Stephanie Schede

COEVOLUTION - COGNITION - COOPERATION - CREATIVITY

A Socio-Cognitive Perspective

on Creative Processes

"Human creativity is the fire
that drives gene-culture coevolution.
From creativity flow innovations,
the raw material of cultural diversity."

Charles Lumsden

"Art is the lie that reveals the truth."

Pablo Picasso

"As long as the idea or product has not been validated,
we might have originality, but not creativity."

Mihaly Csikszentmihalyi

TITEL DER DISSERTATION:

COEVOLUTION - COGNITION - COOPERATION - CREATIVITY

A Socio-Cognitive Perspective on Creative Processes

KOEVOLUTION - KOGNITION - KOOPERATION - KREATIVITÄT

Eine sozio-kognitive Untersuchung kreativer Prozesse

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Wien, im März 2013

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ABSTRACT:

Key Words:

creativity - coevolution - cognition - sociobiology - cooperation - knowledge - science - research - noise - art

ABSTRACT - ENGLISH:

Background: Studies of human's artistic abilities based on a sociobiological understanding of creativity are scarce. This thesis was focused on a cognitive understanding of creativity in relation to knowledge generation processes, thereby drawing on theories related to co-evolution, cognition and art. The purpose was to examine to which extend such perspectives can be applied to (cognitive) information processing and, thus, contribute to broadening the understanding of cognitive, creative and art making processes. ***Methods:*** This study originated from a co-evolutionary approach, which was complemented by a *socio-cognitive* perspective on creative abilities and artistic performance. Focus lied on the analysis of cultural knowledge generation and how information structures are varied, selected and transmitted. ***Results:*** The creative ability of the human being can be considered as a pre-requisite for cultural development. Social and strategic behaviors based on the ability of shared intentionality are vital for the understanding of human creativity. The socio-cognitive approach allows for a knowledge generation model, which can be applied to both science and art (research, paradigm-shifts). The factor of noise might have a significant influence on innovative and creative outcomes - an aspect that is particularly relevant for artistic research. ***Conclusions:*** It is considered, that artistic outcomes potentially trigger knowledge generating processes with coevolutionary relevance (epigenetic). Further studies of the re-coding (knowledge) effects of artistic research through the impact of noise may give valuable insights for a methodological understanding of art making; findings to this end could also enrich other fields (education, innovation research, business consulting etc.).

ABSTRACT - GERMAN:

Key Words:

Kreativität - Koevolution - Kognition - Soziobiologie - Kooperation - Wissen - Wissenschaft - Forschung - Störung - Kunst

Thema: Die Arbeit leistet einen Beitrag zur soziobiologischen Untersuchung der menschlichen Kreativität. Anhand von Forschungsergebnissen aus den Evolutions-, Kognitions- und Kunstwissenschaften wird untersucht, inwieweit Erkenntnisse aus dem Bereich der (kognitiven) Informationsverarbeitung Aufschluss über Prozesse der Wissensgenerierung geben können; der Zusammenhang von kognitiven, kreativen und künstlerischen Prozessen steht im Fokus der Arbeit. ***Methode:*** Der koevolutionäre Forschungsansatz bezieht sich insbesondere auf Prozesse der kulturellen Wissensgenerierung und ist als *sozio-kognitiv* definiert. Im Vordergrund dieser Arbeit steht die Untersuchung von Kreativität und sozialem Verhalten sowie die Frage, wie Wissensstrukturen variiert, selektiert und weitergegeben werden. ***Ergebnisse:*** Die kreative Fähigkeit des Menschen verweist auf dessen kognitive Komplexität und spielt eine entscheidende Rolle im Prozess der kulturellen Evolution. Von großer Bedeutung ist dabei die menschliche Fähigkeit des intentionalen Verstehens seiner Artgenossen: soziales, kooperatives und strategisches Verhalten ist entscheidend für das Verstehen von Kreativität. Der sozio-kognitive Ansatz erschließt Wege für ein Modell der Wissensgenerierung, das sowohl auf den Bereich der Kunst als auch auf den der Wissenschaft übertragen werden kann (Forschung, Paradigmenwechsel). Faktoren der Störung und Irritation können innovative und kreative Lösungen unterstützen, was insbesondere für den Bereich der künstlerischen Forschung gilt. ***Implikationen:*** Es wird angenommen, dass die Auseinandersetzung mit Kunst (Kultur) Prozesse der Wissensgenerierung auslösen kann, wobei ein soziobiologischer Einfluss (Epigenetik) nicht ausgeschlossen wird. Erkenntnisse einer methodischen Untersuchung künstlerischer Forschung anhand recodierender Wissenseffekte, die insbesondere auf dem Element der Störung basieren, können auch für andere Bereiche (Beratung, Bildung, Innovationsforschung etc.) relevant sein.

1 INTRODUCTION

The present thesis operates on the assumption that creativity is based upon the cognitive processes of the human being. Focus is inter alia put on a transdisciplinary analysis that stretches from the evolutionary to cognitive and art sciences. Furthermore, the development of the human cognition and the constructive and inventive impact it has brought about is examined. In this context, it is considered that the creative abilities of the human being are related to the generative competences and potential of accumulating and maintaining cultural knowledge. To this end, knowledge is regarded as a capacity for problem-solving at individual or collective level by means of creative cognitive competences. It should be noted that, according to Laland et al. (2012), knowledge is not only "stored" in individual brains (internal representation), it is also represented in social structures, material artifacts, external representations and environmental structures (external means). Thus, knowledge can be shared among individuals via various processes, typically involving several such external means. Hence, the question arises which coherences exist vis-a-vis the generative, creative and artistic competences of the human in relation to individually or socially achieved knowledge structures. This thesis explores how the outcome of creative processes and the generative potential of such output can be transformed into new information, which might enrich the prevailing culture (i.e. knowledge gain). It is suggested that this perspective could be applied to the specific creative practices of artistic performance.

For the scope of this thesis, the following assumptions are predominant:

- If human cognition describes a trait of evolutionary fitness;
- if cognition refers to culture generating performances of the human;
- if the cultural cognition is linked to the specific human creative ability; and
- if creativity is a cognitive process:

Then it can be argued that artistic performance, potentially, contributes to generating innovations and accumulating knowledge that increase the pool of evolutionary relevant information at group or society level.

1.1 Aims and Overview

In general, the present thesis commences from a *socio-biological* understanding of the generative processes of the human; findings from both natural sciences and the humanities are exploited. The term *co-evolutionary* is used at times for underlining the relevance of biological as well as cultural conditions when analyzing the generative processes of the human being. According to Faßler (2009), the coevolutionary aspect is related to processes that may carry a potential for generating programmatic variations of the self-organization of the human being. The focus lies on *re-coding processes* affecting individual-biological and individual-communicative forms of live. These processes are not necessarily applicable to biological variations but might, nonetheless, trigger behavioral adaptation processes.

For the purpose of the present thesis knowledge generating processes based on findings from the evolutionary, biological and cultural sciences are in the foreground. To this end, emphasis is put on the underlying conditions and mechanisms of knowledge-generation rather than on the actual impact of cultural influences on the biological setting of the human being. Accordingly, the term co-evolutionary is used when biological impact through cultural influences is specifically discussed. More generally, the term socio-biological or, as developed within this thesis, *socio-cognitive,* is used for the purpose of emphasizing the cultural and biological interdependencies within knowledge generation processes.

In this respect, Part I deals with socio-cognitive aspects of the cognitive development of the human being, in particular with regard to his ability to generate culture. Part II provides analyses of socio-cognitive aspects of creative processes that are considered to be of relevance for innovation and knowledge generation. In Part III an attempt is made to explore how the socio-cognitive avenue could contribute to enhancing the understanding of the impact and applicability of works of art vis-à-vis the society at large.
All three parts are determined through questions related to generation and retention of cultural knowledge. Even though the focus primarily lies on analysis of cultural (evolutionary) mechanisms, the perspective of interdependent criteria of biological and cultural conditions is regarded as highly relevant.

Part I focuses on the question of which circumstances have led to the development of the specific human ability of culture generation and the associated creative abilities. To this end, Part I aims at framing relevant biological conditions and reveal those cultural mechanisms that nurture cultural thinking and, thus, creative competences. The cognitive genesis of the human being is explored on the basis of a co-evolutionary approach whereby the significance of dual inheritance processes is stressed. In this respect, it is essential to understand how the evolutionary development of the human being has been possible and, secondly, which theories for the specific cultural genesis would be of relevance. The former question focuses on the biological genesis and, thus, on the phylogenetic history of the human cognition whereas the latter is concerned with cultural mechanisms, thereby emphasizing the ontogenetic conditions of the human development. Special attention is paid to social theories of cultural evolution, in particular the ones of Tomasello (2000). The claim is made that socio-cognitive criteria are applicable, when referring to mechanisms of cooperation and knowledge generation of cultural evolutionary processes.

Part II aims at exploring the creative ability of the human being and the related generative competences from a socio-cognitive perspective. Creativity is examined in relation to social structures, whereas the social avenue focuses on the environmental factors related to the generation of creative products. It is suggested that the social embedding is key for the acceptance processes related to creative and innovative products and, thus, to accumulation of knowledge and development of innovation within a given culture. Interdependencies between creative performance, creative outcomes and relevant social processes are examined through the systemic analysis of Csikszentmihalyi (2009) which also encompasses an evolutionary perspective.

The cognitive avenue, in contrast, focuses on the individual cognitive competences of the human and related generative performance. Findings from the field of creative cognition, presented by Finke, Ward, and Smith (1992) are used for shedding light on how specific cognitive components, processes and structures can initiate creative performance.

Three aspects are of particular relevance when examining knowledge generation through creative processes: innovation, transmission and applicability. Particular attention is paid to mechanisms of deviations, as they seem to carry a potential for triggering an innovative and original outcome and, thus, contribute to effective synthesizing of new knowledge.

From a socio-cognitive perspective, the creative process represents the basis for innovation and cultural variation, irrespective of the fact that creative products appear in various forms such as artifacts, science, art etc.

Considering that knowledge is also transferred through external means, e.g. material artifacts, Part III poses the question to which extent art can contribute to a socio-cognitive understanding of cultural knowledge generation.
Science has brought about a multitude of definitions of the term art. For the purpose of the present thesis, however, the definition of *systemic art* of John (2004) is used. This definition is related to his *critical-aesthetic* approach which is based on communicative processes of social relevance.
With a view to differentiating between the various forms of knowledge generation, references are made to terms of scientific and artistic research. It is assumed that art refers to forms of cultural variation that carry a certain potential for initiating and facilitating innovative, or, at least, dynamic cultural development of the human. In this context, art is referred to as forms of visual representation of abstract thinking (Schmidt 2010), inter alia aiming at aligning diverging views with regard to controversy contents and eventually leading to paradigm shifts. In this respect, the socio-cognitive avenue is complemented by an evolutionary perspective, which is focused on the relevance of elements of noise for re-coding processes through artwork. Special attention is given to *de-* and *re-stabilization* criteria of knowledge structures through artwork. Such criteria are also of relevance for knowledge generation processes.
In this context, *socio* refers to the communicative (evaluative) process of presenting cultural variations through artwork, claiming social relevance of the artistic performance, whereas *cognitive* refers to those aesthetic means by which artists can synthesize (metaphorical) interpretations of the world. It should be kept in mind, that Part III merely outlines a basic approach of a biological and cultural based analysis with regards for further research.

