

# MATHEMATICS OF INTELLIGENCE AND AESTHETICS

This paper discusses relationships between mathematical theories of the mind and theories of aesthetics. Mathematical theories describe abilities for concepts, emotions, instincts, imagination, adaptation and learning. Aesthetic abilities are related to the mind's ability to adapt and learn. The ability to perceive beauty naturally appears as a property of a complex hierarchical adaptive system. Mechanisms of adaptation are essential to everyday perception and cognition as well as to historical development of higher mental functions. This breadth of adaptive ability leads to a variety of aesthetic phenomena and judgments of taste. Conclusions based upon mathematics confirm, on one hand, that judgments of taste are subjective, and on the other, that they are based on an objective foundation. The paper relates mathematical concepts to those of philosophy and aesthetics.

Based on novel ideas in the area of mathematical theories of the mind (also called artificial or computational intelligence), this paper demonstrates relationships among concepts in mathematics and aesthetics. Contemporary mathematical understanding of thinking processes, involves its conscious and unconscious aspects, concepts that the mind uses in thinking processes, instincts, emotions and their fundamental role in thinking. Aesthetic emotions appear necessary for mathematical theories of the mind.

Many people assume there could be no 'really interesting' relationship between mathematics and aesthetics: the basis of mathematics is in objective impersonal truths far removed from the subjective personal world of human feelings. Relationships between mathematics and aesthetics are commonly thought of along the Plato's understanding of beauty as related to the world of Ideas and pure concepts. Similarly, relationships between mathematics and beauty are today often seen in 'ideal' constructs like symmetries, geometric shapes described by mathematical equations, or (more recently) fractal geometric objects. But these 'mathematical' ideas of the beautiful clearly lack the personal and subjective element, and therefore they do not address the necessary fundamental concern of aesthetics. Similarly, computer tools enabling computer-generated art do not address the fundamentals of aesthetics.

Yet, the new mathematical theories of the mind are coming close to providing a new level of theoretical understanding of emotions, consciousness and unconscious, the individual and collective. These theories are turning out to be closer than expected to the fundamental issues of philosophy and aesthetics. The complex play between the two factors, subjective and objective, in workings of the mind is described and related to debates in philosophy and aesthetics. The next section summarizes results of mathematical theories of intelligence that are most relevant to aesthetics. While the exposition is mathematically correct, it is given at a conceptual level and no knowledge of mathematics is assumed throughout this paper. Readers with knowledge and interest in mathematical details are invited to follow the references.<sup>1</sup> Next, I review the relationship of the mathematical concepts to aesthetics since Kant with references to some of the issues discussed on the pages of this journal. Finally, I summarize fundamental mathematical arguments related to the mathematical 'formula' of beauty.

The following Section 1 describes a mathematical theory of the mind including

concepts, instincts and emotions. Section 2 analyzes a specific aspect of this theory, the ability for learning and adaptation and specific instinct and emotions involved in this ability, and presents ‘initial’ arguments for this being the aesthetic emotion. Section 3 establishes detailed relationships between notions of the mathematical theory and those of Kantian theory of the mind and aesthetics. Section 4 continues elaboration of the mathematical theory from ‘simple harmony’ towards refined beauty. Section 5 relates the mathematical theory to current discussions of issues in aesthetics.

This paper is the first attempt to relate aesthetics and a mathematical theory of the mind. Some issues might be controversial, therefore I attempt to limit the paper to the most basic and least controversial issues. A word of caution is due. I can imagine a critical reader disappointed at once with two opposite qualities that one may see in this paper: its seeming ‘over-ambitiousness’ in addressing fundamental issues, and ‘irrelevance’ to specific questions of aesthetics that might preoccupy the reader’s mind. To such a reader I would suggest to be patient and to give his mind a chance to contemplate the novel connections between mathematics and old issues of aesthetics. For much will have been gained for aesthetics as well as for mathematics of intelligence once we have succeeded in establishing such a connection<sup>2</sup>.

## I. THE NATURE OF INTELLECT: CONCEPTS, INSTINCTS, EMOTIONS

Analysis of mathematical theories of the mind starts here with the processes most accessible to the consciousness. Those are the usual conscious perception of objects around us and comprehension of their usage. For example: ‘this is a chair, it is for sitting’. It turned out to be difficult to create computers capable of such a simple perception-judgment. After sixty years of development of mathematical theories of intelligence, after spending billions of dollars, pounds, franks, marks, rubles, yen on this research, today we begin understanding the nature of the complexity of the problem. How can we explain a complexity of the obvious? A word ‘chair’ written on a paper is very different from the spoken sounds of the same word; a written and spoken ‘chair’ is very different from a chair one sits on. In our brain there are inborn structures that were developed over hundreds of millions of years of evolution specifically to enable fast learning (in childhood) of combining into a single concept a spoken, drawn, and real chair. Let us note that the ‘real chair’ is what is seen by our eyes, but also what is sensed as a ‘seat’ by the sitting part of our body. Therefore ‘chair’ is a bodily-sensed-spatio-thought concept.

The brain structures providing the foundation for learning concepts are called *models* (inner models) of the mind (see<sup>3</sup> and references discussed therein). They model the world around and the results of the modeling are *phenomena* perceived and understood by our minds. What are these models made of? What do they look like? What is the mathematics that could describe them? An original approach of the creators of artificial intelligence (in the 1950s and 60s) was based on an assumption that model-concepts contain ‘photo-likeness’ of objects. An image of an object at an electronic eye ‘retina’ was to be compared to model-concepts stored in the computer memory, resulting in decisions: similar-dissimilar. This early mathematical attempt to describe the working of the mind was based first, on the formal logic operating with binary variables (yes, no) and second, on the then known properties of the brain neurons, which seemed similar to early two-state transistors (0,1), 0=no, 1=yes. This approach failed: an object (say, chair) turned out to be different each time, a different view angle, lighting, surrounding objects, shape of legs or back – the computer could not ‘comprehend’ that all of these are ‘chair’.

Today we know much more about complicated structures of the brain’s neural nets. In neural modeling field theory<sup>4</sup> the original structure-models of the mind are vague and do not

look like photos of objects. They are described by fuzzy logic, which decisions are not similar to simple 'yes-no'. In the process of learning they 'take a form' of a concrete object, retaining a degree of fuzziness, so that during future perception processes they could adapt or 'take a form' of a concrete object at its angle, illumination, etc.

Fuzzy models make up the content of a priori, inborn structures of the mind, providing the foundation for perception and cognition. These structures are not accessible to consciousness directly. Jung called these structures archetypes of the mind<sup>5</sup>. At the moment of birth, and possibly to some extent, even before the birth the process begins of learning-adaptation of these inborn structures to the surrounding world. On the basis of inborn structures-archetypes, the models of concrete objects and situations are created. Models related to vision, hearing, olfaction, touch are created for perception and correspond to objects in the world, or saying more accurately, correspond to object-structures in sensory signals generated by retina and other sensory organs.

