dried up piece of flesh – but if it has a plot, it has not yet been discovered. We agree that both works are novels, but in reality *Gulliver's Travels* probably shares more features with, say, a non-literary history of the Thirty Year's War then with *The Unnameable*. In many poetic traditions, there seems to have been an historical movement of similes and metaphors away from consistency toward remoteness and incongruity. By the same token, it is generally agreed that Western music has become more dissonant across the last several centuries. What has caused such trends?

### *1.1. Extrinsic theories*

#### *1.1.1. Reflectionist theories*

Some theories explain art as a reflection of society and, hence, artistic change as a reflection of social change. Such theories can be traced back to Madame de Staël's (1800) maxim that 'literature is the reflection of society'. This approach is fairly rare on the level of systematic theory. It is much more likely to be encountered as an assumption among those, such as compilers of college textbooks on art history or of literary anthologies, who have not really thought much about aesthetic theory. Amongst such authors, it is extremely common. A few Marxist theorists (e.g. Caudwell (1937), Hauser (1951)) have held this view, but the mainstream of Marxist theorists of art from Trotsky (1925) to Lotman (1970) explicitly argue that artists are so autonomous from social control that they are not reflectionist theorists in the real sense of the word. The ultimate 'conditioning' of art by economic and social structures turns out to be so indirect in mainstream Marxist theory that, to paraphrase Eagleton (1976), art is said to reflect society in more or less the same way an automobile might be said to 'reflect' its raw materials.

At first glance, it may seem obvious that art reflects society. For example, a portrait painting almost always depicts a person dressed in the style of his or her day and perhaps surrounded by the furnishings of the time. A moment's thought reveals that such a painting 'reflects' not society but other art forms–fashion and furniture. Of course, art may 'reflect' non-artistic aspects of society. There are no medieval war stories in which atomic weapons are resorted to and, to my knowledge, no literary depictions of the events of World War II in which battles are settled by jousts between individual mounted and armored knights. However, reflectionist theorists are not concerned with such surface details. Rather, they aim to explain the 'deep structure' of art. For example, gothic cathedrals are explained as being due to the soaring and spiritual character of the medieval mind.

There are at least three problems with reflectionist theories. First, the social factors that art supposedly reflects are very often things that were inferred from art in the first place. As Schücking (1923: 6) pointed out, 'The spirit of

the Gothic period (...) is first deduced from its art and then rediscovered in its art'. Second, there is no very good reason *why* art should be expected to reflect society. Kavolis (1968) attempted to find a reason for reflection in the psychological need for consistency. But he overlooked the facts that artists' attitudes and values are often at extreme variance with the general attitudes and values of the society in which they live (Plekhanov (1913)) and that the individuals recruited as artists are probably not greatly motivated by a need for consistency (Martindale, Abrams and Hines (1974)). Even Marxist theorists explicitly stress that the artistic motive of 'deformation' prevents any straightforward reflection of social reality (Machery (1966), Trotsky (1925)). Third, these theories are not parsimonious. There is often a sufficient explanation for aesthetic trends to be found on the level of purely artistic causes. This makes it quite needless to search for more remote causes.

*1.1.2. Relational theories*

Reflectionist theories seek some sort of one-to-one mirroring of society in art. Relational theories argue that there is relationship between social change and artistic change but that it need not be a direct one. As implied above, mainstream Marxism is really a theory of this sort. There is no doubt that art and society may be related. For example, it seems that the originality or variability of musical compositions is lower during times of intranational civil strife and higher during times of international war (Cerulo (1984), Simonton (1984)). Why should this be the case? Clearly, melodic originality does not directly reflect anything in this case. There is no obvious relationship between originality and war, riots, and rebellions. Rather, the relationship must be mediated by some third factor. We shall discuss below what this factor might be.

*1.2. Intrinsic theories*

*1.2.1. Influence theories*

Probably the most common topic for a Ph.D. dissertation in literary studies concerns the influence of one writer upon another. The implicit theory behind such efforts seems to be that one author has in some sense tried to imitate or has been inspired by another author. While this certainly does happen, Bloom (1973, 1975) has argued that there is, as often as not, an 'anxiety of influence': the imitator distorts or misinterprets the original work so as to *avoid* influence. Even if this were not the case, explanations of imitation are only explanations of the diffusion of innovation (compare Findlay and Lumsden (in press), Martindale (in press, a)). As such, they can only explain how innovations come to be adopted by a population. They shed no light upon the central question of how innovation occurs in the first place. Unless we can

answer this question, we can explain no more then how an innovation is accepted or elaborated by other artists. This will do us no good at all: assume that an innovation has been accepted by all artists in a tradition. What then? Influence theories cannot tell us what will happen next. Given this, they cannot possibly provide an explanation of the history of art forms except across very short timespans.

*1.2.2. Recapitulation of ontogeny theories*

A number of theorists (Chambers (1928), Deonna (1912), Kroeber (1944), Michaud (1950)) have proposed cyclical theories of art history that see artistic styles as following an internally determined pattern of growth, flowering, and decay. In other words, Haeckel's maxim is inverted: phylogeny recapitulates ontogeny. They claim that, unless violently disrupted by external factors, any artistic tradition approximates such cycles. None of these theorists provide a very good explanation of *why* this should or must be the case. Such theories based upon qualitative cycles of growth, flowering, and decay are made suspect by the tendency to rehabilitate styles that have fallen out of taste. For example, the rediscovery of beauty in the baroque style in the 1920's and in the mannerist style in the 1950's suggest that aesthetic quality is not a stable basis for theory building. Reitlinger's (1961, 1965) studies of the wild historical fluctuations in the prices of paintings and *objects d'art* drive this point home: what is seen as a practically worthless product of decadence in one generation may be seen as a consummate and very expensive expression of a style by the next.

A related type of theory is based upon the idea that there is a parallel between the historical growth of either the artist's or of mankind's powers of perception or abstraction and that of the individual person. Neumann (1954) explains changes in mythic content and Kahler (1968) explains changes in European narrative in terms of man's increasing powers of abstraction and analysis. These changes are seen as paralleling mental changes as an individual grows from infancy to adulthood. While these authors make an interesting and internally consistent case for their theories, their only evidence for them is the changes in art that they set out to explain in the first place. That is, they provide no independent evidence that mankind's powers of abstraction actually increased across the timespan they studied.

More recently, Gablik (1976) and Blatt (1984) have proposed that the history of European painting from the Middle Ages to the twentieth century parallels the development of the individual's mental powers from infancy to adulthood. They seem to have gotten things completely backwards. As we shall see below, the historical trend in all of the arts more closely parallels a regression from adult to infantile perception and cognition. Such an historical retrogression was postulated a number of years ago by Ehrenzweig (1954). Be this as it may, neither Ehrenzweig nor Gablik and Blatt were able to explain

*why* there should be any relationship at all between 'ontogeny' and 'phylogeny'.

*1.2.3. Inner-logic theories*

Kubler (1962) proposed a 'rule of series' to explain the tendency of art forms to change gradually and systematically over time. Kubler's rule involves the notion that certain forms logically depend upon others. To draw an example from technology, invention of the locomotive could not possibly precede invention of the steam engine. Earlier versions of this sort of theory were proposed by Foçillon (1942) and Fiedler (1949). Theories of the working out of inherent possibilities of forms, of an inner logic to historical succession, or of the impossibility of work B without work A are weak in that the force causing change is not clearly specified: what exactly *is* the inner logic? These specifications cannot be made because the psychological mechanisms mediating the changes are not made explicit. Forms do not change of themselves but are changed because of the operation of psychological laws governing their producers. Unless these laws are known, one cannot explicate the so-called inner logic.

*1.2.4. Evolutionary theories*

Theories concerning an inner logic driving change in the arts were anticipated by Spencer's quasi-Darwinian theory. Spencer (1892), in his major statement concerning art, set forth the principle that art, like everything else, moves from simple to complex. By 'complex', Spencer meant more differentiated and hierarchically integrated. Kroeber (1956) followed Spencer in proposing such a simple-to-complex law, as did Kubler (1962). It certainly seems to be the case that *if* something – whether that thing be a biological organism, a society, or an art form – evolves, it does follow this path. Again, we must ask of these theorists *why* this is the case. We must also inquire why this evolution occurs in some cases (e.g. human beings or modern art forms) but not at all or only slightly in others (e.g. sharks or ancient Egyptian painting). Spencer, Kroeber, and Kubler give us no real answer to either of these questions.