It is important to note that, in this thesis, the generative and creative abilities of the human being typically refer to processes of innovation and improvement of conditions of life.
From a strict evolutionary perspective, this does not necessarily correspond with generative and transforming processes of development of life due to the fact that evolutionary

processes, in general, do not follow pre-set strategies aimed at specific enhancements. Rather, it can be argued that the evolution follows principles and mechanisms that aim at a general form of development. Whether the result is regarded as positive or negative is, from this perspective, irrelevant. However, research related to creativity and cognition tends to focus on analysis of innovation and knowledge-development with an explicit emphasis on the underlying intentions for such progress.

In this respect, two factors are of particular relevance when analyzing knowledge generating processes: The process of rather uncontrolled emergence and the intentional influence by individuals or social groups. In this respect, the socio-cognitive avenue should be regarded as an attempt to distinguish filtering intentional and non-intentional factors of knowledge and information generation.

1.2 Method

The present thesis follows an interdisciplinary approach whereby both biological and cultural research findings are used for exploring generative and cognitive criteria in relation to the human genesis and the cultural developments it has brought about.

In view of the intellectual, perceptive and communicative abilities of the modern human being, it is evident that complementing perspectives from the natural science and the humanities are essential for analyzing the human cognition. Hence, the scope of the present thesis encompasses methods from biological and cultural evolutionary theories as well as theories from cognitive psychology, neuroscience and art science. Emphasis is put on a comprehensive understanding of knowledge generating processes rather than on a single process analysis.

More precisely, this thesis focuses on the criteria for perception, recognition and knowledge with the aim of depicting the inventive, creative and constructive abilities of human being. In this context, references can be made to the approach of a coevolutionary anthropology of Faßler (2009), who considers that the following questions are of particular relevance to this end: Which dependencies and interdependencies of genetic codes, brain and self-organization exist? Under which conditions do organizational structures of human behavior exist and repeat themselves (Faßler, 2009, pp. 3-4)?

Faßler ((2009) emphasizes that, on the one hand side, a large diversity of behavioral and receptive methods and mechanisms of the human being exist. On the other hand, however, he considers that these mechanisms are based on universal processing structures. Respectively, he regards coevolution as a formative, open dynamic occurrence which is not focused on forms as such but on *formative practices* when relating to the generative ability of the human being. In this context, this thesis follows a coevolutionary approach focused on open process structures and their inherent variations with regard to the dynamics of knowledge generating processes (Faßler, 2009, pp. 7-8).

In general, the coevolutionary approach is concerned with biological and cultural transmission processes. Methods for non-genetic transmission of cultural knowledge, such as scripts, melodies, rhythms, visualization, abstractions etc., play a crucial role for analysis on the basis of this approach.
Questions of how learning processes, repetition, imitation but also artistic transmissions etc. can trigger and manifest generative processes of knowledge gain are being explored within this thesis. According to Faßler (2009), the coevolutionary perspective is of particular relevance for the underlying assumption of epigenetic processes and their post-coding effect on actual forms of life. It is considered, that cultural output might influence the status quo through various forms of information-transformation for example with regard to perceptions, power and knowledge. From this perspective, cultural variations re-determine the organization of life context (the way life is organized.) Such epigenetic processes constitute a fundamental element of the coevolutionary approach (Faßler, 2009, p. 4).

From a methodological point of view, it should be noted that this thesis does not provide a fully-fledged coevolutionary theory, even though it draws on such criteria as well as the theory of epigenetic impact through cultural variation. For this purpose, a *co-lateral approach* on biological and cultural processes is taken, thereby maintaining a focus on interdependencies between the various generative processes.
Accordingly, the co-evolutionary perspective is transferred to the socio-cognitive (socio-biological) avenue, which refers to knowledge generation and its processes of variation, selection and transmission applied to the field of human cognition (Part I), creative ability (Part II) and artistic performance (Part III).

With reference to Uhl (2009), the present thesis aims at providing an integrated epistemologically perspective that combines the hypothesis generating potential from the humanities with the validation methods from the empirical natural sciences (Uhl, 2009, p. 51). Notwithstanding the hermeneutic emphasis in this thesis, it should be noted that research results from the humanities as well as natural sciences are exploited in order to provide a associated scientific perspective that allow for the generation of hypothesis that are relevance for both of these fields.

According to Menninghaus (2011), theories refer in general to not-yet-confirmed empirical data. Hence, also empirical research requires a hermeneutic approach for generating ideas and theories. Even though they may not be based on empirical falsifiable data such ideas and theories may nonetheless, inspire to further research in the field of natural science (Menninghaus, 2011, p. 29). Against this background, an interdisciplinary approach is applied to the present thesis. From a methodological perspective, the overall aim is to explore knowledge-generating processes on the basis of relevant findings in the fields of cultural *and* natural sciences.

PART I HUMAN COGNITION AND CULTURE GENERATION

The present part poses the question of how evolutionary aspects may contribute to the generation of culture. To this end, the relationship between the terms culture and cognition with regard to human interaction and their potential impact on the development of societies is explored. Furthermore, the demarcation criteria in the historical development of cultural evolution of the human are examined.

When examining the evolution of the human cognition, it becomes obvious that culture and ideas are subject to permanent evolvement. These cultural changes gradually emerge from previous knowledge and experiences. Thus, inventions and innovation do not just occur; on the contrary, they build on prior achievements. In this context, theories related to cultural evolution are helpful when distilling the mechanisms of cultural development on the basis of evolutionary findings. Accordingly, both biological and cultural aspects deserve to be taken into account when exploring how the development of human cognition and cultural evolution are linked to each other and describe the co-evolutionary and socio-biological setting of this thesis.

Co-evolutionary approaches have always formed part of evolutionary research. As Blackmore (2010) points out that, ever since the founding of Darwinism, analogies between biological and cultural evolution have been made. Blackmore, inter alia, refers to the idea that civilizations are moving towards an ideal state, i.e. from state of nature, via barbarism to civilization. She particularly emphasizes that, already some 50 years after the breakthrough of Darwinism, Baldwin (1909) launched the idea that natural selection does not only describe the law of nature. This process can also be used for the natural sciences as well as for the humanities. According to Blackmore, Baldwin laid the foundation for an universal Darwinism and created the term *social heredity*, as a means to describe how individuals learn through social interaction, for example by imitation or instruction, thereby presenting a coevolutionary perspective on human development (Blackmore, 2010, p. 57).

Discussions on cultural evolutions tend to trigger reflections on the appropriateness of different definitions of the term culture. For the purpose of the present thesis, however, such considerations are of secondary relevance. The aim is rather to substantiate the relevance of culture - irrespective of the definition applied - with regard to human inheritance mechanisms. Even though there are some indications that cultural inheritance takes place also among animals[1], the term culture is here restricted to the human being.

In this thesis, however, culture refers also to the symbolic modalities of social groups. It manifests itself in customs, habits and traditions of social clusters, which may be represented in language, fashion, ceremonies, art, architecture, notion of faith, technology, engineering etc. From an evolutionary point of view, it is of relevance to understand how cultural values are established, transferred, and preserved. Boyd and Richerson (1985) suggest the following definition of the term culture: "By culture we mean the transmission from one generation to the next, via teaching and imitation, of knowledge, values, and other factors that influence behavior" (p. 33) and add the definition: "Culture is information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation" (p. 2). Correspondingly, the analysis of the social factors enabling evolutionary processes (e.g. social learning) is equally important as the biological setting when analyzing human evolution. In this respect, definitions of culture as a process that generally increase the variety of the fundamental inheritable material, form part of this analysis.

According to Lumsden (2009), the evolution of most animals has mainly arisen from the replication of genetic information, while the evolution of the human being, in contrast, should be regarded as a result of transmission of *both* genetic and cultural information. From an evolutionary point of view, culture describes the human niche, whereas "cultural information refers very loosely to the stories, ideas, and behavioral stratagems shared among people in every society on the planet" (Lumsden 2009, p. 159). In the field of socio-biology it is being argued that it is not meaningful to analyze genetic and cultural heredity of the human being in an isolated manner. Furthermore, also neurobiologists tend to acknowledge that the development of the human cognition depend on both, the genetic

[1] e.g. studies of birdsong (Dawkins, 2010, p.317)

and cultural transmission which leads to the understanding of the genetic-cultural coevolution. The creative ability of the human being plays a specific role in this context: "Human creativity is the fire that drives gene-culture coevolution. From creativity flow innovations, the raw material of cultural diversity" (Lumsden 2009, p. 160).

This thesis operates on the assumption, that the biological preconditions of human being and its surrounding environment is based on a mutual interdependency. The term *environment* relates here to the cultural embedding of the human being within a certain social framework. Strategic thinking is of utmost relevance for a successful lifestyle, for example in order to empathize with counterparts and, thus, predict how others might behave. Thus, the criteria for social behavior are of importance when examining the cultural development of the human being, which underlines the sociobiological approach of this thesis.

The distinction between biological and cultural criteria of human cognition respectively between nature and culture has a long tradition. As Tomasello (2000) points out, already the scientific debate between rational and empirical philosophers during the 18th century dealt with the question of the human mind and its characteristics. It should be noted that this, impulse setting, debate took place even before Darwin's theory had been established and science in general had become significantly influenced by the evolutionary perspective on biological processes. In particular Darwin could be regarded as a booster of an interdisciplinary approach with regard to integrating the cultural and biological perspectives on the human development. This is due to Darwin's distinction between the phylogenetic and the ontogenetic paths for explaining the evolution of the species. Darwin based this theory on a process-based model, where both biological and cultural aspects are of relevance.

Whereas the scope of this thesis is related to a coevolutionary approach of human cognition, the Darwinian perspective underlines the reciprocal conditionality of the cultural and biological characteristics. Tomasello (2000) describes this interdependency via the theory that, during the phylogeny, nature chooses ontogenetic paths, which lead to specific results of the phenotype. These paths, Tomasello argues, are, amongst other, dependent on exogenous material and information, meaning environmental (e.g. cultural) aspects. To this

end, Tomasello formulates a covolutionary point of view by stating that it is *this material* that primarily increases the variety of development options and, secondly, potentially retroacts to the genotype. He underlines the significant influence of the genome as well as environmental conditions for biological and cultural development. In this respect, it is essential to understand the whole picture of processes involved in the development of human kind, focusing on both, fixed (genetic) and variable (cultural) structures (Tomasello, 2006, pp. 68-69).

Accordingly, when trying to understand cognitive mechanisms, only an interdisciplinary approach that combines biological and cultural aspects of evolutionary research methods seems to be suitable. The biological avenue refers here to the question of how information is processed within the cognitive system, whereas the cultural approach is concerned with questions related to transmission and preservation of information within social groups.

2 *Cognition - A Modular Information Processing System*

Human cognition constitutes a complex and highly differentiated information-processing system which is linked to the fields of intelligence, creativity, and knowledge generation. Within this thesis it is considered that the human being has a concrete set of cognitive competences at his disposal that allows for dealing with specific environmental requirements (problem solving strategies) in a creative manner. Moreover, social and strategic behaviors seem to be vital for the understanding of human intellectual and creative performance.

In this context, the present thesis focuses on contemporary research in the fields of cognitive and behavioral sciences, which build on a *modular architecture* with regard to the cognitive mechanisms of the human being. This idea was initially formulated by Fodor (1983) in *The modularity of mind*. In the early 1990s, however, Tooby and Cosmides (1992)[2] specified that the cognitive abilities of the human being constitute a conglomerate of specific problem-solving mechanisms which have been developed through the evolution. In this context, they relate to the mechanisms of a selective modularity, whereas specific environmental information is transferred into evolutionary emerged behavioral controls. In 1999, Sperber launched an alternative theory of modularity, which suggested that information output of one module tends to be transferred to other modules. He considerd that this theory explains meta-representation (self-referential representations) of neuronal occurrences. As Uhl (2009) stresses, a decisive component of Sperber's theory lies in the definition of a specific module that allows for simulation of potential occurrences (hypothesis), which enables human interaction. This interpersonal ability has allowed for a shared understanding of other individual's reasoning; a skill that could be regarded as a pre-requisite for successful cooperation in complex situations, which relates to the socio-cognitive ability of human kind (Uhl, 2009, p. 112).