Cognition and understanding of abstract concepts is similar to 'simple' sensory perception of objects'. In 'simple' sensory *perception*, phenomena-objects are formed from sensory neural signals based on models of objects. Similarly, abstract concepts are formed on the basis of more complex models from simpler concepts understood earlier. This process continues up and up the hierarchy of the mind toward more general and abstract concepts of complex situations and relationships. (The mind is not a strict hierarchy, but for simplicity we will refer to a hierarchy). Mathematical models describe simple objects as well as abstract concepts of complicated situations and relations. Whereas *object*-models represent geometric, color, and other sensory properties of objects, models of *abstract concepts* represent relations among concept-objects. Inborn states of models (of objects and abstract concepts) are vague and described by fuzzy logic; in the process of learning, they could take a structure of concrete concepts, approximately obeying usual logic. In such a form of concrete objects, situations, and relations they become accessible to consciousness<sup>6</sup> and are perceived as objects and situations in the world, or as thought objects. Neural process of visual perception takes about 1/5<sup>th</sup> of a second, however, this process is not accessible to consciousness, we are not aware of it, and we are usually sure that perception occurs immediately. At lower levels of perception, vague models adapt to match concrete objects around us, and the final states of these adapted models are concrete and crisp. At higher level in the hierarchy, when cognizing complex abstract concepts, we continue adapting models all our lives, often their states maintain significant degree of vagueness.

(Let us illustrate the above with simple examples. We perceive a concrete chair on the basis of a vague-fuzzy model of a general-chair, containing *fuzzy* notions of a seat, back, and legs. In the moment of perception, this fuzzy model turns into a model of the concrete chair with *concrete* seat, back, and four legs. A more complicated case is understanding, say, that you are in a concert hall. This understanding is based on a fuzzy model that includes a scene, a big room, and many chairs arranged in rows.)

Objective and subjective are involved in cognition and perception at every level in the hierarchy of the mind. Mechanisms of concept-models and their learning-adaptation are inborn, objective, but concrete experiences involved in the process of adaptation are subjective, different among people. Lower in the mind hierarchy, say during perceptions of objects, concrete sensorial signals are determined by objects in the world and therefore have significant degree of objectivity. Higher in the hierarchy, signals are coming from previously recognized concept-models, which have higher degree of subjectivity, more dependent on individual experiences. (Complex relationships between hierarchies of cognition and language are not discussed in this paper, see<sup>7</sup>).

What are the relationships between concepts and basic needs of an organism? (For example, how to explain that a hungry person 'sees food all around?') The basic needs of an organism, e.g. eating, are indicated by *instincts*, which are like internal sensors that generate

signals in the brain neural networks indicating needs. We have dozens of such sensors measuring sugar level in blood, blood pressure, and many other bodily signals essential for survival. Most of these sensors and signals work autonomously, without reaching consciousness. Mechanisms of concept adaptation have been selected by evolution and therefore have to satisfy instincts evolved for survival. Connection of instincts and concepts is accomplished by emotions. In a usual conversation, ‘emotions’ may refer to communications and to special type of behavior: agitation, higher voice pitch, bright eyes. Emotions are also neural signals performing evaluations ‘good-bad’; these evaluations are not according to concepts of good and bad, but direct instinctive evaluations. An emotion evaluates a degree to which a phenomenon (object or situation) satisfies our instinctual needs.

Some emotions originate in ancient parts of the brain, relating us to primates and even to lower animals. *Emotions* are signals in neural pathways that carry information about object values from instinct-related brain areas to perceptual, cognitive, decision-making and behavior-generating areas. Emotions as if ‘color’ perceived concepts with their values for instinct satisfaction.<sup>8</sup> Every instinct generates evaluative emotional signals indicating satisfaction or dissatisfaction of this instinct. Emotional signals affect the process of comparing concept-models to objects around us – the process called *judgment* by Kant<sup>9</sup>. So, instinctual needs affect our perception and cognition through emotions; and model-concepts formed in evolution and culture originally are intended for survival and therefore for instinct satisfaction.

## II. THE KNOWLEDGE INSTINCT AND AESTHETIC EMOTIONS

Imagine for a moment that you cannot see clearly one object from another, do not understand their relations and purpose; sounds merge in noise, where you cannot discern their sources or directions, there are no clear thoughts in consciousness and will is incapable of concentrating in a concrete desire. A human cannot survive in such a horrible state.

An adequate perception of the surrounding world, an understanding of relationships in the world, and an ability to concentrate will are so important for survival, that it usually outweigh other ‘bodily’ needs. Better said, an adequate perception, orientation, understanding, and concentration of will are conditions of satisfaction of bodily instincts. The need for ‘understanding’ is so important that there is an unconditional, inborn mechanism, an *instinct*, driving this need; driving it independently (to some extent) from satisfaction or dissatisfaction of other instincts.

What is the mechanism of this instinct and how do we perceive it in our consciousness?

Perception and cognition is based on available knowledge (models) and consist in adapting inborn and culturally-received models to concrete conditions around us. The faculty of judgment associates an individual object with the general rule, and also adapts, modifies, the concept-models in this process. Knowledge stored in models of the mind has to be brought in correspondence with the world. That is why the instinct driving the mechanism of adaptation is called the *knowledge instinct*. This same instinct makes little kids, cubs, piglets jump around and play fight, their inborn models of behavior must adapt to their body weights, objects, and animals around them long before the instincts of hunger and fear will demand their usage for direct aims of survival<sup>10</sup>. Kiddy behavior just makes the work of the knowledge instinct more observable; to varying degrees, this instinct continues acting all our life. All the time we are bringing our internal models into correspondence with the surrounding world. Psychologists and biologists studied these mechanisms since the 1950s under names of curiosity, cognitive dissonance, need for cognition<sup>11,12,13</sup> (see also discussion in<sup>14</sup>). But the fundamental importance of the knowledge instinct became clear only with the

help of mathematical theories: without the knowledge instinct we will not be able to perceive even simplest objects; every algorithm of pattern recognition or artificial neural network capable of learning uses some mathematical representation of the instinct for knowledge.

How can we understand the nature of emotions corresponding to the knowledge instinct? Are they accessible to consciousness and what do they feel like? Let us return to the beginning of this section and imagine once more a situation of utmost disorientation; objects and their relations are indiscernible, and those that are behave unpredictably: doors cannot be opened, water does not pour, the teeth cannot bite the apple, the will does not concentrate nor direct our actions, and nothing makes sense – a terror takes hold – this is the stuff of thrillers. On the opposite, when surrounding objects and people behave according to the ideal expectations and needs, and actions reach clear aims we feel pleasant harmony, we like it. A correspondence between the inner concept-models and the outer world we feel as harmony. Emotions of pleasure and terror related to satisfaction or dissatisfaction of the knowledge instinct are *aesthetic emotions*. They are related to processes in the mind, not body. Aesthetic emotions are the foundation of our higher spiritual abilities.

### III. THE KNOWLEDGE INSTINCT AND KANTIAN AESTHETICS

Kantian aesthetics is a subject of many discussions in BJA<sup>15,16,17,18,19,20,21</sup> (and many others). I briefly recollect here some well-known ideas of Kant for the purpose of relating them in detail to mathematical theories of the mind. Kant founded aesthetics on his theory of perception and cognition. Kant discovered that our perception and cognition is related to the world of phenomena and not to the outer world of things-in-themselves. Phenomena are created by our mind in the process of interaction with the surrounding world, with things-in-themselves. A specific ability for creating phenomena (Understanding) is based on a priori concepts of our mind: every phenomenon is created on the basis of the corresponding concept. (In the knowledge instinct theory' concepts are described by models). We are capable of orientation in the world due to (and to the extent of) our concepts being adequate or similar (to some extent) to individual objects-in-themselves.