Taine (1875) proposed a Darwinian theory of evolution of art forms. At any given point in time, he held, art is a product of race, environment, and moment. By moment, Taine meant the currently prevailing Zeitgeist or 'spirit of the time' as well as what had already been done within a given art form. The latter force was, of course, an anticipation of the inner-logic theories discussed above. By environment, Taine meant both the physical and the cultural environment. In terms of the latter, he was explicit in arguing that certain art forms may be selected over others because of the 'moral temperature' of the moment. Such a selection criterion is the analogue of Darwinian fitness. We shall argue below that 'moral temperature' is not constant enough across time to bring about systematic evolution in the arts.

Explicitly evolutionary theories of general sociocultural change have recently been proposed (e.g. Campbell (1974), Cavalli-Sforza and Feldman (1981), Findlay and Lumsden (in press), Pulliam and Dunford (1980)). Campbell (1974) argues for a direct extrapolation of the principles of Darwinian evolution to change in cultural systems and products. Sociocultural change, he contends, is a product of 'blind' variation and selective retention. The three necessities for evolution of any sort are (1) presence of variations, (2) consistent selection criteria that favor some variants over others, and (3) mechanisms for preserving the selected variants. At any time, a number of variants of a given object are produced and the most useful, pleasing, or rewarding are chosen for retention. In aesthetic evolution, retention mechanisms would correspond to books, musical scores, museums, and so on. Then, at the next point in time, there is variation of the new form, and the process continues. Such theories provide a general framework for thinking about aesthetic evolution, but they do not tell us why aesthetic variation exists in the first place. What is the motivation for the blind 'trial-and-error' variation that produces the alternatives upon which the selective forces operate? In science or technology there is often some clear problem to be solved. Thus, it makes sense that trial-and-error attempts to solve it would take place. But the 'problem' to be solved in art is unclear, especially if we follow Kubler (1962) in defining works of art as useless objects (or the useless aspects of useful objects). Further, these general theories tell us nothing about the direction of change in aesthetic forms. They merely tell us why change is bound to occur.

## 2. A psychological theory of aesthetic evolution

### *2.1. Introduction*

If we follow Campbell's general model, a theory of aesthetic evolution must explain at least three things: why variation is present, what the selection criteria are, and what the mechanisms of retention are. However, these are only preliminary and essentially trivial questions unless the theory, in answering them, also provides us with an explanation of all of the main trends in the history of art forms. If, as I argued at the outset of this article, nothing in art makes sense except in the light of evolution, then a theory of aesthetic evolution must make sense of everything worth explaining about art.

I certainly make no pretense of explaining everything about art and its history in this article. However, I do hope to present theoretical arguments and empirical data pointing toward such a complete explanation. In the event that humanistic readers may be aghast at the mere contemplation of such a project, I should clarify what is meant by 'everything' or 'everything worth explaining'. Consider Newton's theory of gravitation. The theory was aimed at

explaining how objects move in a complete vacuum. This aim was more or less completely accomplished. If nothing in the universe existed in any approximation of a vacuum, the theory would be of no interest. By the same token, we shall consider below how art would evolve in a social 'vacuum'. The empirical evidence presented will show that art does tend to evolve in exactly this way. Thus, it must evolve in an approximate vacuum, and other factors must be comparatively negligible.

So far as the theory of gravitation is concerned, the mass, size, shape, or color of an object is of no relevance. These factors have no effect upon objects moving in vacuums. Size, mass, and shape may affect how fast a stone rolls down a mountainside, but–given enough time–note that the stone will always end up at the bottom of the mountain. By the same token, many factors that might be thought to be relevant to art history (e.g., the Zeitgeist, political, economic, and other social events), are by definition completely irrelevant when art is created in a hypothetical social vacuum. To the extent that such a theory of aesthetic evolution can explain actual trends in the history of the arts, we may assume that these factors are irrelevant or contribute only random 'noise' to art history.

### *2.2. Explaining art history versus understanding the individual artist*

Humanistic scholars have complained that the evolutionary theory to be presented below is cold and abstract. Of course it is. This is the nature of all scientific theories. They have also complained that it tells them nothing about the work of an individual artist. Here, I must partially disagree. As I argued at the outset, we cannot understand what an artist does unless we understand the evolutionary process that has brought him to deviate from his predecessors in a predetermined way. Nor can we understand him unless we know how he deviates from his contemporaries. Indeed, these deviations have been taken by many as defining the style of an artist. We cannot compute these deviations unless we have first computed measures such as those described in the second part of this article.

Those concerned with an individual artist are usually interested in the surface structure of his or her work – the specific colors, words, chords, etc. that it contains. On the other hand, any theory of art history, whether evolutionary or not, is concerned with deep structure as opposed to such particular individual differences. A general theory of art history is analogous to asking what happens if we drop an object in a perfect vacuum. Humanistic inquiry is rather analogous to inquiring about a particular stone rolled down a particular mountainside. No one asks about such a stone in the natural sciences. If they did, however, they could not explain its behavior without recourse to the theory of gravity. The question might be asked if the stone were a gigantic diamond that one had no little interest in finding. This is really

the sort of question that is asked in the humanities. We rightly want to know every detail we can about Goethe or Shakespeare, since they stand so far above the rest of humanity. The evolutionary theory does, indeed, tell us little about these details. However, the details cannot be placed in their proper perspective without recourse to the theory.

Another humanistic complaint about evolutionary theory is that it reduces art history to a meaningless quest for novelty. This is rather like rejecting Darwinian theory because it reduces human history to a meaningless struggle for survival. Darwin never denied that people have done a number of other interesting things while they struggled to survive. However, had humanity not survived, we would not be here to ask about what these things were. The theory of aesthetic evolution involves no assertion that artists are motivated solely by a quest for novelty. Artists are interested in accomplishing many other things besides making their works novel. The point is that what these other things are varies unsystematically, whereas the pressure for novelty is constant and consistent. Thus, only it can produce systematic trends in artistic form and content. This is true even if need for novelty is a comparatively *unimportant* motive for any given artist. Even if artists were solely interested in novelty for its own sake, this would not render their work pointless. Wordsworth noted that 'the introduction of a new element into the intellectual universe' must lead to 'widening the sphere of human sensibility'. As William James (1902) pointed out, the manner in which such an idea was conceived does not determine its value.

### *2.3. Mechanisms of selection*

#### *2.3.1. Natural selection*

*Lack of direct relevance.* Darwin (1859,1871) proposed two methods of biological selection. Natural selection or fitness refers to the differential survival of organisms that are more or less adapted to the environment in which they live. Across time, organisms with more adaptive traits are more likely to survive and reproduce. Thus, their numbers increase, speciation in different environmental niches occurs, and so on. Most theorists (e.g. Findlay and Lumsden (in press), Rindos (1985)) who have attempted to extrapolate from biological to cultural evolution have drawn analogies with natural selection. As I have pointed out elsewhere (Martindale (1986), Martindale (in press, a)), natural selection cannot be the proximal cause of cultural (or even biological) evolution. To say that an organism makes choices based upon natural selection leaves completely unexplained how the choices were made in the first place, since it is only the much later consequences of these choices that influence survival. Furthermore, consider the consequences of selecting or preferring one work of art over another. It is difficult to conceive that preferring Marvell over Dryden, or vice-versa, could have had other than the

slightest consequences in terms of natural selection. That is, the choice would seem to be fairly neutral insofar as either biological or social fitness is concerned.

*Protective coloration and loss of meaning in the arts.* May not some analogue of natural selection operate in artistic change? As pointed out above, Taine (1875) did argue that art works may be selected according to whether they match the 'moral temperature' of their times. While this may certainly be the case, 'moral temperature' seems to fluctuate too much to serve as basis for selection. In order to cause evolution, a selection criterion must be stable and long-lasting. There is some evidence suggesting that artists may even have developed devices to *avoid* selection on this basis. A number of theorists have noted that the arts seem to have lost meaning across the last several centuries. Whereas earlier painters wanted to depict great and important subjects, later painters tended to concentrate on form. As Ehrenzweig (1954) aptly put it, it makes no difference to a modern artist whether he paints the king of France or a sack of potatoes. Perhaps the reason for this increasing concentration on form is the analogue of evolution of protective coloration in animals: it makes the artist less subject to social control. It is easy to tell if the meaning or content of a poem or painting is consistent with current social values and attitudes. It is much more difficult to make this determination in the case of formal variables. For example, is iambic or trochaic meter more consistent with Marxist ideology? Subtraction of meaning can, of course, backfire if current social attitudes include the belief that art *should* have meaning. A related device is stabilization of meaning. If all painters paint the crucifixion, the church is satisfied. The real business of art can than continue on the level of formal or stylistic variables, the relevance of which to religious ideology is not readily apparent.

