Cognitive algorithms: dynamic logic, working of the mind, evolution of consciousness and cultures

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ABSTRACT

The paper discusses evolution of consciousness driven by the knowledge instinct, a fundamental mechanism of the mind which determines its higher cognitive functions. Dynamic logic mathematically describes the knowledge instinct. It overcomes past mathematical difficulties encountered in modeling intelligence and relates it to mechanisms of concepts, emotions, instincts, consciousness and unconscious. The two main aspects of the knowledge instinct are differentiation and synthesis. Differentiation is driven by dynamic logic and proceeds from vague and unconscious states to more crisp and conscious states, from less knowledge to more knowledge at each hierarchical level of the mind. Synthesis is driven by dynamic logic operating in a hierarchical organization of the mind; it strives to achieve unity and meaning of knowledge: every concept finds its deeper and more general meaning at a higher level. These mechanisms are in complex relationship of symbiosis and opposition, which leads to complex dynamics of evolution of consciousness and cultures. Modeling this dynamics in a population leads to predictions for the evolution of consciousness, and cultures. Cultural predictive models can be compared to experimental data and used for improvement of human conditions. We discuss existing evidence and future research directions.

Keywords: dynamic logic, knowledge instinct, neural modeling fields, mind, differentiation, synthesis, evolution, consciousness, cultures

1. THE KNOWLEDGE INSTINCT

To satisfy any instinctual need—for food, survival, and procreation—first and foremost we need to understand what's going on around us. The knowledge instinct is an inborn mechanism in our minds, an instinctual drive for cognition which compels us to constantly improve our knowledge of the world. Biologists and psychologists have discussed various aspects of this behavior: the drive for stimulation, [1]; curiosity [2]; cognitive dissonance [3]. Until recently, however, this was not mentioned among 'basic instincts' on a par with instincts for food and procreation.

The fundamental nature of this mechanism became clear during mathematical modeling of workings of the mind. We don't usually see exactly the same objects as in the past: angles, illumination, and surrounding contexts are usually different. Therefore, our knowledge, internal representations always have to be modified [4,5,6]. In fact virtually all learning and adaptive algorithms (tens of thousands of publications) maximize correspondence between the algorithm internal structure (knowledge in a wide sense) and objects of recognition. Without adaptation of internal models we would not be able to understand the world. We would not be able to orient ourselves or satisfy any of the bodily needs. Therefore, we have an inborn need, a drive, an instinct to improve our knowledge, and we call it *the knowledge instinct*. It is a foundation of our higher cognitive abilities, and it defines the evolution of consciousness and cultures.

2. MECHANISMS OF THE MIND

2.1 Neural modeling fields and dynamic logic

The basic mind mechanisms making up operations of the knowledge instinct were described mathematically in [9]. Here we give a brief summary. Among the mind's cognitive mechanisms, the most directly accessible to consciousness are

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concepts. Concepts are like internal models of the objects and situations in the world. Concepts satisfy the basic instincts, which have emerged as survival mechanisms long before concepts. Instincts are like internal sensors indicating the basic needs (Grossberg & Levine, 1987; Perlovsky 2006). For example, when a sugar level in blood goes below a certain level an instinct "tells us" to eat. Instincts are connected to cognition and behavior by emotions. Whereas in colloquial usage, emotions are often understood as facial expressions, higher voice pitch, exaggerated gesticulation, these are outward signs of emotions, serving for communication. A more fundamental role of emotions within the mind system is that emotional signals evaluate concepts for the purpose of instinct satisfaction. Emotional mechanisms of higher cognitive functions are related to satisfaction of the knowledge instinct. These emotions are not directly related to bodily needs, they are 'spiritual' emotions. We perceive them as harmony-disharmony between our knowledge and the world According to Kant [7] these are aesthetic emotions. In everyday life we usually do not notice them. Aesthetic emotions become noticeable at higher cognitive levels in the mind hierarchy, when cognition is not automatic, but requires conscious effort.