Yet, the concepts and objects are different in their nature. So, how is it possible to establish correspondence between concepts and objects? Kant's answer is that the mind uses a special a priori (inborn) ability, judgment of which (universal) concept corresponds to which (individual) object. Establishing a correspondence from a universal to particular he called determining judgment and from a particular to universal he called reflective judgment. (In the knowledge instinct theory, both abilities are described by specific, closely related mathematical structures, likelihood or mutual information, which measure the correspondence or *similarity* between models and sensory data. Similarity of models to events in the world is a measure of knowledge about the world.) Kant has further demonstrated that the ability for judgment is the foundation for the ability to perceive beauty.

Our reason prescribes *causality* to the world of phenomena, as its fundamental a priori law: in the world of phenomena, one follows another and there is no room for freedom. But in the area of morals governing our will, reason prescribes *freedom*, as a fundamental a priori law of behavior. Everyone considers oneself free, at least, in thought. Freedom and causality seem to be irreconcilable in principle; practically, however, this irreconcilable contradiction is resolved every day by everyone in many minute situations. For example, coming home from an office she eats dinner. She behaves according to the law of causality, according to which the food is needed to support life, and she does it completely free, according to her free subjective choice. The contradiction was reconciled due to the ability of judgment to make a correct choice among many alternatives in correspondence with the general concepts of objects and concepts of behavior. Of course, life is far from being that simple all the time, but

it is important for Kant that such ability for judgment exists in principle.

Kant notes that in the above example a person receives pleasure, which has a dualistic nature: first, a hungry person enjoys eating, and second, a human made a correct choice in a situation. This ‘second’ illustrates the Kant’s discovery: a correspondence between concepts and the world established by judgment ability brings pleasant satisfaction. Kant comes to *the fundamental a priori law governing judgment ability*, it is purposefulness. Judgment ability is *purposeful*. In the knowledge instinct theory, a mathematical formulation of the purpose of judgment is to maximize similarity or knowledge’.

Pleasure brought by judgment ability could appear without satisfaction of ‘lower’ bodily needs related to hunger or fear. Sometimes we enjoy pleasure without expecting any specific benefit. This way, according to Kant, we experience beauty and spiritually sublime. Beauty is *aimless purposiveness* perceived in an object. Spiritually sublime is aimless purposiveness perceived in a will, models of behavior and actions, either, our own, those of other people, or in objects or cultural symbols. ‘Aimless’ means here directed *not* at the satisfaction of ‘lower’ bodily instincts and needs.

In the mathematical theory, ‘pure’ or ‘aimless’ *purposiveness* of judgment is described by the law of maximization of similarity (likelihood, or information), in other words it is equivalent to the drive to *improve the correspondence between concepts (models) and the world*. (Beauty refers to models of understanding, sublime refers to models of behavior). It is definitely not aimless; it is directed at a goal, which is extremely important for survival. However, this goal is not directly aimed at bodily ‘low’ materialistic satisfaction, but to satisfaction of the knowledge instinct. Kant saved no effort in emphasizing that his ‘purposiveness without purpose’ is purposive in the highest spiritual sense (§§1-22). Yet, without a notion of the knowledge instinct the exact meaning of this purposiveness remains unclear<sup>22</sup>, and debates around this central Kantian idea (with much misinterpretations and their rebuttals) have begun since Schiller and continue to this very day<sup>23,24,25</sup>.

After formulating the idea of beauty as purposiveness without purpose, Kant moves on to analytics, deductions, and dialectic, giving a number of examples to clarify his thoughts and explaining why the beauty is both objective and subjective; yet, according to von Hartmann ‘no other thought caused so much difficulty to Kant and turned out so controversial’<sup>26</sup>. And his own thoughts on fine art<sup>27</sup> contradict his fundamental theory of the aesthetic pleasure. The issue of objective and subjective in matters of taste remains an active are of aesthetic theory till this very day.<sup>28</sup>

Pointing out to this complex question of the dialectic of subjective and objective in the beauty, Kant’s system did not resolve it. Insufficiency of the Kantian theory in this regard was extensively discussed on the BJA pages and in other aesthetic publications (see discussion in<sup>29</sup>). The knowledge instinct theory emphasizes the change of the notion of the beautiful in historic change of consciousness as well as in the ontological development of each person. Whereas for Kant, apriority meant unchangeable, in the knowledge instinct theory concept-models are constantly adapting in individual lives as well as in history<sup>30,31</sup>.

#### IV. HIERARCHY OF VALUES AND BEAUTY

Let us repeat that aesthetic emotions in the knowledge instinct theory are related to satisfaction of the knowledge instinct and are experienced independently of other instincts. They are not related directly to hunger or satiation, fear or comfort, sexual procreation. A feel of harmony (between concept-models and the world) is independent, to some extent, from ‘lower’ bodily needs. The aesthetic need is ‘spiritually high’. Harmony is just a first step toward the notion of beauty. According to the knowledge instinct theory, aesthetic emotions are involved in every act of perception or cognition. At lower levels of perception, aesthetic

emotions, the feel of harmony due to understanding of everyday objects around us is usually below the level of conscious awareness. At higher levels in the mind hierarchy we consciously enjoy aesthetic emotions, when we find solutions to complex problems, demanding cognitive efforts, and occupying for a while our minds. At the highest levels of the hierarchy of the mind aesthetic emotions are felt as the emotion of the beautiful.

To understand in details the nature of the beautiful in the knowledge instinct theory, we now analyze models at the top of the mind hierarchy. Near 'the bottom', models of concrete objects are crisper than models of abstract concepts, and as discussed earlier they are more objective. 'Higher up' in the hierarchy models are more abstract, vaguer, and subjective. They are less accessible to consciousness. Their conceptual contents are less separated from their emotional contents.,<sup>32</sup> Higher-level models unify knowledge at lower levels (e.g. models of situations unify knowledge about many concrete objects making up this situation). Models at the top of the mind hierarchy unify the entire knowledge; these unifying models are necessary for concentrating the will and for survival; they are psychologically experienced as the meaning and purpose of life. Nothing in the surrounding world could be directly perceived as life's meaning and purpose; just the opposite, random destructions and deaths are abound, convincing us that there is no such meaning or purpose. Survival however demands concentration of will, which is only possible if one perceives his or her life as meaningful and purposeful. This is why art and religion, since time immemorial, were directed at understanding these highest models, at building these models in our consciousness, despite vicissitudes of life. Whereas aesthetic emotions related to improving these models could sometimes be strong, conceptual contents of these models are vague, the meaning and purpose of life cannot be as crisp and clear as a simple object in front of our eyes. When these models improve, we feel the emotion of the beautiful. This emotion is influenced by the entire life experience, therefore it is subjective. At the same time the mechanisms of the model creation and adaptation are objective. Thus the beautiful is at once objective and subjective.

Sometimes perception of an object could stimulate adaptation of abstract complex models, bringing a deep satisfaction of the instinct for knowledge. This process may continue up the hierarchy, reaching the highest models at the top of the mind hierarchy. Aesthetic emotions in such a case are perceived as a presence of beauty. A flower may seem beautiful, possibly, because a flower is full of biological meaning, it hints to our unconscious about their joint evolution lasting billions of years and it reminds to the unconscious about purpose. The fullness of meaning in a simple object gives us a possibility to feel meaning in nature in general, and in particular, the meaningfulness of our existence. Knowing of the biological function of a flower, procreation, one may conclude that the meaning of a flower is related to a finite goal. However, being a part of the natural evolution, including human, a flower as if sets ajar a possibility of a meaning aimed beyond a concrete aim, what Kant called *purposiveness without purpose*. The beauty of a flower is a perceived possibility of improving ourselves, improving the inner concept-models of our purposiveness toward the aim that is hidden from us as of yet. A flower example illustrates both, a possibility of change of aesthetic criteria and slowness of this process: for a human being who learned botany a flower beauty may lose a part of its mystery (aesthetic fascination may be shifted toward scientific analysis), yet the biological nature of our emotions changes very slow, and flowers will continue bringing us aesthetic joy for thousands of years. Objects of art that we perceive as beautiful remind us of our purposiveness and thus improve the highest models of the meaning. This conclusion is in general agreement with thousands publications in aesthetics since Kant, despite multiple disagreements on various aspects of its interpretation, some of which will be considered later.