*2.3.2. Hedonic selection*

If it has done nothing else, twentieth-century psychology has produced literally thousands of experiments demonstrating what has always been at least intuitively known: people prefer stimuli that give them pleasure and dislike stimuli that give them displeasure. So far as we know, the same is also true of all other organisms as well. If we know what causes pleasure and displeasure, then we are in a position to explain why one thing is chosen over another. In order to explain phenomena (e.g. the brilliant plumage of birds such as peacocks, pheasants, and birds of paradise) that could not possibly be due to natural selection, Darwin (1871) postulated a second criterion of sexual selection. So far as it concerns us, sexual selection might as well be called hedonic or aesthetic selection: in a number of species, females select their mates on aesthetic grounds. The more aesthetically pleasing the male, the more likely he is to be chosen as a mate. Thus, there is a selection pressure toward increasing degrees of beauty in the eyes of the female of the species. This

selection criterion can be applied immediately to cultural evolution: human beings choose the most pleasing or rewarding of the alternatives presented to them. To determine the selection criterion in the arts, then, we must first determine what brings aesthetic pleasure.

The selection criterion in aesthetic evolution must be equivalent to Darwin's sexual selection or hedonic selection rather than to his more well-known selection criterion of 'fitness' to the environment. While both selection criteria may operate on artistic products, their effects are different. Selection on the basis of preference has presumably been present ever since works of art have been produced. Thus, hedonic selection has exerted a constant pressure in the same direction throughout the course of human history. On the other hand, 'fitness' has tended to vary wildly across time. Pornography has low fitness in a puritanical society, moralistic literature has low fitness in a licentious society, and so on. What is fit in one epoch may not be so in another. Thus, fitness cannot be seen as exerting a consistent, unidirectional pressure on works of art.

### *2.4. Determinants of aesthetic preference*

According to Berlyne (1971), liking or preference for a stimulus is based upon the arousal potential of that stimulus. Arousal potential refers to how much arousal or activation the stimulus produces. The arousal potential of stimulus is determined by collative properties (e.g. novelty, complexity, surprisingness, unpredictability), ecological properties (signal value or meaning), and psychophysical characteristics (e.g. pitch, hue, intensity). There is a good deal of evidence to support the contention that people prefer stimuli with a medium degree of arousal potential and that they do not like stimuli with either very high or very low arousal potential. This contention is supported by a number of general studies reviewed by Schneirla (1959) and Berlyne (1967) as well as by studies of aesthetic stimuli per se. For example, Kamann (1963) and Evans (1969) have found the effect with literary stimuli, and Day (1967) and Vitz (1966) have found it with visual stimuli.

### *2.5. Production and selection of variation*

#### *2.5.1. Difficulty of exact reproduction*

There would seem to be two major sources of variation in art forms. One source, which was pointed out by several early theorists (e.g. Balfour (1893), Haddon (1907)), is based upon the difficulty of exact replication or copying. Experiments on serial reproduction of visual designs (Balfour (1893), Ward (1949)) and of verbal narratives (Bartlett (1932)) show that variations always arise from copying even when people are intent upon producing an exact copy.

Three types of trends are found in such studies: movement toward complexity, movement toward simplification, and movement toward amplification and specialization of some details at the expense of others. Haddon (1907) concludes that the last is the most common. Such changes arise from limitations of technical skill and of memory. If we are dealing with skilled artists, the first factor would be negligible. However, if artists did not work in the presence of the model they had chosen, variation due to the schematizing and simplifying properties of memory would be expected.

*2.5.2. Lack of desire for exact copying*

*Intrinsic pressure for novelty.* Difficulty in copying cannot be the complete explanation of aesthetic variation, because most artists have no interest in producing exact copies of previous works in the first place. The role definition of artist almost always calls for the creation of new, different, or original products. A person who produces exact copies of already-existing art works is usually not even considered to be an artist: we make a fundamental distinction between a typesetter and a poet. Obviously, 'new' is a relative term. It builds a necessity for change into the very definition of what an artist is.

Many theorists have pointed out that if art is characterized by novelty or disruption of expectation, a necessity for change is built into it. If a work of art must be characterized by novelty, then each successive work of art must be different from prior works or it will not even qualify as a work of art. The Russian and Czech formalist argued that poetic devices involve 'estrangement' or 'deformation'. What gives poetry its effect is the use of words in unusual or unexpected ways. The deformed word usages of poetry theoretically intensify perception or grasp attention. In both everyday language and in poetic language, linguistic elements gradually become 'automatized' (Tynjanov (1924)). That is, they lose their impact value. Several formalist theorists (e.g. Shklovsky (1919), Tynjanov (1929), Murkařovský, (1940)) derived from this formulation the hypothesis that literature must therefore evolve. Because aesthetic effects arise from deformation and deformations gradually become automatized, there must be a constant pressure on successive artists to produce new deformations. Similar evolutionary theories have been independently formulated by Laver (1950), Meyer (1956), Peckham (1965), and Cohen (1966). These theories have usually been based upon intuitive and commonsense psychological assumptions. A more comprehensive formulation can be derived from scientific psychological theory.

*Habituation.* Habituation refers to the phenomenon whereby repetitions of a stimulus are accompanied by decreases in physiological reactivity to the stimulus. The psychological concommitant is becoming used to or bored with the stimulus. Habituation is not merely the polar opposite of need for novelty. Avoiding boredom is not the equivalent of approaching novelty (McClelland (1951), Rosen, Moore, and Martindale (1983)). Because of this and because

habituation seems to be a universal property of nervous tissue (Thompson et al. (1979)) it is worth discussion separately.

There is good evidence that reaction to most of the components of arousal potential tends to habituate. Repeated presentation of a given work of art decreases that work's arousal potential or impact value. A work of art – or any stimulus for that matter – gradually loses its arousal potential with repetition (Berlyne (1971)). The consequence is that a work that initially has medium arousal potential will gradually decline in arousal potential. Because of this, it will also gradually lose its capacity to elicit interest, liking, and attention. A number of studies have shown that repeated presentation of the same aesthetic stimulus eventually leads to a decrease in preference for that stimulus (Berlyne (1970), Skaife (1967)).

It follows that if a series of artists were to continue producing the same work of art – or very similar works of art – that liking for their productions would decrease over time. To compensate for such habituation, it would be necessary for successive works of art to have more and more arousal potential. In principle, this could be accomplished by increasing any of the components of arousal potential. Successive composers could create louder and louder musical compositions, or successive painters could produce larger and larger paintings. However, there are practical limits to how loud a piece of music can be or to how large a painting can be. In a medium such as poetry, it is essentially impossible to compensate for habituation of arousal potential by increasing stimulus intensity. Arousal potential could also be increased by increasing the meaningfulness of art works. There are several problems with this technique. First, people vary as to what is meaningful to them. A poet cannot be sure that what is more meaningful for him will also be more meaningful to his audience. Second, there is the problem of ceiling effects. In a religious epoch, where all painters are already painting the crucifixion and other religious scenes, the maximum amount of meaningfulness has already been attained. On the other hand, collative properties such as novelty or unpredictability are much freer to vary in all of the arts. Thus, the necessity to increase the arousal potential of aesthetic products over time must eventually come down to a pressure to increase novelty, incongruity, and other collative variables. This is the reason for the theoretical emphasis on collative properties rather than upon other components of arousal potential.

This argument is similar to the 'exhaustion' theories of aesthetic change proposed by Göller (1888) and Lange (1903). These theories traced artistic change to what Göller termed *Formermüdung* 'form-fatigue'. Göller argued that pleasure arises from the mental effort of what we would today call assimilation of perceptions to mental schemata. If this assimilation becomes too easy because of familiarity, then pleasure decreases and preference for new forms arises. This theory makes perfect sense in light of modern theories about arousal. Thus, for example, Sokolov (1963) argues that arousal is caused by a

lack of fit between mental schemata or expectations and perceptual inputs. It follows that a very close fit between expectation and percept should yield little arousal and, therefore, little pleasure. A somewhat less close fit would produce more arousal and, hence, more pleasure.