A neural architecture that mathematically implements these mechanisms of the mind is called Neural Modeling Fields (NMF) [8,9]. It is heterarchical architecture, accounting for an imperfect hierarchy of the mind. At each level, output signals are concepts recognized in (or formed from) input signals. Input signals are associated with (or recognized, or grouped into) concepts according to the models and the knowledge instinct at this level. This general structure of NMF corresponds to our knowledge of neural structures in the brain. Mathematically, the knowledge instinct drives learning by maximizing a similarity measure between models and signals. NMF maximizes the similarity, while avoiding combinatorial complexity (exponential explosion) of previous approaches, by using dynamic logic [10,11,12,9]. Overcoming combinatorial complexity enabled significant improvement of algorithmic performance in classical areas of detection, tracking, and fusion in clutter; in terms of signals-to clutter ratio performance was improved by up to 100 times [11, 13, 14]. An important aspect of dynamic logic is matching vagueness or fuzziness of the similarity measure to the uncertainty of models. Initially, parameter values of concept-models are not known, and uncertainty of models is high; so is the fuzziness of the similarity measures. In the process of learning, models become more accurate, and the similarity measure more crisp, the value of the similarity increases. This is the mechanism of dynamic logic.

2.2 Conscious, Unconscious, and Differentiation

Dynamic logic satisfies the knowledge instinct and improves knowledge by evolving vague, uncertain models toward crisp models, which maximize similarity between models and data. Vague and uncertain models are less accessible to consciousness, whereas crisp and concrete models are more conscious [4, 9, 15, 16, 17].

In the process of evolution, sensory abilities emerged together with perception abilities. The original state of consciousness is undifferentiated unity. Development proceeded through the differentiation of psychic content into multiple concept-models, emotions, etc. Differentiation of consciousness began millions of years ago. It accelerated tremendously in our recent past, and still continues today [18, 15, 19]. In pre-scientific literature about mechanisms of the mind there was a popular idea of homunculus, that is, a little mind inside our mind which perceived our perceptions and made them available to our mind. This naive view is amazingly close to the actual scientific explanation. The fundamental difference is that the scientific explanation does not need an infinite chain of homunculi inside homunculi. Instead, there is a hierarchy of the mind models with their conscious and unconscious aspects. The conscious differentiated aspect of the models decreases at higher levels in the hierarchy, they are more uncertain and fuzzy. At the top of the hierarchy there are mostly unconscious models of the meaning of our existence (which we discuss later)

Our internal perceptions of consciousness is due to Ego-model, which 'perceives' crisp conscious parts of other models, in the same way that models of perception 'perceive' objects in the world [9]. Freud denoted a certain complex of psychological functions Ego. Jung considered Ego to be based on a more general model or archetype of Self. Jungian archetypes are psychic structures (models) of a primordial origin, which are mostly inaccessible to consciousness, but determine the structure of our psyche. In this way, archetypes are similar to other models, e.g., receptive fields of the retina are not consciously perceived, but determine the structure of visual perception. According to Jung, conscious concepts of the mind are learned on the basis of inborn unconscious psychic structures, archetypes, [15]. The origin of internal representations-concepts is from two sources, inborn archetypes and culturally created models transmitted by language [**Error! Bookmark not defined.**]. Dynamic logic operating at a single hierarchical level of the mind evolves

vague and unconscious models-concepts into more crisp and conscious. Psychologically this process was called by Carl Jung *differentiation* of psychic content [15].

2.3 Hierarchy and Synthesis

The result of dynamic logic operations at a given hierarchical level are activated models, or concepts recognized in the input signals. The activated models initiate can serve as input signals to the next processing level, where more general concept-models are recognized or created. Within the hierarchy of the mind, each concept-model finds its mental meaning and purpose at a higher level. For example, consider a concept-model "chair." It has a "behavioral" purpose of initiating sitting behavior, this is the "bodily" purpose at the same hierarchical level. In addition, "chair" has a "purely mental" purpose at a higher level in the hierarchy, a purpose of helping to recognize a more general concept, say of a "concert hall," which model contains rows of chairs.