Human aesthetic sensitivity could be directed inside self, at inner concepts and intuitions. This is the nature of aesthetic emotion in philosophy and science: harmony is a

correspondence of abstract concept-models (scientific theories) to particular, concrete concept-models which meaning is clarified in this correspondence. E.g., the concept of 'mass' attained an exact meaning in the second law of Newton concerning the relationship between mass, force and acceleration. 'Mass' attained even deeper meaning in the general theory of relativity, which related mass to energy and curvature of space-time. This internal connectedness of phenomena, a meaning that a scientific theory ascribes to nature is perceived by scientists as beauty of a scientific theory. This is why founders of contemporary science, Einstein and Poincare spoke about beauty of a scientific theory as the first criterion of its validity.

In art, creativity has been historically directed predominantly at an outer object, an art object. However, the role of inner object increases, especially beginning from the 19<sup>th</sup> c., the thoughts of an artist or connoisseur stimulated by the work of art are becoming more independent from and of more value than the object of art itself. That is, the aesthetic emotion is directed not at the piece of art, but increasingly at thoughts and feelings of an observer. Despite increased specialization, the nature of creative process brings closer the artist, writer, poet, philosopher, and scientist. According to the knowledge instinct theory beauty of an internal object as well as of an external object in art, philosophy, or science, is a possibility to improve our internal concept-models of meaning of our life and existence that we feel when contemplating an object, idea, or work of art.

## V. DIALECTICS OF AESTHETIC AND ANTI-AESTHETIC IN ART

It is well appreciated that with the evolution of human consciousness enjoying, perceiving, and understanding art concentrates on inner objects, thoughts and experiences of artists and connoisseurs. The art of tragedy cannot be understood in any other way, and the Aristotelian explanation of the catharsis as a mechanism of aesthetic perception of tragedy concentrated on the inner object. Beginning from the 19<sup>th</sup> c. this process has fast accelerated creating tensions, misunderstandings, and arguments about the role of 'non-beautiful' in art. The process of accelerating art toward inner object is neither simple nor straightforward and in the process of developing new expressive means, artists often placed beauty at the backseat, trying first to cope with the basics of the aesthetic perception. This caused much discussion and controversy in aesthetics as the very notions of art and art object came under scrutiny. The complexity of the evolution of art in the 20<sup>th</sup> century brought many to a conclusion that art is impossible to define<sup>33</sup>.

In this section I concentrate on relating the mathematical analysis to several issues currently discussed in theoretical aesthetics. The mathematical theory of the mind touching upon the foundations of aesthetics potentially offers relevant comments to good many current discussions. I limit my comments to the following: the notion of aesthetic attitude and the surrounding discussion of what constitute the specifics of aesthetic; aesthetic attitude, beauty vs. sex; the dynamics of conscious and unconscious in creativity; and the 'anti-aesthetic' in art. Even this limited selection of issues encompasses hundreds of publications making it impossible to comment on all of the aspects of the discussed problems (just to list a few<sup>34,35,36,37,38,39,40,41,42,43,44,45</sup>); my purpose here is not to review these issues, but to attempt establishing an initial relationship between the mathematical theory and aesthetics.

Countering the idea of 'non-definability' of art, and to define art and art perception as a specific type of experience Stolnitz introduced a notion of aesthetic attitude<sup>46</sup>. He emphasized that the attention is selective and directed to achieving specific goals, however, it is never exclusively 'practical' and sometimes directed at the enjoyment of the 'looks or sounds or feels'. And he defined 'the aesthetic attitude as disinterested and sympathetic attention to and contemplation of any object of awareness whatever, for its own sake alone'.

Comparing this definition with the aesthetic emotion as it appears in the knowledge instinct theory, one notices on the one hand, significant affinity (aesthetic emotions being specific and fundamentally different from other emotions, being ‘free’ from immediate bodily practical interests) and on the other, uncertainty and limitation concerning ‘disinterestedness’ and ‘sympathy’. For aesthetic is ‘interested’, but in a higher sense, and not limited to ‘sympathetic’ feelings but open to positive and negative emotions (as well as to complicated superpositions and interactions of ‘positive’ and ‘negative’ at once at different levels of the hierarchy of the mind). These deficiencies of Stolnitz’ definitions are similar to those of Kant. Both Kant and Stolnitz explained in detail what they meant by ‘disinterestedness’, yet concise and clear *positive* definition (what it *is* rather than what it is *not*) was missing because complete scientific understanding did not exist; this left ‘the aesthetic attitude’ open to multiple interpretations similar to those faced by Kant’s theory (e.g. see discussion in<sup>47</sup>).

Discussions of aesthetic attitude are related to complexity of artistic experience in the 20<sup>th</sup> c. and to many debates in aesthetic theory. Considering aesthetic attitude as a form of attention, Dickie concluded that such a notion is self-contradictory and cannot be satisfactorily defined<sup>48</sup>. Dickie’s criticism of aesthetic attitude demonstrates complexity and subtlety of the issues involved. Stolnitz’ identification of aesthetic emotion with a special form of attention is wrong. There are several mechanisms of attention in the mind; all of them are different from emotions in principle. Attention is an amount of the mind resources allocated to a phenomenon (inner perception) based on emotions associated with this phenomenon. Emotions are evaluative signals and the corresponding feelings related to the phenomenon’s ability to satisfy or dissatisfy a specific instinct. And, aesthetic emotions are related to satisfaction or dissatisfaction of the cognitive ability and more specifically the knowledge instinct.

The difference between attention and emotion discussed above might seem subtle, but I am concentrating on analyzing it because it is related to a longstanding fundamental error about the nature of the mind shared by philosophers and mathematicians, and leading to periodic confusions in theoretical aesthetics; the error of considering the mind as a logical system. Its origins can be traced to Plato<sup>49</sup> (even before Aristotle created logic). Aristotle on the one hand founded the science of logic, on the other, he was specific about the mind not working according to logic<sup>50</sup> (his thoughts about the mind are more close to dynamic logic, a mathematical description of the knowledge instinct operations<sup>51</sup>). This subtlety of Aristotelian thoughts was not noticed by mathematicians until recently. Boole<sup>52</sup> and other founders of formal logic, including Frege, Hilbert, and Russell in the 19<sup>th</sup> c. wanted to formalize logic, to eliminate (from logic) the fuzziness of language. This way they hoped to penetrate into the mystery of the mind.<sup>53</sup> The consequences were unexpectedly ‘disastrous’ for logic. The internal contradiction and inconsistency of ‘formal’ or ‘crisp’ logic was proven by Gödel<sup>54</sup>. Logic turned out to be neither as omnipotent nor as ‘logical’ as was expected. It follows that the mind does not work according to logic<sup>55</sup>. Nevertheless, this implication of the Gödel theory was not understood by many philosophers and mathematicians, the erroneous idea of the mind operating as a logical system found its support, among many others, in Wittgenstein, Putnam, and Newell (at least during certain periods in their lives)<sup>56</sup>. Today this idea is discredited among mathematicians due to the fact that more than forty years of attempts to found mathematical intelligence on logic failed. Yet, ‘deification of logic’ and equating mathematics and science with logic is still a powerful myth in collective consciousness of today. When considering the mind as a system operating with logical rules according to the laws of logic, there is no fundamental difference between phenomena, emotions, and attention, all of these are sorts of logical rules, that is concepts. The discussion between Dickie and Stolnitz becomes clearer, when related to the logical conception of the mind that was dominant among mathematicians till the 1970s (under the name ‘Artificial Intelligence’), and among many leading philosophers of the 20<sup>th</sup> c. Thinking of the mind as a

logical system eliminates a distinction between concepts and emotions and inevitably leads to defining the aesthetic according to a concept (that is a rule).