*Peak shift and preference for supernormal stimuli.* Peak shift is a well-established behavioral phenomenon (Hanson (1959)). Consider an animal that is rewarded if it responds to one stimulus (e.g. a 200 Hz tone) and not rewarded if it responds to another stimulus (e.g. a 100 Hz tone). After training, the animal will exhibit maximal responsivity at a point *beyond* which it was rewarded in a direction away from the unrewarded stimulus (e.g. a 220 Hz tone). Staddon (1975) argues that the peak-shift phenomenon may serve as the force behind sexual selection in biological evolution. Consider female birds that prefer to mate with males with bright rather than dull plumage. Because of peak shift, they should exhibit even greater preference for males with supernormal or above average brightness. Because of this, such males should mate more often and produce more offspring. Because of this and because peak shift operates during every generation, the brightness of male plumage in the species should increase across generations.

The same considerations apply to human beings and their preferences. Preference should gradually shift away from what is disliked to a point beyond what was maximally liked previously. For example, if an audience dislikes paintings with pale colors and likes paintings with bright colors, we should expect paintings to become brighter and brighter across time. Of course, the reverse could also occur if initial preference were for pale colors. Thus, peak shift does not imply a undirectional pressure as do need for novelty and habituation. Given that these undirectional pressures have already determined the direction in which art will change, peak shift may serve as a device to keep change gradual and orderly: stimuli that are only slightly rather than vastly supernormal are the ones that are preferred.

### *2.6. The transfer of habituation across generations*

The exhaustion theory of Göller and others has been criticized as involving a logical error (Hauser (1958), Wundt (1904)). The theory shares with our theory the idea that the effects of exhaustion or habituation are transferred from one generation to the next. Critics have argued that this involves an improper application of an intraindividual process to a series of individuals. Given that one generation has become bored with something, why should this have the slightest effect on the next generation? There is no reason to think that it should – if generations really existed in a social as opposed to a biological sense.

Consider the audience of French poetry on January 1 of, say, 1650. It consisted of a group of people varying in age, not of a cadre that could in any

sense be considered as being a generation. Consider the same audience on January 2. No doubt several members have died, but they had probably been replaced by several new members. However, the vast majority of the audience remains the same. Whatever habituation occurred for *them* on January 1 continued on January 2. New members had to either catch up with or be drug along by this process. They were in such a minority that they could not influence taste in the slightest. The same situation has existed on every day since January 2 of 1650 to today. The audience may have grown or shrunk, but at any moment in time, those already in the audience must have constituted the overwhelming majority. It was this majority that transferred habituation across 'generations'.

### *2.7. Rate of aesthetic change*

Tynjanov and Jakobson (1928) and Mukařovský (1940) admitted that their formalist theories could not explain the rate of aesthetic change but only the fact that such change must occur. However, given several considerations, we can derive predictions concerning rate of change from the psychological theory. These considerations concern the average chronic and acute level of arousal of the audience, amount of exposure of the audience to art, and the source of arousal potential in different artistic media.

#### *2.7.1. Background and basal arousal*

There is evidence that preference for aesthetic stimuli is a function not only of the arousal potential of the stimulus itself but also of the arousal potential of 'background' stimuli. That is, the arousal potential of the aesthetic stimulus is pooled with the arousal potential of other stimuli in the surrounding environment. Berlyne and Crozier (1971) allowed subjects to look at either simple or complex designs. More preference for the complex designs was found when the prestimulus environment was dark than when it was enriched. Similar findings with rats are reported by Berlyne, Koenig, and Hirota (1966). Sensory deprivation has also been shown to increase preference for complex, unpredictable stimuli (Jones, Wilkinson and Braden (1961)). It would seem to be the case that if the arousal potential of the environment is high, aesthetic stimuli with lower arousal potential are preferred, whereas if the arousal potential of the environment is low, stimuli with greater arousal potential are preferred (Berlyne (1971)).

There is some reason to believe that chronic – as opposed to acute – high-arousal states leads to the establishment of an adaptation level that requires more arousal potential or more novelty to induce pleasure. Berlyne (1971) proposed such an explanation for the consistent finding (Fischer (1961), Kavolis (1968), Lomax (1968)) that more complex art is preferred and produced in complex societies than in primitive societies. A complex society

subjects its members to more information input on a number of levels, and this leads to the establishment of a higher arousal baseline. Stimuli with complexity sufficient to induce moderate increases in arousal from this basal level of arousal will necessarily be more complex than those sufficient to induce moderate increases from the lower baseline of individuals in primitive societies.

Given the above considerations, it would follow that chronically high arousal states in the artistic subculture and/or audience should lead to rapid rates of artistic change while momentary high-arousal states should retard such change. Berlyne's (1971) hypothesis that social complexity produces chronically higher arousal states is consistent with the apparently more rapid rates of aesthetic change in such societies as compared with primitive societies. Other factors that might be expected to produce chronic high arousal states might be sustained rapid social change, an urban as opposed to a rural environment, and high levels of social mobility. Zajonc (1965) argued that the mere presence of other people increases arousal. If this is the case, then factors such as population density and social solidarity or cohesiveness could influence the rate of artistic change. Rapid momentary increases in arousal could result from wars, depressions, and revolutions; such events could possibly retard artistic change.

The examples given above show that the larger society could influence the art world by changing the acute or chronic level of arousal of artists and their audience. Indeed, Simonton (1984, 1986) has produced quantitative evidence that civil disturbances do have deleterious effects on artistic creativity. It is interesting to speculate that the relationship between art and society may usually be mediated by changes in arousal. If this be the case, then the impact of society upon art would of necessity be diffuse and non-specific. This is because level of arousal influences only the overall arousal potential of works of art. It has no clear relationship with their content. Perhaps, then, society can influence only the rate of aesthetic evolution but not the direction (in terms of content) that this evolution takes.

*2.7.2. Amount of exposure*

More creative people prefer more complex, novel, and surprising stimuli than do uncreative people (Barron and Welsh (1952), Houston and Mednick (1963)). If we assume that the average level of creativity is higher among artists than among their audience, higher rates of change should be found with more autonomy of the art-producing system. (As autonomy increases, artists come more and more to ignore the preferences of the audience and to create only for their fellow artists.) Moreover, with high autonomy, familiarity with and exposure to art would be increased. Thus, the artist-audience would at any time have undergone more habituation trials. This should lead to more rapid change than would be the case with less autonomy.

Berlyne (1971) pointed out that the evolutionary theory has difficulty in explaining cases such as that of Egyptian art that show extremely slow rates of change. However, consider that much Egyptian painting was sealed in tombs – hardly a place bring about much habituation. In general, the more an audience is exposed to a type of art, the faster the art should change. We should find higher rates of change in living room than in bedroom furniture, in everyday dress than in formal dress, and so on.

*2.7.3. Components of arousal potential*

The arousal potential of a work of art is hypothetically a positive function of its psychophysical, ecological, and collative properties and a negative function of its time-in-series, or how often it or similar works have been repeated. Rate of change in collative properties must be influenced by the other factors determining arousal potential. This is especially the case since habituation seems to occur more rapidly for collative variables than for psychophysical or ecological variables. For example, we tire more quickly of a complex design than of something – e.g., our profession or our children – that is very meaningful to us. Works having high arousal potential because of their psychophysical characteristics should be less likely to exhibit high levels of collative properties or high rates of change in the latter since these in combination with the psychophysical properties would make arousal potential too high and cause negative hedonic tone. For example, more incongruity, novelty, and surprise, and faster rates of change in these variables should be found in small than in large works and in works employing weak rather than intense stimuli. Thus, the design of large public buildings should change more slowly than that of smaller private residences.

In the case of ecological characteristics, a similar tradeoff should occur. Works depicting contents of high meaningfulness should change slowly and exhibit low levels of collative variables. For the believer, sacred art has high arousal potential because of its significance. Added arousal due to novelty or incongruity would push affect into the negative range. Paintings of nudes induce some degree of sexual arousal and thus leave less room for variation in collative properties. Thus, nude painting should change more slowly than paintings of, say, still lifes. Nonrepresentative painting should change more rapidly than representative painting because it has little or no intrinsic meaning.

*2.7.4. Cases in which arousal potential declines*

If arousal potential could only increase and never decrease, all art everywhere should be quite complex by now, and there should be no case of an historical decline in complexity. Neither is the case. We mentioned above that momentary high-arousal states should retard artistic change. If such arousal is extreme and longlasting enough, such states could just as well lead to histori-

cal declines in arousal potential. Such states are most likely to occur in situations of social chaos. Even if the art-producing system remains intact, arousal potential should decline.