Models at higher levels in the hierarchy are more general than models at lower levels. At the very bottom of the hierarchy visual models correspond to retinal ganglion cells; they detect simple features in the visual field. At higher levels, models detect more complex features such as contrast edges, their directions, elementary moves, etc. [4,20]. At still higher cognitive levels, models correspond to objects, to relationships among objects, to situations, and relationships among situations, etc. [8,9]. At still higher levels, even more general models reside, corresponding to complex cultural notions and relationships such as family, love, friendship, and abstract concepts such as law, rationality, etc. According to Kantian analysis [21], at the top of the hierarchy of the mind are models of the meaning and purpose of our existence, unifying our knowledge, and the corresponding behavioral models aimed at achieving this meaning.

Models at a higher level act as "eyes" perceiving the models at a lower level. Each higher level in the hierarchy is the "mind of a homunculus" perceiving the meaning of what was recognized at a lower level. As mentioned, this does not lead to an infinite regress, because higher level models are more general, more uncertain, and more vague and fuzzy. Let us note that in the mind hierarchical structure concept-models at the bottom level correspond to objects directly perceived in the world. These models are "grounded" in "real" objects existing in the surrounding world. This is not true for concept-models at higher levels of the hierarchy. These more abstract and more general models are cultural constructs (to some extent). They cannot be perceived directly in the surrounding world (e.g., concept-models of "rationality," or "meaning and purpose of life"). These concepts cannot just emerge in the mind on their own as some useful combination of simpler concepts. Because there is a huge number of combinations of simpler concepts and an individual human being does not have enough time in his or her life to accumulate enough experiential evidence to verify the usefulness of these combinations. These higher level concepts accumulate in cultures due to languages. The study of mechanisms relating language concepts to concept-models of cognition have just begun [9,**Error! Bookmark not defined.**,19,22,23].

The hierarchical structure of the mind is related to the knowledge instinct. Neural and mathematical mechanisms connecting these two are still a matter of research [9,**Error! Bookmark not defined.**,19,22]. Here we outline some basic principles of the knowledge instinct operation in the mind hierarchy. Previous section described the mechanism of differentiation, creating diverse and detailed models, acting at a single level of the hierarchy. We discussed that models acquired deeper meanings and purposes at higher hierarchical levels. The knowledge instinct acting at higher levels and aesthetic emotions at higher levels are perceived more consciously then at lower levels. We enjoy solving complex problems that required a lot of time and effort. This emotional feel of harmony from improving-creating high level concept-models is related to the fact that high level concepts unify many lower level concepts and increase the overall meaning and purpose of our diverse knowledge. Jung called this synthesis, which he emphasized is essential for psychological well being.

Synthesis, the feel of overall meaning and purpose of knowledge, is related to the meaning and purpose of life, which we perceive at the highest levels of the hierarchy of the mind. Dynamic logic differentiates these models so that they correspond to already differentiated models at lower levels. Yet, the demand for unity of knowledge results in creating a higher level model, unifying knowledge at the expense of differentiation. Therefore, models at highest levels are intrinsically vague and undifferentiated, not only in terms of their conceptual content, but also in terms of differentiation of conceptual and emotional. At the highest levels of the mind the two are not quite separable. This inseparability, which we sometimes feel as a meaning and purpose of our existence, is important for evolution and survival. If the hierarchy of

knowledge does not support this feel, the entire hierarchy would crumble, which was an important (or possibly the most important) mechanism of destruction of old civilizations. The knowledge instinct demands satisfaction at the lowest levels of understanding concrete objects around, and also at the highest levels of the mind hierarchy, understanding of the entire knowledge in its unity, which we feel as meaning and purpose of our existence. This is the other side of the knowledge instinct, a mechanism of *synthesis* [15].