In this context, the ability of perception provides a good example for describing the constructive and extensively modular structure of the human nervous system. As Uhl (2009) points out, this ability is closely linked to the function of sensual organs (sensory input) and its impact on behavior (motoric output). Uhl also states that the human brain is

[2] cf. *swiss army knife-Model*

designed for controlling the behavior, while constantly differentiating between the sensory and motoric components of the organisms. Accordingly, the human brain can be regarded as the result of a complex differentiation process, partly based on the perception of the environment (Uhl 2009, p.116). Singer (2003) claims that perception is an active process and argues that the rules which guide the interpretation are also determined via the architecture of the brain. Specifically, this implies that the perception of the world is regulated through the neuronal structure, which presumably during the course of evolution could have developed differently from today's formation (Singer, 2003, p. 72). From a biological point of view, the human brain can be regarded as an information-processing organ that is based on a neuronal system and is capable of enabling a wide range of plasticity in developing neuronal functions. This enormous adaptability of neurons results in dynamic synchronously working networks, representing different aspects of the environment. These areas are determined via the frequency at which they are contacted and react respectively with either enlargement or reduction of their functional units (Uhl, 2009, p. 154).

In concrete terms, this implies that the world is perceived through sensory organs, which, however, do not necessarily reflect a correct picture of the surrounding environment (Roth, 1997, p. 253). Indeed, if perceptions are not based on images but on *constructions,* that are neither of conscious nor arbitrary character, then the question arises, why perception, in general, follows reliable and calculable rules. Roth (1997) suggests that accepting that it is not perception in itself that needs to be adequate but the behavior, is helpful in order to understand this matter (Roth, 1997, p. 86). Uhl (2009) concretizes this point of view by stressing that, from an evolutionary perspective, it is particularly the specialization of the different brain areas which could be understood as developments triggered by concrete problems (solving strategies) (Uhl, 2009, p.153). According to Uhl, it is the environmental selective pressure which is directly related to behavior requirements and thus forming the human nervous system. This underscores the interdependency between biological and cultural features with regard to the evolutionary development.

In this context, Uhl (2009) underlines the relevance of the plasticity of the brain. To this end, he specifies two characteristics of the neuronal processing system: Firstly, it is the regularity of the environmental factors that make abstractions possible. This ability, i.e., to

conclude from a single occurrence to valid interrelationships and construct categories of objects is, again, based on the need to regulate human behavior. Secondly, it is the ability of the neuronal system itself to react dynamically on important requirements and to transform this information into the modular network of the human brain (Uhl, 2009, p. 154).

This poses the question of how information can be exchanged. The human being distinguishes himself from other species by its specific ability of language-based communication. Communication in this context means direct or indirect interaction with others, aiming on influencing others behavior in a medium or longer-term perspective. This specific aspect of cooperation distinguishes the human being from non-human animals. Compared to other primates, the human being is not only able to reflect and relate to non-current matters but also to preserve the related content by means of culturally developed techniques (Uhl, 2009, p.118). It is the influence of the cultural environment on the cultivable organism and its ontogenesis, which refers to the setting of cultural evolution.

To sum up, the term *cultural evolution* is directly related to human ontogenesis where social and cultural abilities are manifested. The upbringing of a human being within any given culture can be regarded as interplay of the congenital potential and cultural stimulation. It is important to understand that, through the process of cultural evolution, new cognitive abilities do not necessarily evolve but the underlying congenital foundations may be modified (Tomasello, 2006, p. 26).

2.1 General Conditions - Biological and Cultural Heredity

A child's ability to interact with others can be derived from both the biological heritage and cultural adaptations. This ability is a prerequisite for enabling the child to take different perspectives on extro-, intra- as well as interpersonal matters. Tomasello (2006) illustrates this by giving examples of specific cultural activities such as playing chess or basketball. As he stresses, it is not the culture in itself that provides the cognitive and sensory-motoric abilities that are required but rather extensive exercising. Indeed, it is the

accumulated experience over time that brings about an understanding of functions and rules of the social interplay and, thus, constitutes a basis for anticipating how others may react. Notwithstanding the biological and cultural inheritance, Tomasselo argues that it is the upbringing in the cultural context which leads to a fully developed and matured cognitive human being (Tomasello, 2006, p. 252).

The, in relative terms, rather lengthy upbringing-phase of a human child, during which, for example, communicative abilities and symbolic competences are developed, constitutes the foundation of the phenomenon culture. It is the cultural environment that influences the ontogenetic path of the human being. In spite of a 98.8 percent similarity with the genome of chimpanzees, the cognitive performance of the human differs significantly from the one of the apes. It should be borne in mind that it is no more than approximately six million years which separates the human being from the last common ancestor of the chimpanzee - from an evolutionary point of view, this is a remarkable short period of time. Hence, the enormous and rapid development of the communicative and cultural competence of the human being during this period of time is all the more surprising. Uhl (2009) summarizes that these abilities are based on the following three components: The genetically predetermined abilities, the cultural environment disposing the conditions for developing these abilities, and the individual competences and preferences used for their application (Uhl, 2009, pp. 119-120).
Correspondingly, Tomasello (2006) considers that the human being has advanced cognitive abilities which are biological inherited over a phylogenetic period of time. These abilities are used for applying cultural resources which have been developed over time, whereas these resources are used over the ontogenetic interval (Tomasello, 2006, p. 67).

In conclusion, the information-processing capacity of the nervous system of the human refers, on the one hand, to the individual demands of the human being and, secondly, describes the result of an evolutionary adaptation process. It is the congenital disposition which enables the human to its cognitive competence, whereas the environmental conditions have shaped human behavior over million of years resulting into complex cultural techniques enabling the global and digital communication that characterizes today's society. A short overview of the biological development of human cognition should give a first step to the understanding of the interdependency of biological setting and cultural requirements.

As mentioned above, the ability to optimize behavioral strategy is directly related to the human cognition, commonly referred to as intelligence or/and creativity. With regard to the previous question, it is important to concretize: i) Which selective criteria have led to the specific form of human cognition; ii) which environmental conditions; and iii) which mechanisms resulted into a neuronal system designed for the genesis of culture, innovation and creativity and, finally, iiii) how this competence for innovation relates to the co-evolutionary conditions of cognitive origin.

The study of the anatomical development of the human brain allows for some conclusions with regard to the selective environmental requirements. The growth of the brain volume gives a clear picture of the proportional modification of the human skull: During the evolutionary period of time, the *facial skull* has decreased in size progressively whereas the *brain skull* continuously has gained volume. This is of interest if one bears in mind that these two parts of the human skull correspond with different functions. The facial skull, obviously, represents the sensual-physiological interface and, thus, allows for direct interaction with the surrounding environment. Important functions, however, i.e., breathing, eating, seeing, smelling, tasting, hearing and speaking, are primarily connected directly to the head. At the same time, the brain skull protects the central accumulation of nerve cells - the brain - representing the control center of human acting, behavior and thinking (Uhl, 2009, p. 98).

The development of the nervous system can be regarded as an illustration of the evolutionary path of biological information processing that has enabled the human being to cope with the continuously increasing ecological plenitude of stimuli and options. Uhl (2009) exemplifies this by suggesting that the nerve cells represent a biological equivalent to the complex challenges of the environment with the task to direct behavior most efficiently. He refers to Spitzer (2002), who formulated the fundamental task of the nervous system simply as the rapid and efficient impulse conversion from inputs into outputs. Correspondingly, Singer (2003) demonstrates the impressive scale of human cognition by comparing it to the nervous system of the snail, which is distinguished simply by a more complex network system. In this respect, Uhl emphasizes that the specificity of human being is determined through quantitative rather than qualitative criteria. No other

organisms of comparable size have such voluminous brains. The size of the human brain can be regarded as a result of man's exposure to complex environmental requirements (Uhl, 2009, pp. 106-108).

The term environmental requirement implies that the human being has had to develop specific abilities (problem-solving) for meeting demands of the outside world. In fact, the anatomy of the brain of a modern human being resembles the grown capacity of dealing with highly complex matters. This manifests itself via an eminently diverse modularity of networking systems. A significant amount of energy is required for maintaining this complex neuronal system but the benefit of reacting towards the evolutionary pressure justifies the additional costs for supporting the growth of the nervous system. Accordingly, the cognitive abilities of the human mirror the evolutionary adaptation process, where anthropologists tend to refer to the term of *Environment of Evolutionary Adaptedness (EEA*) (Uhl, 2009, p. 108).

In this context, Tomasello (2006) refers to human cognition as a form of primate cognition, where both, hominids and chimpanzees, have a large part of cognitive abilities such as sensory-motoric and social abilities in common (Tomasello, 2000, p. 201). From a biological point of view, the remarkably growth of the human brain raises the question which selective pressures have influenced this development. No comprehensive answer to this question is available. However, an historical overview of the cognitive development of the human being, from the perspective of the biological influence on cultural development, is provided.

2.1.1 The Evolutionary Mechanisms of the Natural Selection

Even though Darwin (1809-1882) is the, by far, best-known representative of the evolutionary theory, both de Lamarck (1744-1829) and Russel Wallace (1823-1913) deserve to be mentioned as important contributors to the establishment of this evolutionary theory. Currently, terms such as *Neo-Darwinism* or *Synthetic Theory of Evolution* combine Darwin's theory with cutting-edge research in the field of evolutionary theory, especially

with the genetic (Mendell). To this end, arguments of the *epigenetics* have drawn attention to the environmental influences on the human genome. Furthermore, the terms *genetic drift* and *genetic shift have* given a new impetus to the question whether the evolution should be regard as a random or deliberate process. In this context, the contribution of the evolutionary biologist Dawkins (2010) should be mentioned; with his idea of the *egoistic gene* he laid the foundation for an universal Darwinism on the basis of a replicator model (cf. chapter 3.2).

The success of Darwin's theory can be attributed to its emphasis on the reproduction mechanisms as means of explaining the variation of biological species over the bio-historical process. His evolutionary theory is primarily focused on the phylogenetic development of organisms that are being exposed to a continuous environmental interplay, which influences the conditions for reproduction. The impact of this process can be described via the impact of the evolutionary factors on population, as there are variation/mutation, selection/isolation and inheritance/transmission (Uhl, 2009, pp. 90-91). These factors can be regarded as key for the development of a population. Accordingly, those species that are best adapted survive and pass on their genetic material to their descendants. This selection is determined through the influences of the environment. Due to this the reproductive capacity of certain individuals is reduced with the effect that others are more likely to survive and, thus, pass on their genetic material.

Darwin (1859) considered that two factors are responsible for this cross-generational process of population development: First and foremost, the prevailing ecological circumstances such as access to environmental resources, avoidance of predators, reproduction and breeding conditions. Secondly, the descendants of parents tend to differ in their appearance. Such phenotypic and genotypic variation, describe unpredictable combinations of the features involved in the process and are commonly referred to as *mutations*. Darwin's true genius lies in the combination of these two elements. The reproductive capacity alone does not ensure survival; rather; it is the combination of mutations and an ability to adapt to an ever-changing environment (Uhl, 2009, pp. 90-91).

In this respect, Uhl (2009) refers to Campbell's (2002) principles of *random genetic variation and non-random selection* that are considered to correspond to the one of *survival of the fittest*. Today, however, emphasis tends to be put on processes of *selection-*

conditioned adaptation. This is because there is no objective means of measuring fitness maximum for physiques or behavior. It is rather the variation of environmental conditions that carry the potential for demoting the competitive advantages of a previously well-adapted individual. Hence, Hauser (2001) suggests that, in the struggle for the daily survival, it is the nature that set the conditions for survival and the survivors are those who were intelligent enough to cope with this dynamic. It should be noted, though, that, in this context, intelligence does not necessarily imply physical strength but, rather, the best ability of adapting to the prevailing environmental conditions (Uhl, 2009, pp. 90-92).