Politicians can in some situations exert direct control over artists. If the politicians in question do not like art with high arousal potential, they can certainly bring about decreases. An obvious example is Nazi Germany, where artists producing disliked art were forced into exile or even killed. Remaining artists were controlled and censored in their work. Note, however, that, even in this extreme case, all that the Nazis could do was to pick one – Art Deco – of the already existing styles and destroy the others. They were not able to establish a completely new style. In order to do that, they would have ended up having to create the art themselves.

If enough artists with the requisite talent cannot be recruited by a given tradition, then arousal potential will decline. This can occur for a variety of reasons. In fact, it is quite likely to occur if the population from which artists are recruited is small, since genius is an extremely rare trait. Because the population of primitive tribes is generally quite small, this may be one of the major reasons that primitive art often does not show the sustained and regular sort of aesthetic evolution found in more developed societies. Even in the latter, the number of eminently creative individuals varies widely from one generation to another (Simonton (1984)).

There are some misleading cases where arousal potential has apparently shown long-lasting historical declines. The clearest example comes, perhaps, from women's fashion. The clothing worn by upper-class women has certainly become simpler across the last several hundred years. However, the relevant stimulus is not the clothing in isolation but the clothing plus the woman wearing it. The simpler the clothing, the more of the woman it tends to reveal. Thus, the decreased arousal potential of the clothing is more than offset by arousal potential produced by the wearer. Interested observers of sufficient age no doubt recall having observed many women wearing miniskirts. It is interesting that the often vivid memories of such observations are usually quite sketchy as to the texture, pattern, or even color of the garment. This is because attention was focused on the wearer rather than upon the miniskirt itself. It is well established that we only recall things upon which our attention was once focused. Furthermore, though dresses may be simpler at present than in the eighteenth century, a woman today probably has a larger wardrobe. Thus, increased variety also offsets the decreased complexity.

### *2.8. The direction of aesthetic evolution*

The exhaustion theories of Göller and others have been criticized because they do not provide an explanation of the direction of aesthetic evolution (Hauser (1958), Kautzsch (1917), Wölfflin (1888)). That is, they only explain why art

changes but not the character of this change – i.e. the way in which the specific style or content of art changes over time. The formalist theorists (Tynjanov and Jakobson (1928), Mukařovský (1940)) themselves uniformly agreed that their evolutionary theory could not explain the direction of aesthetic change, that it was necessary to look to extra-aesthetic social or cultural forces for an explanation of such changes. By the same token, the theories of Peckham, Meyer, and Cohen are mute concerning the specific direction that changes in aesthetic content will take. One of the merits of the psychological theory proposed here is that it does make quite specific predictions concerning the sequence of contents and styles that should be expected to occur in any aesthetic tradition.

*2.8.1. Psychological means of production*

These predictions arise from a consideration of the psychological means by which works of continually increasing arousal potential could be produced. How could successive poets, for example, produce poetry that continues to become more and more novel, original, or incongruous over time? To answer this question, we must ask how novel works of art are produced in the first place. According to Kris (1952), novel or original ideas arise from a biphasic process: an initial inspirational stage involving 'regression' is followed by a subsequent stage of elaboration involving a relatively less regressed mode of thought. By regression is meant a movement away from secondary process thinking toward primary process thought. The secondary process–primary process continuum is hypothetically the fundamental axis along which states of consciousness and types of thought vary (Fromm (1978)). Secondary process cognition is abstract, logical, and reality-oriented. It is the thought of everyday, waking reality. It is concerned with problem solving, logical deduction and induction, etc. Primary process cognition is free-associative, concrete, 'irrational', and autistic. It is the thought of dreams and reveries. As used in this article, 'primary process' and 'secondary process' are simply used as labels for types of thought rather than as psychoanalytic constructs. It would have been equally accurate to have used other terms such as Werner's (1948) 'dedifferentiated' vs. 'differentiated', McKellar's (1957) 'A-thinking' vs. 'R-thinking' or Berlyne's (1965) 'autistic' vs. 'directed' thinking.

Primary process thought is free-associative and undirected. Because of this, it increases the probability of novel combinations of mental elements. Such combinations form the raw material for the work of art. Once discovered, this raw material must be put into final form (e.g. be made to conform to current stylistic rules) in a secondary process state of mind. Kris did not discover the nature of the creative process. Virtually all eminently creative people who have reported upon how they created have said something similar. Ghiselin (1952) provides a valuable compilation of such self-reports. It is no surprise, then, that other major theories of creativity are essentially identical to Kris' theory but use different theoretical vocabularies (see Martindale (1981)).

Novel ideas could emerge in two ways from the inspiration–elaboration process: holding the amount of elaboration constant, deeper regression (movement toward primary process thought) should lead to more free-associative thought and therefore increase the probability of original or remote combinations of mental elements. In other words, to produce a more novel idea one could regress to a more primary process level. Holding degree of regression constant, decreasing the amount of elaboration should lead to statements that are original by virtue of being nonsensical or nonsyntactic in varying degrees. Productions of the latter sort are probably always more improbable than those of the former type. A statement composed of close associates but with a low amount of elaboration (e.g. 'chairs the fooding tabler') is certainly less probable than even the most far-fetched metaphor concerning a table that is elaborated into a syntactically or semantically meaningful form. Similar considerations apply to the other arts as well.

The amount of regression and elaboration during the creation of an art work should leave their marks on the work. That is, the greater the regression during inspiration, the more content indicative of primary process thought the resultant work should have. Because of this, we can predict the historical direction of changes in artistic content.

*2.8.2. Change within styles*

Because increasing the novelty of utterances by decreasing level of elaboration is more drastic than increasing novelty by increasing depth of regression during inspiration, artists seem to favor the method of increasing depth of regression rather than the method of decreasing level of elaboration. If possible, successive artists should engage in deeper and deeper regression while maintaining the same level of elaboration. Each artist or poet must regress further in search of usable combinations of ideas or images not already used by his predecessors. We should expect the increasing remoteness or strangeness of similes, metaphors, images, etc. to be accompanied by *content* reflecting the increasingly deeper regression toward primary process cognition required to produce them. Thus, across the time that a given style is in effect, we should expect works of art to have content that becomes increasingly more and more dreamlike, unrealistic, and bizarre.

*2.8.3. Stylistic change*

Eventually, a turning point to this movement toward primary process thought during inspiration will be reached. At that time, increases in novelty would be much more profitably attained by decreasing level of elaboration – by loosening the stylistic rules governing the production of art works – than by attempts at deeper regression. This corresponds to a period of major stylistic change. Changes in stylistic rules allow increased arousal potential in two

ways. In either case, arousal potential can be increased in a way that requires *less* regression than was required by the previous style. Because of this, amount of primary process content should decline when stylistic change occurs. One type of style change involves allowing new elements to enter the artistic 'lexicon'. Since the elements themselves are new, even the most obvious similes and metaphors concerning them will be new. This requires no great regression, since these obvious combinations come quite readily to mind. Once poets have said all they can think of about great men, they will be tempted to begin writing about lesser men. Wordsworth, in his poem on the leech gatherer, showed rather definitively that it is not even necessary to say anything novel or of the slightest interest about leech gatherers when they are first introduced into the poetic realm.

In the second type of stylistic change, the rules governing artistic style are loosened. Again this allows increase in arousal potential at a cost of less regression than was previously necessary. Perhaps the clearest example of this type of change can be found in French poetry. Nineteenth-century French poets accepted the rule that the work 'like' had to join like words. If a poet wanted to compose a simile, 'A is like B', then 'A' and 'B' had in fact to be alike at least by some stretch of the imagination. Around 1900, this rule was explicitly abrogated. It became acceptable to combine completely unlike words with the word 'like'. Thus, Eluard's image, 'the earth is blue like an orange', was perfectly acceptable. Surreal images tend to be composed of easily accessible work associates such as 'blue' and 'orange'. No great regression is needed to think of 'orange' given the word 'blue'. While primary process content should decline with the introduction of a new style, once the stylistic change has taken place, it should begin to rise again. After the obvious combinations of mental elements have been discovered, more regression will be required to think of the less obvious ones.