3. EVOLUTION OF CONSCIOUSNESS AND CULTURES

3.1 Differentiation and synthesis

Estimating a large number of models from limited data is difficult and unreliable. Since individual minds have limited experience, a finite number of concept-models are sufficient to satisfy the knowledge instinct. Psychologically, the average emotional investment in each concept decreases with an increase in the number of concepts, and a drive for differentiation and more knowledge subsides. Emotional investment in a concept is a measure of the meaning and purpose of this concept within the mind system, that is, a measure of synthesis. Thus, the drive for differentiation requires synthesis.

At each level of the mind hierarchy some concepts are used more often than others, they acquire multiple meanings, which is opposite to differentiation. These more general concepts "move" to higher levels and are invested with more emotions. This creates synthesis. Another aspect of synthesis involves language. Its integration with cognition involves synthesis of emotional and conceptual contents of psyche [**Error! Bookmark not defined.**]. Higher level concepts are more general, vaguer and less differentiated. They are less conscious (remind, more differentiation leads to more conscious content). Also, their conceptual and emotional contents are less differentiated [9]. Therefore, synthesis connects language and cognition, concepts and emotions, conscious and unconscious. Synthesis is opposite of differentiation; we all have high-value concepts (related to family life, or to political cause, or to religion) which are so important to us and so emotional, that we cannot "coldly analyze," cannot differentiate them. "Too high" level of synthesis invests concepts with "too much" emotional-value contents, so that differentiation is stifled.

To summarize, differentiation and synthesis are in complex relationships, at once symbiotic and antagonistic. Synthesis leads to spiritual inspiration, to active creative behavior leading to fast differentiation, to creation of knowledge, to science and technology. At the same time, "too" high level of synthesis stifles differentiation. Synthesis is related to hierarchical structure of knowledge and values. At the same time, high level of differentiation discounts psychological emotional values of individual concepts, and destroys synthesis, which was the basis for differentiation. The next section develops mathematical evolutionary model of interacting differentiation and synthesis.

3.2 Evolutionary models

Differentiation and synthesis are processes leading to measurable quantities: differentiation, D, can be characterized by the number of often used words and phrases in language, and synthesis, S, by strength of emotions associated with various concepts [24]. Below we develop evolutionary models for these measures averaged over population. Results of this modeling can be used in sociological cultural studies to understand past, present, and future of cultures, emerging cultural phenomena, and to improve current and future models.

When considered alone, separate from other mechanisms discussed above, differentiation involves developing new, more detailed models from the old ones, and therefore the speed of differentiation is proportional to accumulated knowledge, $dD/dt = aD$, a is a constant. Solution of this equation, describes exponential growth of knowledge, $D(t) = D_0 \exp(at)$. R. Kurzweil uses this kind of equation to predict coming singularity of human evolution [25]. However, from time to time, growth in knowledge and conceptual diversity in all societies was interrupted; cultures disintegrated or stagnated. This is true in all known cultures, e.g., Western culture disintegrated and stagnated during the Middle Ages. Whereas disintegration of Roman Empire was attributed to barbarians or lead poisoning [26], here we model spiritual mechanisms related to the working of the minds. We have to account for the effect of synthesis.