Another aspect of Dickie's criticism was directed at 'disinterestedness' of the aesthetic. Understanding 'disinterestedness' as irrelevancy to real life and human feelings is widespread. Conceptual difficulty in comprehending 'disinterested purposiveness' led some to forget the 'purposiveness' and to emphasize the 'disinterestedness'. Dickie's criticism helped to identify fallacious misunderstandings of this idea, especially when it was directed at the popular notion of 'psychical distancing', which carried the aesthetic from 'disinterestedness' further into the realm of 'irrelevancy' and it is this interpretation that drew his sharpest criticism. The tradition of interpreting Kant's theory of aesthetic, beauty, and 'free play' as enjoyment of art for art's sake, that is irrelevant for 'real life', has a long history descending from Schiller. This discussion continues in Scruton<sup>57</sup>, Guyer<sup>58</sup>, Zangwill<sup>59</sup>, Kemp<sup>60</sup>, Robinson<sup>61</sup> (to mention just a few). The mathematical theory explains 'free play' as the working of the mechanism of the knowledge instinct, which is 'free' in the very specific Kantian sense: free from 'lower' bodily instincts<sup>62</sup>.

An opposite direction of misunderstanding of the 'disinterestedness' is in denying it altogether. Aiken attempted to explain art 'ethologically', similar to other types of instinctive behavior<sup>63</sup>. She asked the relevant question, along the lines of Kantian teleological analysis, 'What purpose has this behavior' for the survival of this species?' Yet, according to a review by O'Hear, her answers relating origins of aesthetic to sex are 'all too clearly... restricted' and represent a 'wasted opportunity' to answer an important question of the biological basis for aesthetic emotion. I would also like to add that the idea that beauty is related to sex is a pervading one. When several years ago at an intermediate stage of my research I was discussing the biological and neural origins of aesthetic emotion with a leading authority in the field of cognitive and neural science, he told me that he was contemplating this problem for many years, but the relationship between beauty and sex confuses the issue and makes this matter impenetrable to scientific analysis<sup>64</sup>. Detailed discussion of relationship between emotions of the beautiful and sex<sup>65</sup> emphasizes different mechanisms involved: the instincts for knowledge and procreation.

A philosophical and psychological analysis of aesthetic experience similar in many respects to the knowledge instinct theory is offered in Carroll<sup>66</sup>. In particular, Carroll examines the role of evolutionary mechanisms as ultimately responsible for our aesthetic ability<sup>67</sup>. This leads to a conclusion that, ultimately, aesthetic ability has specific instrumental (pragmatic) purposes. The knowledge instinct analysis is in agreement with Carroll as far as considering a hierarchical system including individuals (at a lower level) and specie (at a higher level). Aesthetic ability at the lower level serves (in part) a pragmatic goal at the higher level. Nevertheless, this does not deny the fundamental difference between aesthetic and pragmatic at the level of individuals: aesthetic and pragmatic goals 'are implemented' through different mechanisms of the body-mind as discussed above. Another aspect of this issue is that the top levels of the hierarchy of our mind are not subsumed within individual-specie hierarchy; first, this is suggested by what we know about hierarchical organization of our brain: the hierarchy is only approximate, interactions encompassing several levels of the 'hierarchy' are present in the brain; second, this is evident from our ability to formulate and pursue goals beyond the limits of (and contrary to) specie's pragmatic interests.

Let me continue this discussion because some might firmly believe that an evolutionary theory leads to a pragmatic explanation of our aesthetic abilities<sup>68</sup>. First, this is just a belief; it is based on the impressive power of an evolutionary theory, but there is no scientific evidence that evolutionary goals completely explain the aesthetic ability (even if we adhere to a scientific view that we are products of evolution). Second, consider our mathematical ability. Obviously, evolution favors some mathematical ability, say, to catch a rabbit, a hunter needs to be able to anticipate its trajectory. With what accuracy? Probably,

10% (or 0.1) would suffice, well, let us be generous, say 1% (0.01). Therefore, it might be reasonable to conclude that evolution might lead to our ability to predict events in the world of phenomena with accuracy 0.01. But how would one go about explaining our ability to predict measurements in certain physical experiments with accuracy of 0.0000000001 ? There are no scientific explanations for the origins of such ability, nor for the reason why the 'real world' is mathematically predictable with such accuracy. (This is an unresolved mystery of contemporary science. Is this a property of the world, or of our minds? We don't know.) Third, the beautiful involves a choice among 'too many' alternatives; the number of alternatives is much larger than the total number of all elementary particle interactions in the entire life of the Universe., Clearly, no human being can accumulate sufficient experience to make such a choice. Nevertheless we are capable of making these choices. At the top levels of the mind hierarchy we are not satisfied with considering our ultimate goal to be the specie or gene propagation; we are searching for the 'aimless' purpose, not limited by any finite aim. Among the goals of this paper is to come as close as possible today to scientific understanding of the beautiful. It turns out that a part of this understanding is that the ideal of beauty involves mystery<sup>69</sup>. This mystery is related mathematically to a most profound result of the 20<sup>th</sup> c., Gödel theory, and psychologically, to the fact that a significant part of models of the meaning and purpose are and forever will remain unconscious.

In discussing Carroll's paper, Stecker<sup>70</sup> continued the mental experiment with 'Jerome and Charles' by considering them to attend a psychologist lab and to receive subliminally 'evolutionary advantages' similar to what can be derived from observing an artwork but to an even greater degree. After this experiment Charles did not feel a need anymore to look at the painting. Stecker concluded that Charles did not have any aesthetic experience in the first place. This 'mental experiment' is limited to the 'logical' conception of the mind discussed previously. The psychologist lab is very much like our real life experiences. While moving through life, our aesthetic taste does change, and as it evolves, we might enjoy not any longer an artwork that once was a source of genuine aesthetic experience. The knowledge instinct theory suggests that this happens when unconscious contents addressed by the artwork have become fully conscious, and does not any longer improve models of the meaning and purpose. This essentially dynamic nature of the interacting conscious and unconscious explains a seeming contradiction between why on one hand the feeling of beautiful has a quality of 'absoluteness,' and on the other, it changes in one's lifetime and in history of cultures. The 'absoluteness' is due to involvement of *the highest* models the most important for our mind and life, the changeability is due to changes in our consciousness, including the highest models of the meaning during the life experience and in cultural evolution. Interaction between conscious and unconscious is an essential aspect of artistic experience and creativity. This conclusion from the knowledge instinct theory is essentially in agreement with many publications, e.g.<sup>71,72,73</sup>

The role of the anti-aesthetic in art was much discussed and a subject of great controversies. It was at the core of initial difficulties of aesthetic theories in the 20<sup>th</sup> c. related to separating art from non-art and leading to a pessimistic idea of non-definability of art, discussed previously. Reflecting on forty years of the *British Journal of Aesthetics*<sup>74</sup>, Lamarque noted that 'from the mid-1960s, the debate (about what is art) settled broadly into two camps: ...the functions of art, and... procedures under which art was created' and 'away from more traditional emphases' on properties of artwork, 'away from either aesthetic responses or... aesthetic qualities.' While anti-aesthetic was always a part of art (e.g., Goya, Brueghel the Elder, Bosch), the overwhelming influence of the ugly during the 20th c. led to 'a retreat from the aesthetic'. As long as 'beauty' was an essential part of art, the definition of art was not felt as needed. But what is the role of 'ugly' in art? Is it possible that ugly for one is beautiful for others?