### *2.9. The extinction of styles*

#### *2.9.1. Least effort*

A complete theory of aesthetic evolution must explain why and when stylistic changes occur. Three explanations seem plausible. The first could be called the least-effort hypothesis: artists adopt a new style when it requires less effort to increase arousal potential in a new style than in the old style (Martindale (1975)). In this view, the old style could be successful continued but only at the cost of ever increasing difficulty. According to this hypothesis, indices of both arousal potential and primary process content should increase monotonically across the entire time during which the old style was practiced. That is, the style yielded the required increases in arousal potential due to successive artists' engagement in deeper and deeper regression.

*2.9.2. Exhaustion*

An alternate explanation might be termed the exhaustion hypothesis. In this view, late practitioners of the old style fail to increase arousal potential as compared with that of their predecessors. Arousal potential may either decline or its rate of increase may fall below the necessary level. This failure leads new poets to choose or invent new styles. It also causes the audience to prefer any new style that produces works with the required amount of arousal potential. One difficulty with the least-effort hypothesis is that new artists could not know that the old style required excessive effort without trying to create in it. But the initiators of new styles are not usually defectors from a previously dominant style. This is easy to explain if the old style had produced actual observable failures, as suggested by the exhaustion hypothesis.

The most obvious reason for exhaustion would be that, within the constraints of the old style, no usable combinations of ideas are left to be discovered. Of course, not every conceivable art work in the old style will have been created, but those remaining would be too similar to existing ones. This implies that deeper regression is simply impossible, because it is regression during inspiration that produces the ideas for artistic products. To say that no ideas are left implies that regression has reached a maximum. Had it not, even deeper regression should produce more new ideas. If this were the problem, then measures of primary process content should reach an asymptote in the late stages of a style.

*2.9.3. Evolutionary traps*

A third explanation, which we shall term the evolutionary-trap hypothesis, is based upon the possibility that depth of regression and originality may in fact be curvilinearly related. Perhaps there is a point beyond which deeper regression does not lead to more originality or variability but rather leads to *decreasing* variability. Very deep regression causes not only free-associative and disorganized thought but also simplification of mental contents (Martindale (1981)). Thus, there are fewer mental elements to combine and therefore less potential variability or originality. In this view, the late practitioners of a style are caught in an evolutionary trap: more regression should lead to more originality, but in fact it does just the opposite. If this explanation is correct, primary-process content should increase across the entire timespan of a style, whereas measures of arousal potential should increase at first and then level off or decline. In a study of English metaphysical poetry, Martindale (1984b) obtained results supportive of the evolutionary-trap hypothesis.

*2.10. Strong versus weak versions of the theory*

The evolutionary theory can be construed to two ways. The weak version would be that the types of changes predicted do occur, but along with may

others. That is, there might be a number of unrelated trends in content occurring simultaneously with the trends predicted by the theory. The strong version of the theory is that it accounts for most historical changes in style and content. In this version, any major trends in content or style are subsumed by the general trends in arousal potential and primary process content. The strong version of the theory is not altogether unreasonable. The fundamental continuum along which works of art are held to vary by many theorists is in fact cognate with the primary process–secondary process dimension. Examples would be Nietzsche's (1872) Apollinian vs. Dionysian, Riegl's (1901) objectivistic vs. subjectivistic, Wölfflin's (1915) linear vs. painterly, Sorokin's (1937) ideational vs. sensate, Sachs's (1946) ethos vs. pathos, and Worringer's (1957) abstraction vs. empathy. For the strong version of the theory, romantic, mannerist, or baroque styles are seen as 'local realizations' of a general primary process style. They differ only in their surface details but not in their 'deep structure'. By the same token, classic, neo-classic, or realistic styles are viewed as examples of a general secondary process style. Note that acceptance of the strong version of the theory necessitates rejection of the theories holding that art history is more than minimally reflective of or related to social change. In two studies, Martindale (1984a, b) found evidence for the strong version of the theory: from 41 to 67% of the overall general similarity in content among poets can be explained by or reduced to the two theoretical variables, arousal potential and primary process content.

*2.10.1. Specificity of aesthetic evolution*

The evolutionary theory applies only to a series of artists working within the same tradition. Just as biological evolution is species-specific, aesthetic evolution is tradition-specific. An evolutionary change in elephants has no very direct implications for kangaroos. However, traditions are not as clearly demarcated as species. What, exactly, is supposed to be evolving? It is left as an empirical question whether it is a specific tradition within a specific medium, the entire medium, or all artistic media together. If the last possibility is the case, then we should expect to find the primary process cycles in various artistic media to be in synchrony. If the first or second possibility is correct, we should expect the cycles to be more or less randomly related. The question is of interest, since historians of art and literature have been debating for several centuries whether the arts move in synchrony or not. Probably because of the lack of quantitative methods, centuries of humanistic investigation have produced no generally agreed upon answer to this question. In the empirical studies described below, the general finding has been that the cycles are not in synchrony, that evolution occurs at the level of quite specific sub-genres. However, there are cross-media influences. For example, primary process content in British music is correlated with primary process content in British painting during prior periods (Martindale (1984a)).

### *2.11. Application to individual artists*

One may also ask whether the theory applies to individual artists. Does an artist try to keep increasing the arousal potential of his works across the course of his own life or is he satisfied with surpassing his predecessors? Biological evolution offers us no hints in this case. An organism's genotype is fixed at its conception and does not vary across its lifetime. The selection mechanisms in aesthetic evolution should, however, operate on individual artists across their lifetimes. That is, an audience – as well as the artist himself – should tire of repetitions of minor variations on the same theme. Thus an artist should certainly be under a pressure to surpass the arousal potential of his own prior work. Indeed, Simonton (1980a,b) has shown that originality of musical composition tends to increase across a creator's lifetime, though it does show a slight decline toward the end of his career.

### *2.12. General predictions*

If the theory is valid, several general predictions may be made about any series of artistic products produced within a given tradition: measures of collative properties such as novelty, complexity, and variability should increase monotonically over time. Measures of primary process content should exhibit cycles of increasing and decreasing density of words indicative of regressive thought. Periods when primary process content decreases should coincide with periods of stylistic change. These predictions hold only if the autonomy of the artistic subculture and the chronic arousal level of the society remained relatively constant. There certainly must be cases where indices of collative variables and primary process content have exhibited erratic trends. These would be cases where autonomy and chronic or basal arousal have not remained relatively constant.

## 3. Empirical investigations

### *3.1. Literature*

Several studies have been conducted to test the evolutionary theory described above. Those concerning literature include investigations of nineteenth- and twentieth-century French poetry (Martindale (1975)), sixteenth- through twentieth-century British poetry (Martindale (1984a)), seventeenth-century English metaphysical poetry (Martindale (1984b)), twentieth-century Hungarian and American short stories (Martindale and Keeley (in press)), modern American popular music lyrics (Kaplan (1975)), and an experimental simulation of literary change (Martindale (1973b)). Details may be found in the

references cited above and in Martindale (in press, b)). All of these studies have produced evidence supportive of the evolutionary theory. Below, because of considerations of space, only the study of British poetry will be described.

*3.1.1. Method*

Because of the large amounts of text analyzed, computerized content analysis was employed. To attempt to test the theory using a traditional humanistic or qualitative approach would have been impossible. The study of British poetry concerns several hundred thousand words sampled from the works of a series of 109 poets. The task of reading this poetry and deciding whether arousal potential increased in a monotonic fashion across the timespan of interest vastly exceeds the capacities of human memory. Several steps are involved in computerized content analysis. First, one needs to devise objective methods of selecting authors and of sampling from their texts. Then the textual samples must be put into machine-readable form. Finally, one must either devise or obtain content analysis dictionaries containing words indicative of the type of content one wants to measure and a program that will take each text word, determine whether it is in the dictionary, and maintain a tally of how often words in each content category in the dictionary were used in each text.

The texts were analyzed with several computer programs written by the author. COUNT (Martindale (1973b)) is a general purpose content analysis program. SEMIS applies dictionaries in which dictionary entries are rated on up to four dimensions. Output consists of the average rating on each dimension of the text words which were found in the dictionary. Both COUNT and SEMIS have suffix-removal procedures similar to those employed in early versions of the General Inquirer (Stone et al. (1966)). LEXSTAT (Martindale (1974)) computes standard lexical statistics, such as average word length, type-token ration, and so on. LEXSTAT and SEMIS were used to compute some of the variables used in the Composite Variability Index described below.