According to the previous analysis, influence of synthesis on speed of differentiation is not linear. In moderate amount synthesis inspires creativity and stimulates differentiation. But, "too much" emotional value invested in every concept, stifles differentiation; it makes concepts "stable" and difficult to modify or differentiate. We account for this by modifying the above incomplete equation as follows, $dD/dt = a\ D\ G(S),\ G(S) = (S - S_0)\ exp(-(S-S_0)/ S_1);$ function G first grows, then declines. We also need to account for evolution of synthesis. With growth of differentiation, emotional value of every individual concept diminishes; we also have to account for hierarchical synthesis: $dS/dt = -bD + dH$ (b and d are constants, and H, is the number of hierarchical levels, on average in the minds of the population). Expanding knowledge in long term leads to expanding hierarchical levels. Growth of hierarchy involves differentiation of models at the highest level, concepts of the meaning and purpose of life. These are related to theological and religious concepts of the Highest. Changes in these concepts involve changes of religion, such as from Catholicism to Reformation; they involve national upheavals and wars, and they do not proceed smoothly. Here we smooth over time these complex processes and consider slow expansion of the hierarchy, which might characterize average evolution over the long term, $H(t) = H_0 + e*t$. Combining these equations, we obtain

$$dD/dt = a\ D\ G(S), \quad G(S) = (S - S_0)\ \exp(-(S-S_0)/ S_1) \tag{7}$$
$$dS/dt = -b\ D + d\ H \tag{8}$$
$$H(t) = H_0, \text{ or } H(t) = H_0 + e*t. \tag{9}$$

Solutions to these equations, at moderate levels of synthesis, are oscillating and growing, Fig. 1. This and following figures are only preliminary qualitative indications of the important effects, because we do not know actual values of the equation parameters. These should be measured in future experimental studies.

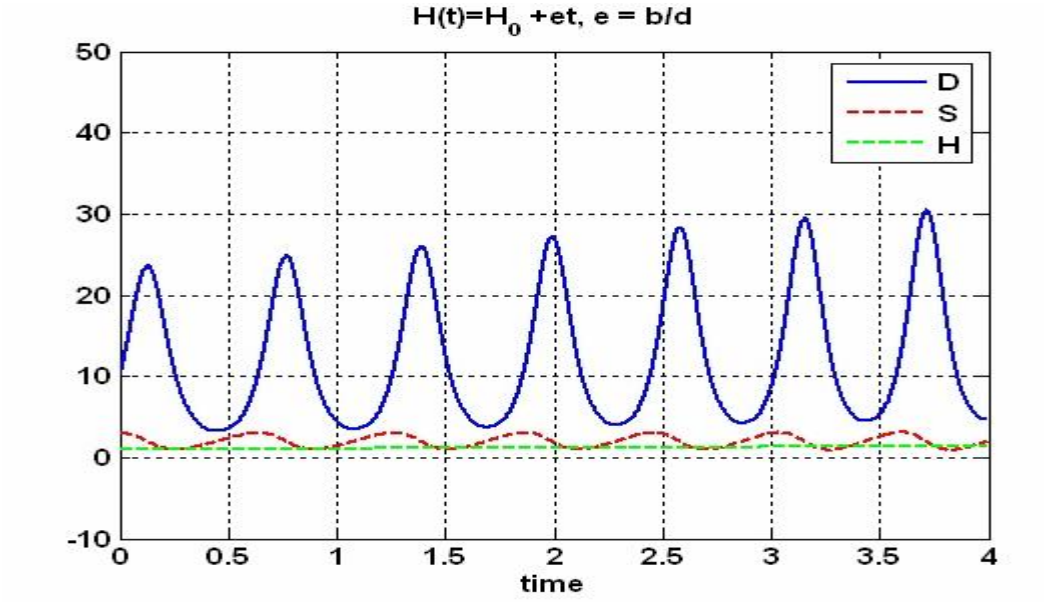

Fig. 1. Moderate values of synthesis lead to oscillating and growing differentiation and synthesis (eqs. 7, 8, 9, with parameter values a = 10, b = 1, d = 10, S_0=2, S_1=10, H_0 = 1, and initial values D(t=0) = 10, S(t=0) = 3). A unit of time here could be decades, or centuries or longer. Periods of growth and knowledge accumulation are followed by collapse and destruction. In long time knowledge is slowly accumulated, corresponding to slowly growing hierarchy, e = 0.1.