How is it possible that disgusting and disharmonious could bring an aesthetic

satisfaction? Upon a little thought, an answer might seem simple: an ugly scene might contain an important moral or political message. Criminal chronicle, for example, is a source of moral sweeteners, satisfying a need for compassion and a need to be convinced once more in the triumph of the moral principle. But wrong would be those seeing in these enjoyments a predominant aesthetic basis. They mostly serve other instincts, not related to improvement of concept-models of the meaning and purpose. A distinction between the aesthetic on the one hand and the moral, political, or other sympathies on the other, were well appreciated within the aesthetic theory (e.g.,<sup>75</sup>), yet, in the anti-aesthetic art of the 20<sup>th</sup> c. there was a clearly perceived (by many) an irreducible remainder of an aesthetic nature, as if an ‘aesthetic ugliness’. But is not it an oxymoron?

A possibility of negative judgments of tastes, in particular, in Kant’s aesthetics, was a subject of intense discussion in this journal and in BJA. In Thomson’s opinion, ugliness cannot be reconciled with morality<sup>76</sup>; opposing arguments were presented by Guyer<sup>77</sup>. Shier<sup>78</sup> again argued that there is no room in Kant’s aesthetic for negative judgments of taste, with opposing arguments by Wenzel<sup>79</sup>. These discussions are closely related to the knowledge instinct theory. Wenzel’s ‘negative purposiveness’ and ‘disharmonious free play,’ it seems, are related to Kant’s notion of ‘free play’, where the word ‘free,’ according to the knowledge instinct theory, on one hand means ‘free’ from ‘lower bodily instincts’ and on the other indicates that Kantian aesthetics missed a clear understanding of the mechanisms involved. A negative judgment of taste, for example, occurs when one sees on a road a cat’s body overrun by a car. A feeling of disgust, of intense aesthetic displeasure is related to this sight because it is disharmonious with our concept-models of meaning. It reminds us that the spiritual meaning and purpose are limited in the material world by chance. Not the cat we pity<sup>80</sup>, but ourselves, the dead cat reminds us of our finiteness in the material world, reminds us about ‘insufficient basis’ for concept-models of meaning and purpose of our life and contributes to destruction rather than improvement of these models. But, how is it possible, that a similarly disgusting sight of destruction can be a source of aesthetic pleasure, when rendered in oil on canvas?

Danto<sup>81</sup>, Levinson<sup>82, 83</sup>, and other authors have discussed the fact that art perception, in principle, is related to the entire art culture and its history. These discussions are closely related to the instinct for knowledge. Improvement of the mind’s models can only go on if there is a perceived imperfection. Therefore, new improved concept-models created by an artist ought to contradict in some degree to previous concepts, and consequently, satisfaction of the knowledge instinct is only possible in a state of broken harmony. Received ideas of ‘theoretical harmony’ should not and cannot dictate artists, which objects to pick and how to render them in artworks; because everyone has one’s own experience, one’s own acquired models, one’s own ‘previous’, and one’s own ‘novel’.

Aesthetic enjoyment of ugly and disharmonious is a complicated feeling related to the tragedy of human existence. A tragedy in a movie, novel, or on a theater stage could deeply move, producing inside us at once a sad and beautiful emotion. Can we understand this emotion, if it is experienced in a purified form, if we consider it separately from a pity or compassion for the protagonist, as a pure aesthetic mixture of sadness or despair and beauty? According to the knowledge instinct theory, the explanation for this complex mixture of feelings is in that we at once perceive inadequacy of our highest models of the meaning and also a possibility of improving them; and only in this combination a satisfaction of the knowledge instinct and therefore experience of beauty is possible.

## VI. CONCLUSION

Will mathematical theories of the mind help to analyze the pressing aesthetic

questions? Would they eventually lead to a ‘rule’ prescribing the norms of beauty? In this paper, I attempted to demonstrate that, in our contemporary view, mathematics of the mind are not limited to logical rules with simple ‘yes’ or ‘no,’ and these mathematics can be useful in the analysis of fundamental issues of philosophy and aesthetics. The ‘refusal’ of mathematics to be bound by crisp logic is essential. For a mathematician, this refusal is a natural result of the Gödel theory that logically proved the inconsistency of crisp logic. As discussed in this paper, fuzzy logic is related to the unconscious. Yet, in the historic development of the mind, the role of crisp conscious logic is ever increasing. We exist in this dialectical paradox between crisp and fuzzy, conscious and unconscious. Growing tensions between these opposites provide the ever-strengthening impetus for the art. This is not necessarily shocking news for a philosophically inclined person, but it is good to know that mathematics does not contradict philosophy; this knowledge may spare efforts that have periodically been devoted to doubts and confusion.

A new understanding gained with the help of mathematics is that beauty is a property of hierarchical adaptive systems, capable of learning and changing. The notion of beauty is determined by the contents of models at the top of the mind’s hierarchy, which are genetically inherited, transferred through culture and language, and improved by individual experience. Therefore a computer, before coming close to the notion of beauty inherent to the human mind, would have to learn and absorb human individual and cultural experience, including tactile, bodily experience and models transferred through culture. A ‘formulae of beauty’, understood as a finite combination of mathematical signs, which meanings are fixed axiomatically, is *impossible*, because beauty is not a finite notion. It involves incomputable complexity, which we experience psychologically as a mysterious depth, infinity of perfecting our internal models of the meaning of life.

The knowledge instinct analysis of the nature of beauty reveals the historical dialectic of the a priori and adaptive, penetrating into the interaction of objective and subjective. It leads to the understanding of the increasing role of rational and conscious in the beautiful in interaction with unconscious and instinctual, as a part of the general historic process of the evolution of the mind and consciousness,<sup>84</sup>. The development of consciousness combining such diverse principles, models of minute objects and of the meaning and purpose of life, subjective and objective, involves striving toward the infinite. It explains the nature of disharmony in the beauty not as ugly and disgusting as such, but as a mechanism of creating new meanings, mechanism of understanding the infinite ‘aimless’ purpose of our existence – improving our internal image of Self.