The Regressive Imagery Dictionary (used with COUNT) was designed to measure primary process content. It contains 3,647 words assigned to 43 categories. Each word is assigned to only one category. The categories are summed to yield two summary categories that measure primary process and secondary process content. The primary process categories have been grouped into subdivisions of Drives, Sensations, Perceptual Disinhibition, Regressive Cognition, and Icarian Imagery. Each of these has been suggested by various theorists as being important in primary process thinking (see Martindale (1975)). The categories measuring secondary process content have, likewise been proposed by theorists in describing this type of thought. Martindale (1975) presents evidence concerning the rationale and reliability of the coding scheme.

In order to obtain a general measure of primary process content, an index,

Primary Process, is constructed from the Regressive Imagery Dictionary categories: the five primary process categories are standardized in *z*-score form and added together. The resultant sum is restandardized and secondary process (in *z*-score form) is subtracted from it. In this way, equal weighting is given to the direct (primary process) and inverse (secondary process) measures of amount of regression.

Evidence for the construct validity of Primary Process as a measure of regressive or dedifferentiated thought comes from a number of studies where the measure has behaved as theoretically predicted. Significantly more primary process content has been found in the poetry of poets exhibiting signs of psychopathology than in that of poets not exhibiting such signs (Martindale, (1975)); in psychoanalytic sessions exhibiting therapeutic 'work' as opposed to those marked by resistance and defensiveness (Reynes, Martindale and Dahl (1984)); in sentences containing verbal tics as compared with asymptomatic sentences (Martindale (1977)); in texts composed by a subject under the influence of psilocybin as contrasted with texts composed before and after the drug experience (Martindale and Fisher (1977)); in fantasy stories written by subjects under the influence of marijuana as opposed to stories written by subjects given a placebo (West, Martindale, Hines and Roth (1983)); in fantasy stories told by younger as opposed to older children (West, Martindale and Sutton-Smith (1985)); in written fantasy stories of subjects with more right-hemisphere EEG activity (Martindale, Covello and West (1986)); in fantasy stories of hypnotized as compared with unhypnotized subjects (Comeau and Farthing (1985)), and in folktales of more primitive as opposed to more socioculturally complex preliterate societies (Martindale (1976)).

*3.1.2. British poetry*

Martindale (1984a) tested the evolutionary theory on a series of 109 British poets born between 1490 and 1949. The timespan of interest was divided into 23 20-year periods. For each of these periods, the poets born during the period were ranked on the basis of number of pages devoted to them in the relevant Oxford anthology of English verse. For the first two periods, the two most eminent poets per period were selected. For all other periods, the five most eminent poets were selected. This produced a sample of 109 poets. Once poets had been selected, the most recent complete edition of their works was obtained. Fifty random samples were taken by selecting 50 pages from a table of random numbers. For each of these pages, the first eight line of verse were reduced into computer-readable form. The mean number of words per poet was about 3000.

*Arousal potential.* The first question of interest concerns the prediction that the arousal potential of poetry has increased over time. Martindale (1978) constructed a Composite Variability Index to measure the collative properties of texts. The goal was to create an index of the degree of complexity,

surprisingness, incongruity, ambiguity, and variability of texts. In creating the index, several steps were involved. First, non-redundant measures with face validity were selected. Then, since many of them are spuriously related to number of words or phrases in a text, the effects of these variables were removed with multiple regression techniques. That is, residual scores with the effects of number of words and number of phrases statistically removed were computed. Finally, a Composite Variability Index was created by adding together the variables in standard score form (to give each variable equal weighting). The index is composed of the following measures: Polarity (a measure of semantic intensity of strikingness), Number of Word Associates (a measure of use of words with multiple meanings and, thus, more potential ambiguity), Hapax Legomena Percentage (percentage of words occurring only once in a document: an index of complexity or difficulty), Mean Word Length (a measure of complexity or difficulty), Coefficient of Variation of Word Frequency, Coefficient of Variation of Word Length, and Coefficient of Variation of Phrase Length (measures of variability).

The Composite Variability Index varies across periods in a statistically significant way; $F(22, 86) = 9.16$, $p < 0.0001$: differences among the periods are much greater than differences within the periods. These differences are due solely to a linear uptrend over time, $F_{\text{lin}}(1, 86) = 178.32$, $p < 0.0001$, whereas $F_{\text{higher-order}}(21, 86) = 1.11$, *ns*. Some of the components of the Composite Variability Index show non-linear trends, but all of them also show highly significant ($p < 0.001$) linear uptrends. Poets of different periods prefer to obtain arousal potential in different ways. In some periods poets emphasize long words and lots of infrequent words, whereas in others poets obtain their impact by use of words of high polarity. An obvious objection to a theory that takes a quest for novelty and variability as the basis for literary history is the existence of movements such as neoclassicism that ostensibly call for simplicity, order, symmetry, and balance. The English neoclassical poets occupy periods 8–11. The Composite Variability Index continued to rise across these periods. An examination of the component indices shows that some of them, such as polarity and the coefficient of variation of phrase length, did decrease but that these decreases were more than offset by increases in other measures such as the hapax legomena percentage and mean word length. These results suggest that the popular view of the neoclassical style as a reversion to order following seventeenth-century excesses is incorrect. On the contrary, it would seem that the neoclassic style shift was in the service of *increased* arousal potential or variability, that these poets' rhetoric concerning order with regard to some aspects of poetic practice has obscured their pursuit of disorder in other aspects.

The finding that the Composite Variability Index shows a simple linear uptrend over the whole timespan covered by the samples is of interest. There is no support in the data for the idea that the rate of increase has accelerated

during the more recent periods. One might have expected that poets in recent times have been more isolated or autonomous from the larger society and that the rate of increase in arousal potential would therefore be higher. It may be that automony has not really changed as much as might be thought over time.

*Primary process.* Primary Process rose over time but a cyclical or oscillatory trend is superimposed on the linear uptrend. Results of an analysis of variance show that both trends are real ones: $F(22, 86) = 5.71$, $p < 0.0001$; $F_{\text{lin}}(1, 86) = 88.58$, $p < 0.0001$; $F_{\text{higher-order}}(21, 86) = 1.76$, $p < 0.05$. Primary Process does tend to decline during periods commonly seen as involving initiation of new styles: Tudor, Jacobean, Neoclassic, Romantic, Post-Romantic, and Modernistic. It begins to rise once each new style is established.

Spectral analysis of mean Primary Process scores for each period showed a clear peak indicating the existence of a four-period cycle. Theoretical considerations and the fact that the cycles vary somewhat in their lengths suggest that they arose from a stochastic rather than a deterministic cause. This means that an autoregressive statistical analysis is most appropriate. In such an analysis, one attempts to predict the mean score for one period from the scores for prior periods. Of course, this is consistent with the evolutionary theory, which involves the assertion that the cause of poetic content in any period is the poetic content of prior periods. Cycles of the sort observed can arise from a second-order autoregressive process: that is, the mean value for a given period is determined by the value for the prior two periods plus random error (Gottman (1981)). Autocorrelation analysis of detrended average Primary Process scores for the 23 periods supports this notion: autocorrelations at lags from 1 to 10 periods exhibit a damped sinusoidal pattern. On the other hand, partial autocorrelations (the autocorrelation at a given lag partialling out of the effect of autocorrelations due to earlier or intervening lags) fall to about zero after a lag of two. This is the pattern expected with a second-order autoregressive process (Gottman (1981)). It is of less than incidental interest that a completely different pattern of autocorrelations would be found if the reflectionist theory (primary process content in a given period is due to extra-literary 'shocks' in the current and/or prior periods) were true (Gottman (1981)). Since the first autoregressive parameter is statistically insignificant, the best autoregressive model for Primary Process in a given period ($PP_t$) is $PP_t = -0.48PP_{t-2}$. That is, amount of primary process content in the poetry of a given period is a function of primary process content two periods prior ($PP_{t-2}$) to the period. The autoregressive parameter is significant, $t(22) = 2.63$, $p < 0.05$. When Primary Process scores are regressed onto scores predicted from this model, a significant fit is achieved. $F(1, 19) = 6.89$, $p < 0.05$, $R^2 = 0.27$. The fact that the first autoregressive parameter is insignificant suggests that we are dealing with a 'seasonal' rather than a second-order autoregressive process. Both processes can produce periodic trends.