Until the 1980s, evolution was usually regarded as a causal process that has triggered the physiognomic variation of species during the history of the earth. Uhl (2009) stresses, however, that the anatomy of the species should only be regarded as half of the answer with regard to the central questions of survival and reproduction. As mentioned above, the control and steering of behaviors is, though less obvious, essential for the other half of the evolutionary success and especially relevant for the approach taken in this thesis. When discussing the behavioral avenue, Uhl refers to the term of optimization, meaning that there are better and worse options for dealing with challenges posed by the evolution: natural shortage of food, competitor, difficult environmental conditions and other eventualities (Uhl, 2009, pp. 105-106).

Roth (2003) shares the idea of *continuity of behavior* ("Kontinuität des Verhaltens") between the chimpanzees and the human being. He argues that in direct comparison to the evolutionary development of the ape's behavior (chimpanzees), the human being distinguishes itself by its ability to vary the setting of the evolution (phylogenetic determination) through conditioning, education and reflection (Roth, 2003, p. 93).
From an evolutionary point of view, it is the selection-conditioned adaptation that constitutes the guiding principal of the evolutionary mechanisms. In concrete terms, this implies that survival is ensured through adaptation of ecological niches. Evidently, for the human evolution, it is the growth and development of the brain that has boosted its cognitive abilities. In the following section, a brief historical overview of human evolution, with the focus on the interdependency of selection and adaptation processes, is provided.

2.2 The Human Evolutionary History - A Brief Outline

The expose below aims at pointing out some evolutionary mechanisms which may have contributed to the development of the human cognition.

A focus on the development of the specific cognitive abilities of the human being is essential for the understanding of the rapidly increased number of descendants. In fact, the evolutionary history of the human being is comparatively young; 10.000 years ago, the Homo sapiens populated the earth with no more than about 10 million individuals, whereas today - from an evolutionary perspective a very short period of time - the number of species exceeds 7 billion (Uhl, 2009, p. 94).
According to the current state of the arts, the primary cause for the rise of the mammals dates about 65 million years ago when a mega-impact (an asteroid hitting the earth) led to the extinction of the dinosaurs. The vanishing of these huge lizards led to new opportunities for the mammals. Embarking from their ecological niche as nocturnal animals, they became the dominating type of animal with a rich diversity of species (Uhl, 2009, p. 95). The history of the human being took off about six million years ago when a population of great man-like apes became isolated from its peers. Via reproduction, this group developed further and split up into new groups. Over time, variations of the first two-legged ape, the species *Australopithecus* arose in these groups (Roth, 2003, p. 77).

As Tomasello (2006) stresses, recent studies suggest, that only one of these groups survived. This one species survived up to two million years ago, when it had developed to such an extent that it had become a new species: the *Homo*. In comparison to its ancestors, i.e. the Australopithecines who were about 1,20 meters tall, had brains of a size comparable to other apes and did not produce any tools, the Homo species (e.g. *Homo habilis, Homo erectus*) was not only larger but had bigger brains and was capable of developing artifacts such as stone-tools. The Homo soon tried to expand his borders beyond Africa, but did not succeed establishing decisive population sizes. It was only around 200 000 years ago that a new population-line of the Homo developed in Africa and, subsequently, spread over the whole world. Over time, this version of the Homo suppressed all other populations of it. The ancestors of this type of the Homo are today

recognized as *Homo sapiens*. The size of the brain of a Homo sapiens is considerably larger than the one of his ancestors but the most striking difference lies in his cognitive abilities. These abilities manifest themselves for example in the production of advanced artifacts such as highly developed stone tools, symbolic forms of communications as well as social practices, rituals and values (Tomasello, 2006, p. 12).

It is assumed that the typical, human-syntactical, language of the Homo sapiens evolved some 100 000 years ago. Even though no evidence has been presented, it is anticipated that the first maturation of this development was achieved 70 000 years later, resulting in evolutionary modifications of the brain structure. This coincided with a cultural explosion that inter alia culminated in great works of art, e.g. the advanced cave paintings in Spain (Altamira) and South-France (Lascaux) (Roth, 2003, p. 80).
It is during this time that the Homo sapiens finally prevailed against its closest relatives, i.e. the *Homo erectus* and *Neanderthal,* and, boosted its cultural development pace considerably. Around the end of the most recent ice age, some 10 000 years ago, the first agriculture occurred in the Near East. This resulted in the first bigger settlements, with up to several thousands of individuals. The first advanced civilizations arose in such, densely populated, communities in China, Mesopotamia and along the rivers of the Nile and the Indus. Inventions such as the alphabet led the foundation for developments in the fields of astronomy, mathematics, art etc. (Roth, 2003, p. 81).

To this day, it is not clear which biological factors have made this development possible. It appears plausible, though, that the human brain and its cognitive abilities have not changed dramatically within the last 30 000 years, from a biological point of view. Furthermore, the Homo sapiens is genetically very homogenously equipped, e.g. there are no significant differences between races as regards intelligence etc. In an attempt to analyze the major development leap of the human history, Roth (2003) suggests that it could be best explained via a synergetic effect of many single factors. Besides the syntactical language, it is the formation of densely populations, the requirements of settlement and thus the resulting necessity of cultural coexistence, which are assumed to be of the highest relevance (Roth, 2003, p. 81).

According to the present state of research, one significant difference between the Homo sapiens and its closest relatives is the kind of locomotion. Simultaneously with the upright posture, about 3,5 million years ago, the alteration of the human brain begins. The significant increase of weight and the, concurrently accumulated, cognitive abilities give raise to questions with regard to the underlying evolutionary factors (Uhl, 2009, p. 97). Still today, the scientific reconstruction of the human phylogenetic history is an on-going project, with several key questions to be explored.

2.3 The Rapid Growth of the Human Brain

As mentioned in the previous section, the increase of the human brain size started approximately 2,5 million years ago, simultaneously with the beginning of the stone tool production: the phase, which represents the step from the species of Australopithecus to Homo. At that time, a global cooling changed the African forests into scrublands and, subsequently, grassland savannahs. It is assumed that the process of adapting to this new environment caused some of the modifications that resulted in the origin of the species of Homo. The earliest form of the Homo species was the *Homo habilis*, the creator of tools, with a brain volume of 600-700 cubic centimeters, i.e., considerably larger than the one of the Australopithecines. About 1,8 million years ago the *Homo erectus* appeared. Compared to his predecessors, the Homo erectus was taller and had an even bigger brain volume (800-900 cubic centimeters). The Homo erectus could master fire-making techniques and as far as known, he was the first Homo to leave the geographical boundaries of the African continent. In some part of the world, his ancestors survived until just 100 000 years ago (Blackmore, 2010, p. 124).

Even though quite a bit of fossil evidence of the Homo species has been found meanwhile, the origin of the modern human being is still uncertain. It is assumed that one Homo sapiens lineage occurred about 150 000 years ago in Africa. However, another lineage, the earlier referred to Neanderthal, lived at the same time and declined only 30 000 years ago. Which of these two lineages led to the modern Homo sapiens is still being debated among

scholars. Nevertheless, it is considered proven that this archaic form of the modern human being already had a brain volume of about 1100 cubic centimeters (Blackmore, 2010, pp. 124-125).

It is the dramatic increase of the brain volume within a relatively short period of time that constitutes the crucial point in the evolutionary history of the human being. No more than 3,5 million years separate the Australopithecines from the modern man. Within this time frame, the brain volume has tripled, (i.e. the former had a volume of about 450 cubic centimeters while the man of today has a volume of 1300-1400 cubic centimeters) (Roth, 2003, p. 85). It is assumed that 100 000 years ago all living hominids belonged to the Homo sapiens who had a brain volume as large as the one of today's human being. This massive expansion of the volume of the brain came at high energetic costs for maintaining the new structures. Hence, it is evident that there must have been strong evolutionary reasons for this development (Blackmore, 2010, pp. 125-126). As Uhl (2009) points out, sufficient brain volume is biological pre-requisite for the development of abilities such as intelligence, perception and communication (Uhl, 2009, p. 105).

The, in relative terms, extremely short period of time during which the volume of the human brain increased so dramatically together with the significant development of cognitive abilities leads to the question whether biological models are sufficient for explaining such a growth. To speak with Tomasello (2000), the problem with biological theories is that the given time frame (irrespective of whether one considers 6 million or 230 000 years) is far too short for normal biological evolutionary mechanisms to achieve this expansion. Tomasello stresses that it is not only the rapid and complex development of human cognition but also the ability to nurture the related competences that has lead to man's comprehensive achievements in the areas of technology, media communication and social organizations. This, Tomasello stresses, cannot be reduced to biological-evolutionary mechanisms only (Tomasello, 2000, pp. 4-5).

In this context, Tomasello (2000) refers to mechanisms of social and cultural transmission, which, in his view, operate on a quicker time scale than processes of organic evolution. Tomasello argues that cultural transmission form part of the evolutionary process; thereby ensuring that already existing knowledge and skills can be preserved through generations.

This includes different processes such as dissolving patterns of behavior and passing on skills via imitation learning and teaching, to mention only a few of them. However, it is assumed that the specific set of cognitive abilities and related cultural products, e.g. arts, science, mathematic and music etc., represents a result of various cultural transmission processes (Tomasello, 2000, pp. 4-5).

In conclusion, it can be stated, that the development of the human cognitive abilities has played a major role in the evolutionary genesis of the human being. It is considered that a major selective pressure triggered by the environment has led to the massive growth of the human brain volume during a time frame which has to be regarded as remarkably short for such substantial physical and cognitive changes. The significant increase of the brain size and the parallel cognitive and cultural achievements of the human being give rise to the question how this enormous acceleration of cultural and behavioral changes could be explained. It has been demonstrated that merely biological mechanisms seem to be not sufficient for explaining this genesis; cultural processes with a social and cooperative impact might bring one closer to a solution.

2.4 Cultural Ability as an Evolutionary Advantage

As mentioned above, the development of the human brain can be regarded as a long evolutionary evolvement of a highly dynamic system based in many respects on the individual capacity of learning. Accordingly, the scientific approaches of the 1950s, for example, comparing the brain structure with a computer hardware system and the idea of a *domain-general hypothesis*[3], appear rather obsolete today. It can even be argued that the concept of a blank platform, which needs to be structured, is contra-productive from an evolutionary perspective. Today, research is mainly focused on the modularity of the human nervous system (cf. chapter 2). This complex and cross-linked structure of nerve cells mirror human cognition with its possibility of strategic and complex thinking based on an evolutionary development of the brain structure (Uhl, 2009, p. 109).

[3] Traditionally, the nature of human intelligence has been explained on the basis of a *domain general* perspective. From this point of view, intellectual capacity has been regarded as a general, unspecific and retrievable potential of the human brain that can be drawn on when the need arises (UHL, 2009, p. 112).

The above gives rise to the question exactly what constitutes the advantage of such highly developed cognitive abilities with regard to the unique plasticity of the brain. Uhl (2009) points out that a large brain provides both the possibility to react on outside stimuli with congenital behavior as well as with the adaptation of behavior on concrete environmental situations (Uhl, 2009, p. 98). In this context, the terms of intelligence, perception and communication refer to fundamental dispositions of the human, being developed over the course of time and jointly responsible for the accelerating development of cultural abilities. This is ensured through the ontogenetic phase and related adaptation processes of e.g. learning different languages, gaining motoric competences to individual set requirements and dealing with the communicative codes of the social surrounding (Uhl, 2009, p. 123).