Another type solution possible here involves high level of synthesis, with stagnating differentiation. If $dH > bD$, according to (8), synthesis grows; differentiation levels off, whereas synthesis continue growing. This leads to more and more stable society with high synthesis, high emotional values attached to every concept, while knowledge accumulation stops, Fig. 2.

Cultural psychologists and historians might find examples of stagnating internally stable societies. Candidates are Ancient Egypt and contemporary Arab Moslem societies. Presently, these are only suggestions for future studies. Levels of differentiation, synthesis, and hierarchy can be measured by scientific means; these data should be compared to the model. This would lead to model improvement, to developing more detailed models, including simulations of large societies of interacting agents, involving the mind subsystems of cognition and language [27]. This will help better understanding existing cultural differences in the world and lead to less confrontations and more harmonious coexistence.

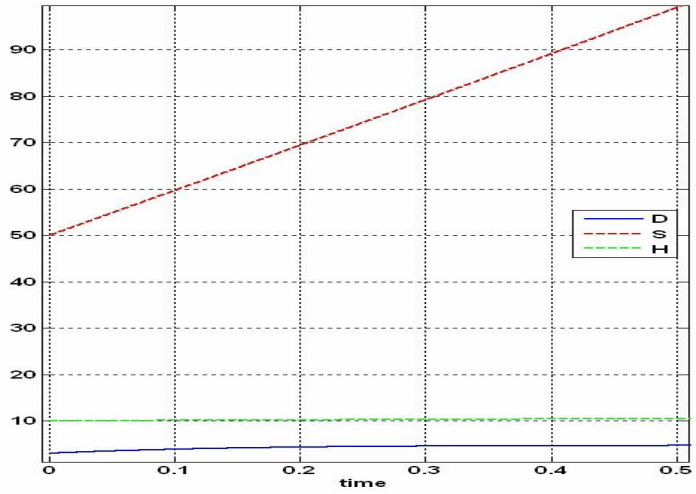

Fig. 2. Highly stable, stagnating society with growing synthesis. High emotional values are attached to every concept, while knowledge accumulation stops; parameter values: D(t=0)= 3, H_0 = 10, S(t=0) = 50, S_0 = 1, S_1 = 10, a = 10, b = 1, d = 10, e=1.

3.3 Interacting cultures

Let us now study the interaction of cultures having different levels of differentiation and synthesis. Both are populations of agents characterized by NMF-minds and evolutionary eqs. (21, 22, 23). Culture k=1 is characterized by parameters leading to oscillating, potentially fast growing, differentiation and a medium oscillating level of synthesis ("dynamic" culture). Culture k=2 is characterized by slow growing, or stagnating, differentiation and high synthesis ("traditional" culture). In addition, there is a slow exchange by differentiation and synthesis among these two cultures (examples: the US and Mexico (or in general, immigrants to the US from more traditional societies); or academic-media culture within the US and "the rest" of the population). Evolutionary equations modified to account for the inflow and outflow of differentiation and synthesis can be written as

$$dD_k/dt = a_k D_k G(S_k) + x_k D_{\underline{k}} \quad (25)$$
$$dS_k/dt = -b_k D_k + d_k H_k + y_k S_{\underline{k}} \quad (26)$$
$$H_k = H_{0k} + e_k * t \quad (27)$$

Here, the index $\underline{k}$ denotes the opposite culture, i.e., for k=1, $\underline{k}$ = 2, and v.v. Fig. 3 illustrates sample solutions to these equations.

In Fig. 3 the evolution started with two interacting cultures, one traditional and another dynamic. Due to exchange of differentiation and synthesis among cultures, traditional culture acquires differentiation, losses much of its synthesis and becomes a dynamic culture (by about t = 2.5). Although, parameters determining exchange of differentiation and synthesis are symmetrical in two directions among cultures, it is interesting to note that the traditional culture does not "stabilize" the dynamic one, the effect is mainly one-directional: traditional culture acquires differentiated knowledge and dynamics. Social psychologists can judge experimentally if the beginning of this plot (t < 2.5) represents

contemporary influence of American culture on the traditional societies. Wild swings of differentiation and synthesis subside only after t > 5, when both cultures acquire similar level of differentiated knowledge.