It is clearly necessary to distinguish trends in poetic language from trends in language in general. Thus, for control purposes, it was necessary to analyse a series of non-literary texts. A study of prose samples from the *Annual Register* was conducted (Martindale (1978)). The *Annual Register* has been published yearly in England since the mid-eighteenth century. It consists of a narrative description of world events for the year. For the period from 1770 to 1970, 10 samples from the Annual Register for every twentieth year (i.e. 1770, 1790, etc.) were drawn at random. The mean number of words per volume sampled was about 2690. The Composite Variability Index was computed for each sample. It showed no significant interperiod differences, $F(10, 99) = 0.76$, and no linear trend over time. Likewise, there were no interperiod differences for Primary Process, nor any linear or higher-order trends. Thus, the trends found in poetry do not appear to be mere reflections of general trends in the English language.

### *3.2. Visual arts*

Studies of British painting (Martindale (1984a), Italian painting (Martindale (in press, c)), and Japanese *ukiyo-e* prints (Martindale (unpublished data)) have produced results in conformity with the evolutionary theory. Below, results of the study of Italian painting will be described. Similar methods were used in other studies.

#### *3.2.1. Method*

In order to test the evolutionary theory on paintings requires different measures of arousal potential and primary process content than were used in the study of poetry described above. Berlyne (1974) has shown that arousal potential can be measured with the use of rating scales such as simple–complex, passive–active, or relaxed–tense. Perhaps primary process content could also be measured by use of rating scales (e.g. natural–unnatural, photographic–nonphotographic, representational–nonrepresentational). Indeed, Martindale, Ross, and Miller (1985) produced evidence suggesting that this possibility is viable. In their experiment, one group of people rated a set of paintings on scales such as these. Another group of people wrote stories about the paintings. The stories were then content analyzed with the same dictionary that was used to measure primary process content in poetry. There were high correlations between amount of primary process content in a story and the degree to which the painting that was used to elicit it was rated as being unnatural, nonrepresentational, nonphotographic, and meaningless. Thus, it would appear that both the arousal potential of a painting and the amount of primary process content in it can be measured by obtaining ratings of the painting by naive subjects.

*3.2.2. Italian painting*

Martindale (in press, c) carried out a study of fourteenth- through eighteenth-century Italian paintings. Beyond the desire to test the evolutionary theory on a visual art form, there were several reasons for choosing to examine Italian art. On the theoretical level, it has been argued (e.g. Berlyne (1971)) that the pressure for novelty in art is of recent origin. It was desired to show that this is not the case. On a more practical level, Italian painting across the timespan investigated constitutes a long and uninterrupted tradition, and large numbers of reproductions of these paintings are readily available.

*Method.* The timespan from 1330 to 1729 was divided into 20 consecutive 20-year periods. The four most eminent Italian painters born during each period were selected. Eminence was defined as amount of space devoted to a painter in several biographical listings. A color reproduction of a painting by each artist was obtained by searching a set of sources in a predetermined manner. Reproductions were constrained in several ways; e.g. each had to contain a representation of a person but not be a portrait, drawings and sketches were not used. Fifty-one artistically naive subjects rated color slides of the paintings on a set of 24 seven-point rating scales. The slides were shown in a random order.

*Results.* Since subjects agreed in their ratings, a single mean score for each painting on each of the scales was obtained. These scores were factor analyzed in order to see if, as hoped, the 24 scales were measuring a smaller number of underlying dimensions. Five factors emerged from this analysis. One of these clearly tapped arousal potential: it had high loadings on scales such as Active, Tense, Disordered, and Complex. Another seemed to measure primary process content: it had high loadings on scales such as Nonphotographic, Other Worldly, Unnatural, and Not Representative of Reality. Factor scores on these factors were obtained for each painting. Below, the factors are labelled as Arousal Potential and Primary Process.

Analysis of variance of factor scores was used to test for the predicted trends. Arousal Potential exhibited the predicted temporal increase, $F_{\text{lin}}(1, 60) = 4.88$, $p < 0.05$. No higher order trends were present, $F(18, 60) = 0.80$, *ns*. For Primary Process, $F(19, 60) = 1.81$, $p < 0.05$. Several polynomial trends were significant. Inspection of the data showed that the predicted oscillations were clearly present. A spectral analysis indicated the presence of a cycle with a periodicity of about six 20-year periods. An autoregressive analysis indicated that the best prediction equation for Primary Process in period $t(\text{PP}_t)$ was $\text{PP}_t = 0.40\ \text{PP}_{t-1} - 0.41\ \text{PP}_{t-3}$. Correlating observed scores with scores predicted by this equation showed a significant fit, $F(1, 14) = 16.66$, $p < 0.01$, with $R^2 = 0.54$. Thus, a little over half of the observed variation in average primary process content during a period can be accounted for by the autoregressive equation. Declines in Primary Process coincided with the introduction of generally recognized styles: Late Gothic (Periods 1–5), Renaissance-Mannerist

(Periods 6–10), Baroque (Periods 11–17), and Rococo (Periods 18–20). In each case, Primary Process content declined when the style was introduced and began to increase once the style was generally adopted.

### *3.3. Music*

Martindale and Uemura (1983) tested the evolutionary theory on a series of French, German, British, and Italian classical music themes by composers born between 1490 and 1909. This epoch was divided into 21 consecutive 20-year periods. The three most eminent composers born during each period in each country were selected by a systematic search through a set of reference works. Then, for each composer, the theme – consisting of three to six bars – of one of his compositions was selected by searching a set of collections of scores and of reference works. The 252 themes were played by a professional violinist and tape recorded. Because of the large number of themes, three groups of subjects each rated a third of them on 13 seven-point scales.

A mean score for each theme was obtained, and these scores were factor analyzed. Two factors were obtained. One, apparently tapping arousal potential, was composed of scales such as Complex, Tense, Active, and Strong. Scales such as Unnatural, Meaningless, and Disorderly had high loadings on the second, which was labelled Primary Process. An objective measure of melodic originality devised by Simonton (1980a) was also computed for each theme: note-to-note transitional probabilities were computed for the first 10 notes of all 252 themes. For each theme, melodic originality was computed by adding the probabilities of each of its two-note transitional probabilities. This yields a measure that, when inverted, tells how original or unusual the note-to-note transitions of a theme are in reference to the entire set of themes. A net Arousal Potential score was computed by adding together, in standardized scores, a theme's first factor score and its melodic originality score.

*Arousal potential.* Analysis of variance of Arousal Potential scores yielded a significant effect for Period, $F(20, 168) = 4.56$, $p < 0.001$. The interperiod differences arose from a significant linear increase across time, $F_{\text{lin}}(1, 168) = 49.60$, $p < 0.001$, with a superimposed quadratic trend, $F_{\text{quad}}(1, 168) = 12.02$, $p < 0.001$. The trends for Britain and Germany were monotonic, and that for France was almost so. However, an inverted-U trend was found in the case of Italian music. This decline may have arisen because of changes in the audience. Many of the later Italian composers wrote popular operas with great popular appeal. Thus, their audience was much larger than that of earlier Italian composers. In theoretical terms, this corresponds to a decline in autonomy.

*Primary process.* For French, German, and British music, Primary Process exhibited an oscillating pattern with declines corresponding to recognized stylistic changes: Mannerist, Early Baroque, Late Baroque, Classical, Early

Romantic, Late Romantic, and Modern. Autoregression analyses yielded significant results in all three cases. For British and German music, the best prediction of Primary Process in period $t$ was Primary Process in period $t - 2$. This was also true for French music, but in this case, the best fitting model included all lagged values from $t - 5$ through $t - 1$. The autoregressive models accounted for an average of 30% of the variation in mean Primary Process scores across periods. Primary Process content in Italian music exhibited an erratic course across time. There was no correspondence between declines in Primary Process and stylistic changes, and no statistically significant autoregressive model could be fit to the data. Apparently, across most of time span examined, there was no such thing as Italian music but, rather, several fairly distinct intra-national traditions (e.g. Roman vs. Venetian). Presumably, better results would have been obtained had composers from only one of these traditions been studied. Sampling from several traditions would produce 'smeared' data unless the traditions were exactly synchronized.

## 4. Conclusions

Successive artists must increase the arousal potential or impact value of their works in order to counteract the effects of habituation. Within a given style this is done by regressing to a more primary process state of conciousness during the inspirational stage of creation. However, this method works for only a limited amount of time. Then, artists are caught in an 'evolutionary trap' where more regression actually produces less arousal potential. At this time, the old style is replaced by a new one, and the cycle begins again. Quantitative studies of poetry, painting, and music are supportive of this evolutionary view of art history. The evolutionary process accounts for about half of the variation in historical changes in artistic content or style. Whether the other half of the variation is due to the operation of other general laws or to random and idiosyncratic effects remains to be seen.

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