As Uhl (2009) summarizes, several hypotheses that aim at explaining the unique development of cognitive competences of the human being. At an early stage, it had been assumed that the manufacturing and the handling of tools represent the starting point for the specific human genesis (Oakley, 1967). In this respect, the complex coordination of sensory and motoric competences needed for handling weapons constitutes the starting point of human advanced cognitive development and describes one possible hypothesis (Calvin, 1993; Neuweiler, 2005). A comparatively young theory positions the respective selective pressure in an entirely different area of the ecological niche. Rather than production of tools, it is the social interaction which has led to the remarkable acceleration of the brain growth. According to Blackmore (2010), the psychologist Humphrey (1986) was one of the first advocates for this perspective; he introduced the theory that the decisive development stage had been reached when the early hominids started to empathize with each other. This was followed by the so-called *Machiavellian Intelligence* of Byrne and Whiten (1989), who took the social approach further by not only limiting it to social interaction and relationship but also stressing the importance of rapid parallel processing mechanisms.[4] Moreover, the *social intelligence hypothesis* (Kummer, Daston, Gigerenzer & Silk, 1997) generally underlines that during the course of evolution cooperative forms of behavior (complex socialization) increasingly gained importance and were decisive for the development of the human brain size. Within this thesis special

[4] Machiavelli (1469-1527), the patron of this theory, was well known for his capacity of conspiracy and forming strategic alliances and detecting plans of competitors with a view to defeating them. Not only does this principal of competition refer to evolutionary mechanisms it also applies to social processes, e.g. when individuals interact with each other for the purpose of improving the conditions for survival (Blackmore, 2010, pp. 130-131).

attention is given to the theories of *shared intentionality* (Tomasello, 2000) which underscore the relevance of cooperative and empathizing abilities of the human being.

In summary, since the 1990s, the social theories on the evolution of intelligence are generally recognized by science as relevant for explaining the increase of the brain volume.
The ability to simulate and imagine the other's course of action characterizes the *Homo psychologicus*. The expansion of the brain is related to orientation abilities within complex hunters and gatherer communities, where strategic thinking and cultural interplay are considered as selective factors. In particular, the evolvement of the communicative abilities of the human being has provided it with an evolutionary advantage as far as mutual understanding and cooperation characteristics is concerned.

As mentioned above, current theories on the evolution of intelligence tend to be based on social, rather than technical, approaches (cf. domain general hypothesis as mentioned above). However, many questions related to the specific selective pressure that has triggered the extraordinary development of the human brain remain open. From an evolutionary point of view, it seems evident, though, that both biological and cultural factors play an equally important role. Accordingly, the interdependencies of congenital dispositions, cooperative behavior and thinking processes are of utmost relevance for the present analysis.

2.5 Cognition and its Impact on Cultural Generating Performances

Until to the 1980s, the evolution was commonly understood as a causal mechanism operating as a selective process on the physiognomy of the body and evolving in the diversity of species. However, as mentioned above, in addition to the central evolutionary problems of survival and reproduction, the control of behaviors is of equal importance for the understanding of the evolving mechanisms of the human being. In this context, it is the ability to consciously enhance the own behavior and influence the behavior of opponents. For the purpose of the present thesis, the ability of strategic thinking (optimizing and

adapting behaviors) is particularly relevant for the understanding the complex cultural development of the human.

It is important to note that the human brain structure (cognitive disposition) and its cultural-generating abilities are not based on newly created features but on an evolutionary conditioned adaptation process of phylogenetic structures and mechanisms. These structures and mechanisms mirror the mutual survival strategies of all forms of life: the non-random coping with the environment. Accordingly, the abilities and characteristics of modern organisms reflect adaptation processes related to challenges dealt with during the phylogenetic past.[5]

Viewed from an evolutionary perspective, the development of the human cognition, from hunting and gathering to cultivating, could be described as the result of an emergency strategy. Due to its specific cognitive competences, the human being has continuously triggered cultural processes. The modern human being can be regarded as defined through his ability of connecting comprehensively with the prevailing cultural conditions. In fact, it could be argued that the human being has found his appropriate ecological niche, representing not the optimum of a development stage but showing a constantly work-in-progress form of organism, which is defined by its specific cognitive development (Uhl, 2009, pp. 104-105).

In this context, it is essential taking into account Uhl's (2009) concept of *cognition as ecological niche* ("Kognition als Ökonische", p. 98). On the one hand side, this concept represents the biological manifested genesis of the human species, based on evolutionary defined regulations. On the other hand side, however, it encompasses the cognitive competence of culture generation that is enabling the human to relate to himself and his cultural context as well as empathizing with others. It is also the ability to develop and establish cultural forms of life, which the human being, compared to the apes, is more capable of enhancing, developing and preserving in a more complex and efficient manner. It is evident that, besides the mere biological mechanisms of the human genesis, the

[5] This is particularly well illustrated by the ability of color vision, which only the most developed species of apes possess. This environmental adaptation process within the primate phylogeny can be regarded as a biological response to a decisive selective problem. It is assumed that the driving force behind this very specific sensory advancement either stems from the need of finding fruits in the predominantly green jungle vegetation or to requirements of *social cognition*. A major factor in this context is, that the development of this specific ability did not only effect the eyes development but also generated an adaptation of behavior as well as of brain anatomy (Uhl, 2009, p. 93).

cultural mechanisms are essential when analyzing the evolution of the human cognition. In this context, the inherent interdependencies between natural and cultural processes of evolutionary genesis have to be taken into account.

Summarized, it can be said that the criteria of perception, intelligence and communication refer to the specific intellectual capacity of the human being, which clearly distinguishes him from the non-human species. Specifically put, it is the innovative and, thus, creative competences of the human being and his ability of culture generation and stabilization that differentiate him from his descendants. It has been indicated that biological models are insufficient for explaining such development. However, interdependent evolutionary mechanisms (biological and cultural) seem to come into play when analyzing human genesis. The following chapter introduces such theories based on a universal Darwinism and the so-called replicator model representing an important starting point of dual inheritance models.

3 Universal Darwinism and Replicator Model

3.1 Darwin's Paradigm

Darwin's groundbreaking theory is based on three major processes, i.e. variation, inheritance and selection, which all contribute to generating characteristics of living organisms that increase the chances for survival. Inevitability, it is this broad perspective on the evolutionary process, which makes Darwin's perspective so convincing.

With reference to Darwin's theory, Dennett (1995) describes the evolutionary process as an algorithm, i.e, an instructional default which, ultimately, leads to a given result. As Dennett points out, algorithmic processes are neutral vis-à-vis any material. Dennett considers that all living creatures and their biological environment can be regarded as evolutionary material. He, however, emphasizes that it is the underlying logic, i.e. processes related to variation, selection and heredity that are applicable to any evolving system. This approach is related to the idea of the *universal Darwinism,* which implies that algorithmic processes are irrational and without any intention. In other words, they are simply functioning by an inherent set of rules. Due to this reason, Dennett describes Darwin's theory as a *principle* of development that emerges from chaos without a conscious mind, thereby he emphasizes that processes that follow algorithmic rules are neither predetermined nor predictable (Dennett, 1995, p. 50).

In this context, Blackmore (2010) refers to the chaos theory, which aims at explaining why simple processes such as a tripping tab or flowing gases, by following simple algorithmic instructions, can lead to complex, chaotic and unpredictable results. In general, these chaotic systems are extremely sensitive with regard to starting conditions, i.e. even the occurrence of a diminutive change within the initial phase can lead to a completely different result. Blackmore points out that studies conducted in the field of chaos science tend to compare the evolution of life with a compressible computer algorithm. Again, it is not foreseeable how this process will look like but universally valid rules that control these unpredictable development processes, can, nonetheless, be defined. As described,

evolutionary processes do not necessarily lead to meaningful and progressive results. Accordingly, the highly diverse biological environment of today is, to some degree, a result of coincidences triggered by the evolutionary principles (Blackmore, 2010, pp. 38-41).

Blackmore (2010), furthermore, refers to *Campbell's rule* (*random genetic variation, non-random selection,* cf. chapter 2.1.1*)*. Campbell (1960) stresses the similarities between the processes of the organic evolution, creative thinking and cultural evolution. Within these processes, a random variation, as well as a selective inheritance of some variations, on costs of others, take place between the replicative units. Campbell regards this as a general model for evolutionary changes. To this end, the organic evolution is only one example of such mechanisms but it is applicable to other progressing systems. In this context, Blackmore summarizes that it is the replicative mechanism, which is referred to the concept of universal Darwinism, applicable on numerous systems as e.g. the evolution of sciences (Blackmore, 2010, p. 47).

In this regard, it becomes obvious that the genes are not necessarily the only replicative units of the evolutionary system. Dawkins (2010) was the first to develop a comprehensive theory of replicators, based on the competitive process of replicators triggering new information units. He considers that this theory can be applied on both the biological and cultural evolutionary processes.
The following chapter provides a short introduction to the biological and cultural idea of a replicator theory on the basis of universal Darwinism. It should be pointed out that this theory does not aim at covering social aspects in a comprehensive manner but, nonetheless, presents an important contribution to the theme of knowledge generation from an universal evolutionary perspective.

3.2 Dawkin's Replicator Theory

Dawkins (2010) is the founder of the concept of the *selfish gene*. In his view, the evolution is best understood as a competition between genes. According to Dawkins, "selfish" implies that a "desire" to replicate themselves constitutes the driving force of genes. In this respect, Dawkins distinguishes between *replicators* and *vehicles*. A replicator is the unit that is copied. Those that are particularly well suited and, thus, enjoy a higher chance of being copied are referred to as *active replicators*. A vehicle is the unit that interacts with the environment; it is the carrier and protector of the replicator. Dawkins considers that one of the first replicators was a primitive, self-copying molecule in the primordial soup. The best-known replicator of today is the DNA. Its vehicles are innumerable organisms that interact with each other all over the globe. Accordingly, Dawkins considers genes as selfish replicators that drive the evolution of the biological world (Dawkins, 2010, p. 56).

This new perspective has led to an understanding of evolution that is based on a replication of processes but not necessarily on the individual interest of the preservation of species. It implies that, as long as there is one replicator available who reproduces, potentially imperfect, copies of itself (thus, only a few of them survive), evolution, nevertheless, occurs. In this context, *selfish* represents the mere drive to replicate, based on the chemical order for copying information. Dawkins, furthermore, (2010) argues that the selfishness of the genes causes egoistic behavior of the individual. At the same time, he, however, stresses that biological determined human behavior could be potentially altered through culture and processes of learning (Dawkins, 2010, pp. 37-38).

Dawkins' (2010) idea of universal Darwinism becomes evident in his hypothesis that all forms of life have originated through replication processes. By introducing the *meme,* as a second replicator, he stresses that the idea of the gene as the only fundament of the evolutionary processes has to be reconsidered. According to Dawkins, cultural information as melodies, thoughts, fashion, handicraft skills etc. can be regarded as examples of (the impact of) memes. Compared to the gene, which he describes as the predominating replicator, the meme replicator is capable of copying information at a much higher pace.

Similar to the reproduction of genes, via *gene pools*, memes are distributed via *meme pools*, i.e., memes reproduce themselves via brain-to-brain contacts. Accordingly, Dawkins suggests that memes are stored in the human brain, but also in media such as books etc., and are transmitted via the process of - in the broadest sense of the term - imitation (Dawkins, 2010, pp. 317-324).