In long run (t > 5) cultures stabilize each other and swings of differentiation and synthesis subside while knowledge accumulation continues. Note, that in this example hierarchies were maintained at different levels. Is this representative of Catholic and Protestant communities coexisting with approximately equal levels of differentiation and synthesis, but different hierarchies? This is a question for social psychologists. We would like to emphasize that co-existence of different cultures is beneficial in long run: both communities evolve with more stability. Possibly stabilization along with expanding knowledge beyond t > 5 represent effect of multiculturalism and explain vigor of contemporary American society?

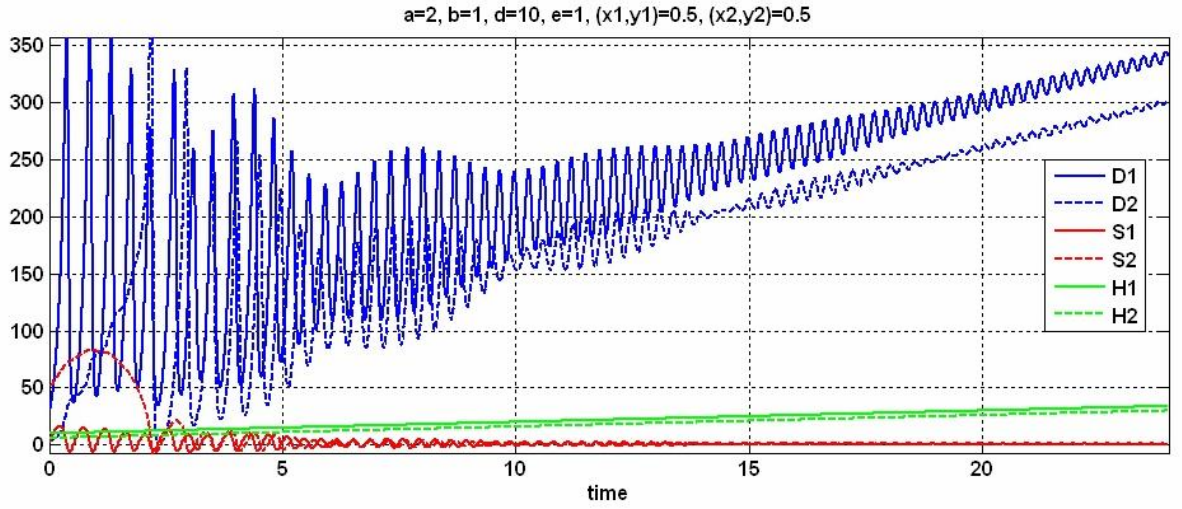

Fig. 3. Effects of cultural exchange (k=1, solid lines: D(t=0)= 30, H_0 = 12, S(t=0) = 2, S_0 = 1, S_1 = 10, a = 2, b = 1, d = 10, e=1, x = 0.5, y = 0.5; k=2, dotted lines: D(t=0)= 3, H_0 = 10, S(t=0) = 50, S_0 = 1, S_1 = 10, a = 2, b = 1, d = 10, e=1, x = 0.5, y = 0.5). Transfer of differentiated knowledge to less-differentiated culture dominates exchange during t < 2 (dashed blue curve). In long run (t > 5) cultures stabilize each other and swings of differentiation and synthesis subside while knowledge accumulation continues. Note, that in this example hierarchies were maintained at different levels (exchange of hierarchical structure would lead to the two cultures becoming identical).