## REFERENCES

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- <sup>1</sup> In this paper references are used sparingly, especially in the mathematical sections. Virtually every sentence in these sections summarizes extensively published results, some of which were discussed for years in specialized literature, readers interested in mathematical details or in doubt about the validity of given interpretations of mathematics are strongly advised to consult the references (primarily, **Error! Bookmark not defined.**) for detailed discussions and further references.
- <sup>2</sup> A paraphrase from F. Nietzsche, 1872, *The Birth of Tragedy*, tr. F. Golffing, Doubleday, Garden City, NY, 1956.
- <sup>3</sup> L.I.Perlovsky, 2001, *Neural Networks and Intellect*, Oxford Univ. Press, New York, NY
- <sup>4</sup> Perlovsky, L.I. (2006). *Toward Physics of the Mind: Concepts, Emotions, Consciousness, and Symbols*. *Phys. Life Rev.* 3(1), pp.22-55.
- <sup>5</sup> Jung, C.G., 1921, *Psychological Types*. In the *Collected Works*, v.6, Bollingen Series XX, 1971, Princeton University Press, Princeton, NJ.
- <sup>6</sup> Grossberg, S. (1975). *Neural Networks and Natural Intelligence*. MIT Press, Cambridge, MA, 1988.
- <sup>7</sup> Perlovsky, L.I. (2006). *Symbols: Integrated Cognition and Language*. Chapter in *Semiotics and Intelligent Systems Development*. Eds. R. Gudwin, J. Queiroz. Idea Group, Hershey, PA, pp.121-151.
- <sup>8</sup> Grossberg, S. & Levine, D.S., 1987, Neural dynamics of attentionally modulated Pavlovian conditioning: blocking, inter-stimulus interval, and secondary reinforcement. *Psychobiology*, **15**(3), pp.195-240.

- <sup>9</sup> I.Kant, 1790, *The Critique of Judgment*, tr. J.H.Bernard, Prometheus Books, Amherst, NY.
- <sup>10</sup> There is no need here to discuss various neural and biological aspects and manifestations of the learning instinct. I'll just mention that language faculty proposed by Chomsky (N.Chomsky, 1972, *Language and Mind*. Harcourt Brace Javanovich, New York, NY.) implicitly includes an instinct for knowledge of language as well as a priori structures enabling this learning (Chomsky did not separate instinctual, conceptual, and emotional mechanisms).
- <sup>11</sup> Harlow, Harry. 1953. 'Mice, Monkeys, Men, and Motives.' *Psychological Review* 60:23-32.
- <sup>12</sup> Festinger, Leon. 1957. *A Theory of Cognitive Dissonance*. Evanston, IL: Row, Peterson
- <sup>13</sup> Berlyne, D. E. (1960). *Conflict, Arousal, And Curiosity*, McGraw-Hill, New York, NY; Berlyne, D. E. (1973). *Pleasure, Reward, Preference: Their Nature, Determinants, And Role In Behavior*, Academic Press, New York, NY.
- <sup>14</sup> Levine, D.S., Perlovsky, L.I. (2007). *Simplifying Heuristics versus Careful Thinking: Scientific Analysis of Millennial Spiritual Issues*. *Zygon*, in print.
- <sup>15</sup> P. Guyer, *Kant and the Claims of Taste* (2<sup>nd</sup> ed., Cambridge: Cambridge Univ. Press, 1997)
- <sup>16</sup> A. Danto, 1996, *From Aesthetics to Art Criticism and Back*, *JAAC*, 54(2), pp.105-115
- <sup>17</sup> N. Carroll, 2001, *Modernity and the Plasticity of Perception*, *JAAC*, 59(1), pp.11-17.
- <sup>18</sup> Ted Cohen, *Three Problems in Kant's Aesthetics*, *Brit J Aesthetics* 2002 42: 1-12
- <sup>19</sup> Townsend, D. (2003). *Cohen on Kant's Aesthetic Judgments*. *Brit J Aesthetics* 43: 75-79
- <sup>20</sup> Paul Guyer, *The Cognitive Element in Aesthetic Experience: Reply to Matravers*  
*Brit J Aesthetics* 2003 43: 412-418
- <sup>21</sup> A. Rueger and S. Evren, *The Role of Symbolic Presentation in Kant's Theory of Taste*, *Brit J Aesthetics* 2005 45: 229-247
- <sup>22</sup> Kant discusses this limitation of his theory in (§2).
- <sup>23</sup> F.Schiller, in *Essays*, German Library, v. 17, ed. W. Hinderer and D.Dahlstrom, Continuum Pub Group, 1993.
- <sup>24</sup> H. Spencer, in *Essays*, Scientific, Political and Speculative, Williams & Norgate, London, 1891. J.M.Guyau, 1884, *Les problemes d'esthetique contemporaine*.
- <sup>25</sup> L.I.Perlovsky, 2000, *Mathematics and Beauty*, *Zvezda*, 8, pp.190-201, St. Petersburg (Russian).
- <sup>26</sup> E.v.Harmann, in V.Soloviov, *Aesthetics*, *Encyclopedic Dictionary*, ed. F.Brokhause & I.Efron, St.Peterburg, Russia, 1904 (Russian).
- <sup>27</sup> §51-54
- <sup>28</sup> Budd, M. (2007). *The Intersubjective Validity of Aesthetic Judgements*, *Brit J Aesthetics*, 47: 333-371.
- <sup>29</sup> Perlovsky, L.I., 2002, *Aesthetics and Mathematical Theory of Intellect*, *Iskusstvoznanie*, *Journal of History and Theory of Art*, 2, pp.558-594 (Russian), Russian Academy of Sciences, Moscow.
- <sup>30</sup> Perlovsky, L.I., 1998, *Computational Complexity and the Origin of Universals*. Proc. World Congress on Philosophy, Boston, MA.
- <sup>31</sup> Absence of dynamics in Kantian theory is almost unnoticed, among exceptions is N.Carroll, 2001, *Modernity and the Plasticity of Perception*, *JAAC*, 59(1), pp.11-17.
- <sup>32</sup> Perlovsky, L.I. (2006). *Modeling Field Theory of Higher Cognitive Functions*. Chapter in *Artificial Cognition Systems*, Eds. A. Loula, R. Gudwin, J. Queiroz. Idea Group, Hershey, PA, pp.64-105.
- <sup>33</sup> M.Weitz, 1956, *The Role of Theory in Aesthetics*, *JAAC*, 15, pp.27-33.
- <sup>34</sup> B. Gaut, 'Art' as a Cluster Concept, in Noël Carroll (ed.), *Theories of Art Today* (Madison: University of Wisconsin Press, 2000), pp. 25-44
- <sup>35</sup> M. Budd, *The Pure Judgment of Taste as an Aesthetic Reflective Judgment*, *Brit J Aesthetics* 2001 41: 247-260
- <sup>36</sup> N. Carroll, *Aesthetic Experience Revisited*, *Brit J Aesthetics* 2002 42: 145-168
- <sup>37</sup> J. Levinson, *The Irreducible Historicity of the Concept of Art*, *Brit J Aesthetics* 2002 42: 367-379
- <sup>38</sup> D. Matravers, *The Aesthetic Experience*, *Brit J Aesthetics* 2003 43: 158-174
- <sup>39</sup> P. Livingston, *On an Apparent Truism in Aesthetics*, *Brit J Aesthetics* 2003 43: 260-278
- <sup>40</sup> G. Dickie, *Reading Sibley*, *Brit J Aesthetics* 2004 44: 408-412
- <sup>41</sup> S. Davies, *The Cluster Theory Of Art*, *Brit J Aesthetics* 2004 44: 297-300
- <sup>42</sup> B. Gaut, *The Cluster Account of Art Defended*, *Brit J Aesthetics* 2005 45: 273-288
- <sup>43</sup> N. Carroll, *Ethics and Aesthetics: Replies to Dickie, Stecker, and Livingston*, *Brit J Aesthetics* 2006 46: 82-95
- <sup>44</sup> D. Matravers, *Institutional Definitions And Reasons*, *The British Journal Of Aesthetics* 2007 47(3):251-257
- <sup>45</sup> R. Scruton, *In Search of the Aesthetic*, *The British Journal of Aesthetics* 2007 47(3):232-250
- <sup>46</sup> J. Stolnitz, 1960, *The Aesthetic Attitude*, In Ph. Alperson, ed. *The Philosophy of the Visual Art*, Oxford. Univ. Press, NY, 1992
- <sup>47</sup> A. Danto, 1996, *From Aesthetics to Art Criticism and Back*, *JAAC*, 54(2), pp.105-115.