In other words, the meme is *the* generator of cultural transmission and imitation processes. As examples of successful *memetic* transmissions, he refers to scientific and religious concepts that tend to prevail for considerable periods of time. Dawkins (2010) regards the meme as an independent replicator that is driven by an autonomous force. In his view, the reproduction of memes cannot be attributed to a biological fundament. Dawkins emphasizes that the mechanisms of replication of memes can be seen in analogy with the reproduction of genes, but the former runs under its own determined conditions (Dawkins, 2010, p.323). Further to the thinking of Dawkins, Blackmore (1999) has introduced the term *memetic drive*, whereby she stressed the relevance of social processes for memetic transmission processes.

3.3 Blackmore: The Meme as a Replicator Unit

Blackmore (2003) refers to the Oxford Dictionary, where meme is defined as „[a]n element of culture that may be considered to be passed on by non-genetic means, esp. imitation“ (as cited in Blackmore, 2003, p. 55). Blackmore, however, considers that knowledge and competences, which have been acquired through imitation, can be considered as memes (language skills, customs, social rules etc). Furthermore, she suggests that memes are shared and develop through brain-to-brain transmission, whereas it is the behavior of the respective vehicle (individual) triggering copying processes (Blackmore, 2010, pp. 32-33). Blackmore considers that memes exist *both* within and outside of brain structures. This is of particular relevance when referring to evolutionary processes of natural and artificial systems. Hence, she distinguishes between two categories of memes: those belonging to a group of stored information, such as ideas, neuronal patterns, memory

and knowledge within the brain and those provided through behavioral patterns or artifacts, for example statements, expressions, gestures, art and invention or digital stored information (e.g. in books and computers) (Blackmore, 2003, p. 55). However, as Blackmore points out, ad hoc perceptions and emotions should not be regarded as memes, since they refer to the individual only and are, potentially, never transmitted further by imitation (Blackmore, 2010, pp. 44-45).

It is essential to note that Blackmore (2010) regards the process of imitation as directly linked to human behavior. Like Dawkins (2010), she considers memes to be selfish units in the sense that their sole objective is to replicate themselves - whether the impact of that is meaningful, neutral or destructive is irrelevant (Blackmore, 2010, p. 33) Analogous to the theory of universal Darwinism, it needs to be recalled that also Dennett (1995) regards memes as information related to an algorithmic process, regardless whether they are stored in the brain, in a book or another physical object. Dennett emphasizes that the process of imitational behavior results into neuronal changes of the brain. Hence, when two brains are copying the same meme it is likely to result in different meme structures in each brain (Blackmore, 2003, p. 56).

According to both Dawkins (2010) and Blackmore (2010), memes are replicators that are based on the evolutionary algorithm of variation, selection and heredity. *Variation* implies, for example, that stories are rarely told twice the same way. Memetic *selection* is referred to when some memes draw more attention than others with the consequence that the former are being copied more often and more precisely. Furthermore, each time memes are transmitted through the emerge of ideas or behavior, *heredity* of memetic structures occur (Blackmore, 2010, p. 43).

Memes are selfish replicators that strive to increase their reproduction rate and, thus, secure their survival. Blackmore (1999) refers here to three criteria defined by Dawkins (1996) with regard to the efficiency of memes: *durability, fertility* and *accuracy* of reproduction. The higher the match vis-à-vis these criteria are, the higher the chances of survival. Applied to the idea of the meme-pool, it becomes clear that the proportion of memes that meet these criteria is increasing over time, at the expense of less fit ones. To

sum up: Memes that are easy to memorize (durability) plus memes, which are easy to copy and imitate (fertility), and those, which are difficult to modify (accuracy) will spread (Müller, 2010, p. 53).

Another possibility of improving the efficiency of meme reproduction, through increased accuracy rate, is to apply a *copy-the-instruction* approach, rather than a *copy-the-product* one. According to Blackmore (1999), imitation based on given instructions will always increase accuracy of the reproduction and, thus, reduce energy costs. Blackmore anticipates that the driving force of the memes will shift towards the direction of *copy the instruction*. Examples of instructive mechanisms for efficient meme distribution include language and digital communication (internet) (Müller, 2010, p. 54).

Blackmore (2010) considers that the human being acts both as a selector of and imitator for memetic transmission. From a memetic point of view, however, the human brain provides the environment for memetic transmission. According to Blackmore, three criteria are of importance for the filtering mechanism of memes. First of all it is the mechanism of attention control, leading to selective meme focusing. Secondly it is the nature of human memory filtering storage options of specific memes and, thirdly, it is the limitation of the imitation capacity of the human (Blackmore, 2010, p. 45).
Generally speaking, these criteria are of utmost relevance for the understanding of cultural transmission processes. The social aspects of imitation and mutual attention control are of particular relevance for Part 1 of this thesis.

3.3.1 Social Criteria for Imitation

Blackmore (2010) regards the imitation-process as the central procedure for evolution and distribution of memes. She, thus, emphasizes that the definition of this process needs to be concretized with regard to the memetics (Blackmore, 2010, p. 32). In that context, Müller (2010) refers to imitation as a genuine basis for developing inter-human understanding. Imitation, he argues, is a form of a learning process and it must not be confused with other

forms of learning as the classical conditioning or the trial-and-error-method, which almost all animals are capable of. In the latter cases, successful learning does not require that the animal understands the behavior it acquires. With regard to the memetics, the process of imitation that is relevant for (cultural) transmission is based on imitating (not simply copying) the other's behavior. Although acknowledging that it is not uncontroversial, Blackmore stresses (1999), that „[i]mitation is learning something about the form of behavior *through* [emphasis added] observing others, while social learning is learning about the environment through observing others" (as cited in Müller, 2010, p. 47). Successful imitation requires sufficient intellectual abilities and, as human imitation constitutes a process of *intentional* understanding, it may influence strategic decision making (Müller, 2010, pp. 46-48).

For the purpose of the present thesis, it is not warranted to analyze Blackmore's (1999; 2010) definition of imitation in detail. It should be noted, though, that learning processes constitute an inherent feature of most theories related to cultural evolution that is based on universal Darwinism.

4 Social Hypothesis

4.1 Tomasello's Theory of Cumulative Cultural Evolution

The concept of *social intelligence hypothesis* (Kummer, Daston, Gigerenzer & Silk, 1997) (cf. chapter 2.4.) is based on the assumption that social cognition has been decisive for the development of the human brain volume, which, in turn, has allowed for coping with complex cultural challenges. Amongst others, Tomasello (2006) has given impetus to research in the field of social cognition, especially with regard to the social learning processes of the human being during the ontogenetic path. It should be noted, though, that Tomasello takes a coevolutionary point of view, thereby underlining the significant influence of the genome and stressing the impact of environmental features for biological and cultural development. According to Tomasello, both, fixed (genetic) and variable (cultural) structures have contributed to the evolution of the human kind (Tomasello, 2006, pp. 68-69).

Tomasello (2006) refers to *cumulative cultural evolution* in the context of the specific cultural development of the human being. He considers that the unique capability of the human being to accumulate traditions and artifacts distinguishes him from other animal species. Tomasello stresses that the most complex artifacts and social practices of the human have not been invented only once. From his point of view, one determining factor for the cultural developments of the human being lies in the ability to preserve artifacts or practices over long periods of time. It should be noted, though, that such preservation may well be enhanced by subsequent users who thereby introduce new elements within the set of cultural skills (Tomasello, 2006, p.16).

Tomasello (2000) describes this ability of preserving acquired skills and cultural competences as the *ratchet effect*. This effect ensures that new or improved forms of artifacts or social practices may be channeled and modified through generations.

In this respect, cumulative cultural evolution must not be reduced to a matter of inventiveness; processes related to transmission and preservation of skills and abilities deserve to be taken into account as well (Tomasello, 2000, p.5).[6]

Accordingly, the development of human cognition is based on creative achievements, social transmission and, as Tomasello (2000) stresses, three forms of social learning, i.e. *imitative, instructional* and *collaborative* learning. These three types are possible through one unique form of social cognition: the ability to empathize with the counterpart and to understand his perspective. In contrast to the animals, the human being learns not only "from" but also "through" others. Again, this specific element of the human learning processes rests on the fact that the human being is capable of identifying himself with conspecifics. These conditions create a particularly huge, intensive and reliable sphere of cultural transmission processes which form the basis for the ratchet effect. Both the efficiency of human cognition and the related significant inventiveness can be explained on the basis of this combination of complex cognitive competences and stabilizing mechanisms. All these mechanisms belong to the process of socio-genesis, which is based on collective cognitive courses of action. Accordingly, inventions and innovations should not be regarded as achievements of single individuals but, rather, as results of collective modification processes. As Tomasello (2000) points out, this specific social-cognitive competence of the human being is based upon cognitive abilities that, to some extent, are shared with most primates, the understanding of space, objects, quantities, communication etc. However, it is the social-collective key which enables the human being to cumulative forms of cultural evolution (Tomasello, 2000, pp. 5-7).

In summary, Tomasello's (2000) research is primarily focused on social learning processes during the ontogenetic time frame. To this end, he puts particular emphasis on processes related to imitative learning and shared-intentionality.

[6] It is of vital importance to note that several animal species, indeed, are capable of creativity and innovations. However, in the absence of a stabilizing ratchet effect further development is hampered. Respectively, it is evident that non-human primates are capable of intelligent behavior, but their abilities with regard to implementing social learning processes, guaranteeing the stabilization and transmission of already gained competences and knowledge are rather limited.

4.2 Social Learning Processes and their Innovative Potential

According to Tomasello (2006), the cumulative cultural evolution depends on the two processes *imitation* and *innovation* which need to be interlocked within a dialectical process. Concretely, this implies that imitational learning promotes constant re-modification processes on the basis of previous cultural achievements. This process can be regarded as a consecutive development of either accepting existing solutions or modifying them in line with the prevailing environmental conditions. It is important to note that only the process of imitation (including instructional learning) is strong enough for supporting cumulative evolutionary processes. This process should not be confused with less efficient forms of social learning, such as there is local improvements, emulative learning, ontogenetic ritualization, and individual learning (Tomasello, 2006, pp. 54-57).

According to Tomasello (2006), it is this imitative learning process that ensures a high quality of the transmission of cultural achievements and the possibility to maintain those over a historic period of time, i.e. (knowledge gain). Again, it is the human being's unique ability of shared intentionality which boosts processes of social learning and, thus, distinguishes him from other animal species inter alia because it constitutes a pre-requisite for highly developed forms of instructional learning through the ontogenetic path. Consequently, human processes of social learning allow for effective ratchet effects by maintaining newly gained strategies and knowledge structures within a social group for further development (knowledge modification) (Tomasello, 2006, p. 57).

It should be recalled that also primates do show forms of social and, even, imitative learning. However, as Boyd and Richerson (1996) argue in their paper "Why culture is common, but cultural evolution is rare" (as cited in Tomasello, 2000, p. 40), there is a significant qualitative difference vis-à-vis the human being. Chimpanzees may show some ability of social and imitative learning which, however, is significantly limited to the prevailing context. In fact, it is not even proven that all chimpanzees possess this capability. Already, this qualitative difference, Boyd and Richerson suggest, would explain the varying genesis of human being and ape. Nevertheless, they emphasize that, additionally, the social learning structures of the apes show too less of competences

guaranteeing the ratchet effect of cultural achieved accomplishments. Furthermore, Tomasello (2000) argues that also a quantitative difference (reduced social and imitative learning ability) between the abilities of social learning of the human being and the ape can be noted. As mentioned above, the unique socio-cognitive abilities of the human are in particular based on the social learning processes of *imitative*, *instructional* and *collaborative* learning, leading to effectively "powerful forms of collaborative inventiveness or sociogenesis" (Tomasello, 2000, p. 41).