4. FUTURE DIRECTIONS

4.1 Role of music in synthesis of differentiated psyche

Synthesis, a feeling of meaning and purpose, let us repeat, is a necessary condition of human existence. Differentiation of knowledge undermines synthesis. This is the reason for reluctance to expand knowledge in traditional societies. Maintaining synthesis along with differentiation, like in contemporary Western societies, is difficult. Since time immemorial, art and religion have connected conceptual knowledge with emotions and values, for maintaining synthesis. A particularly important role in this process belongs to music, since music directly appeals to emotions [28,29]. Music evolved from the sounds of voice, i.e., from singing. The human brain has *two centers controlling melody of speech*; an ancient center located in the limbic system, and a recent one in the cerebral cortex. The ancient center is connected with direct uncontrollable emotions, whereas the recent center is connected with concepts and consciously controlled emotions.

Contrary to human brain, in animals prosody of speech is governed by a single ancient emotional center in the limbic system. Sounds of animal cries engage the entire psyche, rather than concepts and emotions separately. A monkey or bird seeing danger does not think about what to say to its fellows. A cry of danger is *inseparably* fused with recognition

of a dangerous situation, and with a command to oneself and to the entire flock: "Fly!" An evaluation (emotion of fear), understanding (concept of danger), and behavior (cry and wing sweep) – are not differentiated. The conscious and unconscious are not separated: recognizing danger, crying, and flying away is a fused concept-emotion-behavioral *synthetic* form of thought-action. Most animals can not control their larynx muscles *voluntarily*.

Melody of voice is perceived by ancient neural centers involved with archetypes, whereas conceptual contents of language involve conscious concepts. Human voice, therefore, involves both concepts and emotions; its melody is perceived by both conscious and unconscious; it maintains synthesis and creates wholeness in psyche [30]. Over thousands of years of cultural evolution, music perfected this inborn ability. *Musical sound engages the human being as a whole*—such is the nature of archetypes, ancient, vague, undifferentiated emotions-concepts of the mind. This is why folk songs, popular songs, or opera airs might affect a person more strongly than words or music separately. This uncovers mysterious co-belonging of music and poetry. *High forms* of art effect synthesis of the most important models touching the meaning of human existence. *Popular songs*, through interaction of words and sounds, connect the usual words of everyday life with the depths of the unconscious. This explains why in contemporary Western culture, with its tremendous number of differentiated concepts and lack of meaning, such an important role is taken by popular songs. [8, 19, 31].

Whereas language evolved as the main mechanism for the differentiation of concepts, music evolved as the main mechanism for the differentiation of emotions (conscious emotions in the cortex). This differentiation of emotions is necessary for unifying differentiated consciousness: synthesis of differentiated knowledge entails emotional interactions among concepts [32]. Future research will have to make the next step, that is to define the mechanism by which differentiated aesthetic emotions unify contradictory aspects of knowledge. We will have to understand processes in which the knowledge instinct differentiates itself and the synthesis of differentiated knowledge is achieved.

4.2 Problems for future research

Experimental research will examine mechanisms of emerging hierarchy, especially its higher levels. What is inborn and what is learned. Studies of interaction of language and cognition have already begun [9, **Error! Bookmark not defined.**, 33]. Future research will model differentiated knowledge instinct [**Error! Bookmark not defined.**, **Error! Bookmark not defined.**], emotional interactions among concepts in processes of cognition, the infinite variety of aesthetic emotions perceived in music, their relationships to mechanisms of synthesis [19,30,31]; differentiation and synthesis, their influence on the evolution of consciousness and cultures.

Cultural historians and psychologists can use the results of this paper as a tool for understanding psychological mechanisms of cultural evolution. The results may explain how differentiation and synthesis have interacted with language, religion, art, music, and how these interactions have shaped the evolution of various cultures. Social psychologists can use the results of this paper as a tool for understanding the psychological mechanisms governing present conditions. It is possible to measure the levels of differentiation and synthesis in various societies, and to use this knowledge for improving human conditions around the world. It will also be possible to predict future cultural developments, and to use this knowledge for preventing strife and stagnation, and for stimulating wellbeing.

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