- <sup>48</sup> G. Dickie, 1964, *The Myth of the Aesthetic Attitude*, In Ph. Alpers, ed. *The Philosophy of the Visual Art*, Oxford. Univ. Press, NY, 1992
- <sup>49</sup> Plato. (IV BC). *Parmenides*. Trans. in Plato, L. Cooper. Oxford University Press, New York, NY.
- <sup>50</sup> Aristotle, (IV BC). *Metaphysics*. In the Complete Works of Aristotle, Ed.J.Barnes, Bollingen Series, 1995, Princeton, NJ.
- <sup>51</sup> Perlovsky, L.I. (1996g). *Fuzzy Logic of Aristotelian Forms*. Proceedings of the Conference on Intelligent Systems and Semiotics '96. Gaithersburg, MD, v.1, pp. 43-48.; also see Perlovsky 2001.
- <sup>52</sup> G. Boole, 1847, *The Mathematical Analysis of Logic*, St. Augustine Press, 1998.
- <sup>53</sup> Hilbert, D. (1928). *The Foundations of Mathematics*. In J. van Heijenoort, Ed., *From Frege to Gödel*. Cambridge, MA: Harvard University Press, 1967, p.475.
- <sup>54</sup> K. Gödel, 1986, *Kurt Gödel collected works*, ed. S.Feferman et al, Oxford University Press.
- <sup>55</sup> Perlovsky, L.I., 1996, *Gödel Theorem and Semiotics*. Proc. Conf. Intelligent Systems and Semiotics '96. Gaithersburg, MD, v.2, pp. 14-18; also see.
- <sup>56</sup> L. Wittgenstein, 1921, *Tractatus Logico Philosophicus*, Routledge, 1981; H. Putnam, 1988, *Representation and Reality*, MIT Press, Cambridge, MA; A. Newell is one of the founders of 'Artificial Intelligence', a direction in mathematics of mind dominant among mathematicians from the 1950s till 1980s (A.Newell, 1983, *Intellectual issues in the history of artificial intelligence*, in *The Study of Information*, ed. F. Machlup & U. Mansfield, J. Wiley, New York, NY).
- <sup>57</sup> R. Scruton, 1974, *Art and Imagination*, Routledge, London.
- <sup>58</sup> P. Guyer, 1997, *Kant and the Claims of Taste*, Cambridge U.P., Cambridge.
- <sup>59</sup> N. Zangwill, 1995, *Kant on Pleasure in the Agreeable*, JAAC, **53**(2); 1995, *Groundrules in the Philosophy of Art*, *Philosophy*, **70**.
- <sup>60</sup> G.Kemp, 1999, *The Aesthetic Attitude*, BJA, 39(4), pp.392-399.
- <sup>61</sup> J. Robinson, 2004, *The Art of Distancing: How Formal Devices Manage Our Emotional Responses to Literature*, JAAC, 62(2) 153-162
- <sup>62</sup> This paper is bound to be controversial enough without 'taking on' the romantic ideal; that discussion has to be postponed until a separate paper. Similarly an important discussion of aesthetic vs. moral, which is a third point of Dickie's analysis, is to a significant extent omitted from this paper (relationships between mathematical theories of the mind, the romantic ideal, aesthetics, and ethics was touched upon in).
- <sup>63</sup> N. Aiken, 1998, *The Biological Origins of Art*, Praeger. See also A.O'Hear review in BJA, **40**(3), pp.390-391, 2000.
- <sup>64</sup> A private discussion.
- <sup>65</sup> Mayorga, R., Perlovsky, L.I., Eds. (2007). *Sapient Systems*. Springer, London, UK
- <sup>66</sup> N. Carroll, 2000, *Art and the Domain of the Aesthetic*, BJA, **40**(2), pp.191-208
- <sup>67</sup> Kant came close to this idea (§§65, 80, 83).
- <sup>68</sup> R. Dawkins, *The Selfish Gene*, Oxford University Press, 1976, Oxford, GB
- <sup>69</sup> N. Chomsky, professor at MIT drew a line between the two types of problems: scientific problems that might be difficult, still we know where to start looking for a solution, and 'mysteries,' which we do not know where even to begin. Kant analyzing beauty also came with a similar conclusion (§§65, 80, 83).
- <sup>70</sup> R. Stecker, 2001, *Only Jerome: a Reply to Noël Carroll*, BJA, **41**(1), pp.76-80.
- <sup>71</sup> R. Arnhem, 2001, *What it Means to be Creative*, BJA, **41**(1), pp.24-25.
- <sup>72</sup> Jung, C.G. (1934). *Archetypes of the Collective Unconscious*. In the *Collected Works*, v.9,II, Bollingen Series XX, 1969, Princeton University Press, Princeton, NJ.
- <sup>73</sup> Ph. Alpers, *The Philosophy of the Visual Art*, Oxford. Univ. Press, NY, 1992, pp.58-59.
- <sup>74</sup> P. Lamarque, 2000, *The British Journal of Aesthetics: Forty Years On*, BJA, **40**(1), pp.1-20.
- <sup>75</sup> M. Devereaux (2004) *Moral Judgments and Works of Art: The Case of Narrative Literature*, *Journal of Aesthetics and Art Criticism* **62** (1), 3–11
- <sup>76</sup> G. Thomson, 1992, *Kant's problem with ugliness*, JAAC, **50**(2), pp.107-115.
- <sup>77</sup> P. Guyer, 1992, *Thomson's Problem with Kant: A Comment on 'Kant's Problems with Ugliness'*, JAAC, **50**(4), pp.317-319.
- <sup>78</sup> D. Shier, 1998, *Why Kant Finds Nothing Ugly*, BJA, **38**(4), pp.412-418.
- <sup>79</sup> C. Wenzel, 1999, *Kant Finds Nothing Ugly?*, BJA, **39**(4), pp.416-422.
- <sup>80</sup> I am not suggesting that pitying the cat is bad or wrong, I am emphasizing a deeper nature of the feeling of pity.
- <sup>81</sup> A. Danto, 1964, *The Artworld*, in Ph. Alpers, ed., *The Philosophy of the Visual Art*, Oxford. Univ. Press, NY, 1992
- <sup>82</sup> J. Levinson, 1989, *Refining Art Historically*, JAAC, **47**(1), pp.21-33
- <sup>83</sup> J. Levinson, *The Irreducible Historicity of the Concept of Art*, *Brit J Aesthetics* 2002 42: 367-379

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<sup>84</sup> Perlovsky, L.I. (2007). Neural Dynamic Logic of Consciousness: the Knowledge Instinct. Chapter in Neurodynamics of Higher-Level Cognition and Consciousness, Eds. Perlovsky, L.I., Kozma, R. ISBN 978-3-540-73266-2, Springer Verlag, Heidelberg, Germany.