4.3 Cooperative and Collective Forms of Innovation

According to Tomasello (2006), the specific form of human social intelligence and the related rapid cognitive development can be attributed to one single biological adaptation: The understanding of the other as an intentional being eventually leading to the complex cognitive abilities of the human. More precisely, it is the ability to anticipate the intentions of the other and to align the own behavior towards a mutual goal which forms the basis for cultural learning (Tomasello, 2006, p. 18).

This also constitutes one explanation model for the rapid and enormously growth of the human brain: Thanks to his social and cognitive competences, the human being is capable of constantly developing his cultural potential. According to Tomasello (2000), these competences are based on the (historical) process of socio-genesis. To this end, he distinguishes between two forms. In both of these cases the formation of new skills is based on interaction between individuals. Hence, the origin of new artifacts can be regarded as based on a collective practice:

The first form of sociogenesis describes a process where an individual is confronted with the situation that the currently available artifact or cultural practices are not adequate. In this case, however, the individual deals with the situation by adjusting the artifact and/or practice as appropriate on his own.

In contrast, the second form of sociogenesis implies concurrently cooperation between two or more individuals, for example with regard to mutual problem solving strategies. Through communicative interaction, the individuals involved provide feedback on each other's (innovative) proposals. As Tomasello (2000) points out, this form properly describes the typical situation in cultural development (Tomasello, 2000, pp. 41-42).

In this context, Tomasello underlines that it is not the biological but the cultural mechanisms that determine the pace of the cognitive and cultural development of the human being. However, from his socio-biological point of view, he underscores the importance of the cooperative behavior of the human. This collaborative form of behavior is, primarily, based on the specific social learning processes, which the human being has developed during the ontogenetic path:

> Processes of cultural learning are especially powerful forms of social learning because they constitute both (a) especially faithful forms of cultural transmission (creating an especially powerful cultural ratchet) and (b) especially powerful forms of social-collaborative creativeness and inventiveness, that is, processes of sociogenesis in which multiple individuals create something together that no one individual could have created on its own. (Tomasello, 2000, p. 6)

Although these newly acquired abilities lead to cultural mechanisms operating on a much quicker scale than biological mechanisms it is, nevertheless, important to note that these abilities rest on congenital cognitive disposition of the human descendants

Hence, the development of the human cognition and the related cultural competences constitute a social-collective dimension that has enabled accumulation and preservation of cultural skills and achievements, eventually over a long period of time. This socio-cognitive abilities distinguish the human being from other animal species insofar it describes how the complex cognitive competences have contributed to human cultural evolution.

4.4 Shared Attention and Intention - The Ontogenetic Path

Tomasello's (2000) research focuses on analysis of human cognition during ontogenetic development. He is of the opinion that cultural cognitive competences are based on the cross-linkage of congenital disposition of *shared intentionality* in combination with the ability of *shared attention* which develops further during the individual life cycle (Tomasello, 2000, p. 66). In this context, Tomasello stresses that, in particular, the social learning processes during the ontogenetic path have enabled man to establish and preserve highly advanced forms of cultural knowledge. Accordingly, it is within human evolution only, that the human being is able to refer to the collective knowledge and history of its own kind on such an advanced level.

From an evolutionary point of view, as Tomasello (2000) points out, organisms are not merely the sum of their genes (genome) they also relate to the prevailing environment. As for the human being, the social environment is especially relevant and refers to "what we call culture, and it is simply the species-typical and species-unique 'ontogenetic niche' for human development" (Tomasello, 2000, p. 79). Tomasello considers that two factors are of particular relevance for the cognitive development of the human child. These are the given orientation lines for behavior (habitus) of a group and the explicit instructions of adults, whereas the latter constitutes a highly efficient form of cultural transmission (Tomasello, 2000, p. 79). Tomasello stresses that it is only at the age of nine month, a child typically starts to become capable of shared attention in a comprehensive sense, i.e., experiencing the other and itself as intentional agents, and become capable of imitational forms of learning. Accordingly, the child has then become capable of interacting with the cognitive collective (Tomasello, 2000, p. 61).

Throughout the human evolution, it is this socio-cognitive competence which qualifies the human being to sophisticated and highly developed representation of the given environment. The abilities of *shared attention* and *intentionality* have lead to a need of more advanced forms of communication. Language can be regarded as one of the most prominent examples of the abstract meta-representation of thoughts and intentions for the

purpose of sharing attention and intentions. Linguistic symbols represent symbolic artifacts which enable effective interaction, for example by allowing diverse perspectives on the same content to be exchanged. Fundamentally, Tomasello (2006) argues that language aims both at representing and optimizing interpersonal communication (Tomasello, 2006, pp. 19-20).

Besides, Tomasello (2000) considers that language constitutes only one, however vital, result of the cumulative cultural evolution. In general, evolution has brought about a multitude of cognitive developments in parallel which all have contributed to increasing intellectual competences of acquiring cultural knowledge of the human being. This process of continuously accumulating knowledge stems from the evolutionary need of optimizing survival strategies. In this respect, the ontogenesis represents the time frame when the intellectual needs of the human being meet the cultural resources of the given environment. It is important to note that the social and cultural processes have not led to the creation of new cognitive abilities during the ontogenesis. Instead, already existing abilities have been transformed and, potentially, modified into more complex and advanced forms. From a biological point of view, this implies that the given gene-code determines the basic cognitive abilities. In parallel, though, at the same time, social and cultural behaviors develop during the ontogenesis and are not determined by the gene-code only. From this perspective, socio-genesis and cultural developments can be explained by a series of ontogeneses, which have enabled effective and efficient behavior to the challenges the human being has met throughout his history.

To sum up: during the phylogeny the human being was equipped with a basic set of cognitive abilities which enabled him to deal with cultural challenges in a rudimentary manner. These abilities were subsequently utilized and improved during the ontogenetic phases. Hence, it is important to stress the procedural understanding of an evolutionary cultural theory. Accordingly, Tomasello (2006) argues that the historical time frame and the ontogenetic process should be regarded as the foundation for complex cognitive accomplishments such as language and mathematic. Tomasello suggests that the importance of the ontogenesis tend to be underestimated within cognitive science and refers to the classical debate about nature *versus* culture (Tomasello, 2006, pp. 67-68).

5 Coevolutionary Perspectives

5.1 Nature versus Culture - Nature and Culture

According to contemporary cognitive sciences, the so called nature-versus-culture (innate versus learned) distinction stems from the discussion whether characteristics of species are of a congenital or acquired nature. This controversy has its origin in the rational and empiric philosophy which had emerged in Europe before Darwin introduced his groundbreaking theories on the biological processes. According to Tomasello (2006), Darwin's explanations of the phylogeny and, particularly, the role of the ontogenesis within the phylogeny, should actually have made the nature-versus-culture discussion obsolete.

Tomasello (2006) considers that the modern genetic provides a rather unilateral perspective of the human development as it is mainly occupied with questions such as which genetic and environmental factors have determined a certain characteristic of the adult human being. Tomasselo argues that the value of applying this, rather quantitative, perspective is limited as it does not take the dynamic and multifaceted character of the evolutionary development into account. According to Tomasello, a comprehensive understanding of the development of the species has to be based on both biological *and* cultural factors (Tomasello, 2006, p.69).

Correspondingly, Tomasello (2000) describes the interaction of the phylogeny and ontogenesis within the cognitive development as interplay between biological and cultural factors based on interdependent processes. He emphasizes that, during the phylogeny, nature selects ontogenetic paths resulting in certain specie's phenotype. These ontogenetic paths are determined through both environmental and biological influences (Tomasello, 2000, p. 49).

As suggested above, a balanced analysis of both biological and cultural processes is preferable when exploring the human cognition. The question whether or not a specific characteristic is congenital is valid only when it leads to a better understanding of all involved processes and, thus, contributes to a coevolutionary approach. This method is based on an interdisciplinary understanding of scientific methods.

According to Tomasello (2006), the model of the dual inheritance approach is related to biological and cultural factors of evolutionary transmission principals which, in turn, are based on the overarching principle of natural selection within the organic world.
The process of biological inheritance, through the genetic blueprint, guarantees the transmission of basic functions related to perception, cognition and behavior. For all kinds of mammals, these genetically predetermined abilities come into play during their ontogenesis. The long period of immaturity of the mammals and the related dependency on the parents imply a risky strategy (vulnerability) in the fight for survival. It should be noted, though, that a long growing up phase also implies advantages as it allows for a greater and more flexible adaptation possibility, thus enabling a wider and more complex variety of development-options during the ontogenesis. This is of particular relevance for those organisms that live in different environmental niches or in environments that are subject to rapid changes as it increases the potential for survival (Tomasello, 2006, p. 25).

The significance of cultural transmission within the animal world has led to the development of a dual inheritance theory, which accepts influences of both biological and cultural inheritance processes for the mature phenotype of many species. This model is especially applicable to the cognitive development of the human being, which is naturally predetermined through biological inheritance but also significantly shaped through cultural transmission processes. In this respect, Lumsden (1981), puts special emphasis on cultural transmission processes for his analysis of coevolutionary processes and states the following: “My study (…) offers tentative support for the hypothesis that human culture and the human genome are not evolving independently on their own, isolated tracks. The neurobiology of culture learning makes them codependent, resulting in the process of gene-culture coevolution” (Lumsden, 2009, p. 159).

Focusing on the examination of cultural transmission processes, Tomasello (2000) aims at identifying cultural abilities and competences during the ontogenetic setting through a systematic comparison of cognitive structures of apes and human beings[7]:

> This one cognitive difference has many cascading effects because it makes possible some new and uniquely powerful forms of cultural inheritance. (…) (a) processes of socisogenesis by means of which multiple individuals collaboratively create cultural artifacts (…) and, (b) processes of cultural learning and internalization (…) This means that (…) the species unique cognitive skills of the human being are not due to unique biological inheritance directly, but rather result from a variety of historical and ontogenetic human, biological inherited, cognitive capacity (Tomasello, 2000, p. 15).

To sum up, the processes of cultural development and optimization is inherent to the system of cultural transmission itself; it follows its own mechanisms, most of which are "programmed" according to factors of flexibility and effectiveness. It is grounded on the ability of the human to understand its conspecifics as intentional and intellectually gifted players.[8]

5.2 The Dual Inheritance Theory - Guided Variation

Boyd and Richerson (1985) founded a theory of social evolution referred to as the *Dual Inheritance Theory* implying that two forms of heredity are used for explaining social changes, namely biological and social inheritance mechanisms. This distinction focuses on the effectiveness of cultural mechanisms that are determined both through genetic dispositions as well as interdependently operating mechanisms of cultural heredity.

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[7] Reference to these specific socio-cognitive abilities of the human has been made in chapter 4.5

[8] It must be recalled, that chimpanzees as the nearest relatives of the Homo sapiens (but also the common ancestor of chimpanzees and other forms of Homo up to the time of six million years ago) are cognitively highly developed. Also apes acquire basic cognitive skills in relation to space, category, quantity, social relation, communication etc. through cultural learning processes. According to Tomasello (2006), however, they lack the ability of the human being to steer cultural processes in new and unexpected directions, which, from an evolutionary point of view, the latter has acquired within a time frame that is far too short for attributing it to biological mechanisms only (Tomasello, 2006, pp. 74-75).

For the purpose of their analysis, Boyd and Richerson (1985) operate with a broad understanding of the term phenotype. The conventional definition of it is directly related to the genotype of the organisms, which is responsible for the creation of the phenotype during the ontogenesis. According to Boyd and Richerson, however, genes do not only cause the genesis of the phenotype. They also stress the influence of non-physical characteristics of the individual e.g. with regard to individual and social learning processes, being decisive for the phenotypic development. In this context the broad definition of phenotype[9] refers to the interdependent inheritance mechanisms of both biological and cultural transmission. In this context, Boyd and Richerson operate with the term '*phenotypic adaptation'* for describing which characteristics occur during the ontogenesis of organisms as reactions towards the environment that are determined by the characteristics of the members of a population *and* their behavior. Accordingly, among species that are capable of cultural development, there exists an additional cultural transmission process, which is based on the genetic code of the human being but operates independently. These interacting mechanisms refer to the understanding of gene-culture coevolution (Boyd & Richerson, 1985, pp. 4-6; Müller, 2010, pp.71-72).

Boyd and Richerson furthermore (1985) argue, that phenotypic characteristics can be transmitted from one human to another through cultural processes of individual learning and imitation. In this context, Boyd and Richerson refer to the *population-level phenomenon* in order to illustrate that the cultural inheritance process might take place only at the level of the individuals and their phenotypes (without genetic transmission). Accordingly, the selective process applies to both the genetic disposition of the human being and his social component. Or, in other words, human behavior can be regarded as the result of two interdependent evolutionary processes i.e. the genetic and cultural transmission process. With regard to the latter, it should be noted that it is also determined through criteria of purpose and intention (Boyd & Richerson, 1985, p. 6; in Müller, 2010, p. 73).

In this context Boyd and Richerson (1985) use the term *guided variation* when referring to *cultural variants* that have been acquired through individual learning processes and passed on to other individual through imitation. Learning, in this context, is understood as a form of adaptation: "Organisms learn by experiencing their local environment and then

[9] cf. *extended phenotype*, Dawkins, 1989

modifying their phenotype according to some criteria“ (Boyd & Richerson 1985: p. 94; (Müller, 2010, p. 78)). Accordingly, the evolutionary force of guided variation processes lies in the combination of learning and imitation based on criteria of adaptation and intention. It sets the cultural standards for transmission processes.

5.2.1 Social Learning Processes and their Impact on the Phenotype

Not surprisingly, Boyd and Richerson (1985), regard the term culture as closely related to social transmission processes[10]: „By culture we mean the transmission from one generation to the next, via teaching and imitation, of knowledge, values, and other factors that influence behavior“ (p. 6). Furthermore, the explanation of the above mentioned *extended phenotype* and its interdependency vis-à-vis social behavior is well formulated in the following quotation: „Culture is information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation“ (Boyd & Richerson, 1985, p. 5). Comparable to the approach of Tomasello (2000), also Boyd and Richerson emphasize the importance of social learning processes via imitation and teaching, defined as *observational learning*. In this sense, behavior, mainly developed by observation, determines the cultural transmission processes: „Individuals observe the behavior of others, induce the cultural rules that generated the observed behavior, and then incorporate these rules into their own cultural repertoire.“ (Boyd & Richerson, 1995, p. 79).

This also includes the unique aptitude of the human being with regard to abstract and categorized thinking: „Another important feature of observational learning in humans is the ability to abstract rules from a series of modeled behaviors. In contrast to the behavioral model of imitation in which exact reproduction of specific behavior patterns was stressed, social learning experiments show that people are capable of acquiring rules by observational learning“ (Boyd & Richerson, 1985, p. 43).

[10] cf. perspectives on sociobiology and social evolution in Müller (2010) pp. 70-95

Boyd and Richerson (1985) differentiate between genetic mechanisms and the impact of cultures and behaviors on ontogenetic progress, even though they underline the interplay between evolutionary mechanisms of both cultural and biological heredity: „The fact that social learning experiments indicate that humans acquire rules of behavior supports our intuition that the essence of culture is encoded information rather than the behaviors that result from this information. As we argued above, a given cultural rule may lead to different behavior in different environments, much as a given gene's effect on phenotype is dependent on environmental contingencies" (Boyd & Richerson, 1985, p.43).

Müller (2010) summarizes that social learning ensures transmission of culture and behaviors without full dependency on natural selection processes. This implies that cultural inheritance indeed is related to biological selection processes, however, proceeds differently. Correspondingly, Müller suggests that the Dual-Inheritance-Theory of Boyd and Richerson (1985) primarily aims at developing a model for explaining the evolution of social behavior which is based on genetic inheritance processes, whereas the cultural process can be regarded as autonomy but not-autarky from biological inheritance mechanisms. In this regard, social learning is understood as an adaptation process which occurs during the ontogenesis. Moreover, social learning and imitation are regarded as genetically determined abilities which form part of the phenotype. To that effect, imitation and intentional behavior are not regarded as fully decoupled from biological inheritance. Correspondingly, Boyd and Richerson refer to the term dual *inheritance* and not to *principle* of dual evolution. Nevertheless, Müller emphasizes, Boyd and Richerson operate with a co-evolutionary perspective to the extent that they acknowledge the interdependency between intelligent and intentional behavior of the human as a part of the genetic setting. To this end, they stress the relevance of cultural transmission processes for phenotypic inheritance (Müller, 2010, pp. 74-79, pp. 92-95).

5.3 The Theory of Mind - Socio-Cognitive and Socio-Collective Dimensions

The theories introduced above all indicate that a mere genetic perspective is insufficient for explaining the complex evolutionary processes that have led to the development of human cultures.

According to Tomasello (2006), the genetic avenue implies that single genetic dispositions can be attributed to each aspect of the human cognition. With this explanation, complex cognitive competences, such as the ability of language or mathematic, would have a multitude of genetic equivalents. As Tomasello argues, biological evolutionary mechanisms only cannot be used for explaining how the complex genesis of the human cognition could arise during the relatively short history of the human being (cf. chapter 4.4). He stresses that processes of genetic variation and natural selection operate on a much slower path. Hence, it appears obvious that the influence of cultural mechanisms has been significant (Tomasello: 2006, pp. 75 -76).

In this respect, Tomasello's (2006) theory on the cultural cumulative evolution is regarded as one viable approach for explaining this expeditious progress of the human being based on his complex cognitive abilities. Tomasello stresses that, with this hypothesis, only "one" biological adaptation is needed. Considering that such an adaption could have occurred to any time during evolutionary origin of Homo, the above-mentioned time problem of the genetic based approaches becomes obsolete (Tomasello, 2006, pp.75-76). This specific adaptation has developed over the course of phylogeny during which the human being acquired the ability to identify himself with his conspecifics which, in turn, has allowed for an understanding of the own self. Subsequently, this ability triggered new forms of social learning during the phase of sociogenesis which has enabled the human being to modify, accumulate and preserve various forms of artifacts and behavioral traditions over time.

During the ontogenesis the child benefits from the accumulated knowledge and abilities of the prevailing culture (artifacts, traditions etc). To this end, Tomasello (2006) gives special attention to the linguistic ability, which plays a crucial role for the human cultural development as it enables "perspectivally based cognitive representation" (p.10) leading to "skills of metacognition, representational description, and dialogic thinking" (p. 10).

Correspondingly, Tomasello stresses, that particularly the genesis of language and the associated generation of abstract categories as well as the understanding of analogies and metaphors, has enabled a comprehension of the world which only the human being is capable of. Indeed, it is his communicative ability that has enabled human beings to interaction with each other also at an abstract level and, thus, convey intentions, symbolic aspects etc. within the immediate social group (and beyond). In fact, the way in which the Internet has facilitated global communication could be regarded as an analogous continuation of the communicative abilities of the human being. As stressed throughout the present thesis, intra-human communication is largely based upon the ability to understand the perspective of others and oneself, thereby constituting a construction of mind. On this basis, meta-communication is enabled which triggers constant forms of communicative modification and which might spark innovations (re-codification).

Uhl (2009) stresses that the selective pressure (trigger) for these cognitive developments probably lies in the underlying demand for complex problem solving strategies, related to everyday interactions based on cooperation and adaptation (Uhl, 2009, pp. 100-101). To sum up, on the basis of the cognitive abilities of all primates (orientation in space, handling of artifacts, dealing with quantities, categories, social relations, communication and social learning etc.), the human being developed abilities of shared attention and intention, which are transformed into new, cultural based cognitive competences of a socio-collective dimension.

The co-evolutionary approaches examine the human cognition on the basis of both cultural and biological factors. However, this dichotomous avenue poses some challenges as regards methodical aspects. Tomasello (2006) tries to avoid this phenomenological problem by not distinguishing between *innate* (biological) and *learned* (cultural) characteristics. Instead, he refers to *individual* and *cultural* development lines of the ontogenesis of the human being and apes. In this context, the individual line of cognitive development refers to biological fixed and predetermined mechanism whereas the cultural one relates to abilities that are acquired through interaction with others. Due to his empathizing ability, the human being is capable of interpreting behavior from a perspective of shared intentionality.

Tomasello's (2006) definition of the cultural heredity concentrates on the intentional aspect; particular attention is paid to the process of imitation. Tomasello does not dispute that there is a methodical difficulty in distinguishing between these two development lines, taken into account that they are closely interwoven with each other. His main objective, however, is to distil the effects of the specific cultural adaptation-processes during the human ontogenesis. This is subject to criticism from some cultural psychologists who apply a dialectic perspective and, thus, consider that the child simultaneously acquires knowledge and skills related to both these factors.

The validity of these arguments is acknowledged by Tomasello (2006) who, nonetheless, underlines the importance of analyzing these development lines separately. He considers that this is required in order to conduct a comparative evolutionary analysis vis-à-vis the human being and the apes and, thus, helps to understand the significant cognitive differences between these species.

Moreover, Tomasello (2006) emphasizes that the ability of (socio-cultural) cooperation is based on a socio-cognitive adaptation competence and hence, enables the human kind to a *theory of mind*. He argues that a focus on culturally relevant skills and abilities is required in order to allow for a detailed and nuanced analyses of human behavior and action as, for example, the conventional and creative performance of the human, aspects that are of high relevance for the socio-cognitive approach, which is a main component of the present thesis.

6 *Summary of Part 1*

As discussed in the present part, the human cognition is related to intelligence and creativity and is pre-requite for the ability of strategic thinking and knowledge generation. This specific cognitive capacity of the human being, which is assumed to stem from the selective pressure due to cooperative and social requirements during the sociogenesis, has enabled the human being to carve out his ecological niche. It has been argued that a mere focus on biological evolutionary mechanisms is insufficient for explaining the complex genesis of the human cognition and, furthermore, that the influence of cultural mechanisms has been significant during the evolution. Correspondingly, social factors are of utmost relevance for any analyses of the evolution of the human cognition.

It has been demonstrated that, in general, cultural evolution hypotheses (introduced in chapter 4) are based on the assumption that innovations (e.g. artifacts, language etc.) to a significant extent are generated through social learning processes and, thus, based on the ability of imitation. In this regard, Tomasello (2000) suggests that it is the ability of shared intentionality that distinguishes the human being from the imitative abilities of the animals. This form of social cognition has allowed for the comprehensive development of cognitive abilities of the human being. Along the lines of the social avenue, this empathizing (mind-reading) ability can be regarded as a key asset with regard to meeting evolutionary challenges by modifying and potentially optimizing behavioral strategies.

This specific adaptation has developed over the course of phylogeny, when only one biological adaptation was needed. Theories referred to imply, that this one adaptation process led to human ability to identify himself with his conspecifics and the intentional and mental understanding of the own self. In this context, it is the ability to consciously and deliberately influence the own and opponent's behavior by the competence of empathy (shared intentionality). Accordingly, orientation- and decision making processes, resulting in strategic thinking and behavior, are crucial when trying to understand human complex cultural abilities of today.

Findings from the neurosciences indicate that the intellectual ability of the human being is based on a *modular* architecture of cognitive mechanisms whereas the brain as such can be regarded as an information-processing organ, based on a neuronal system which enables a wide range of plasticity with regard to the development of cognitive functions. To this end, it is considered that the modularity of the brain is determined via the frequency of activated neurons, which react with either enlargement or reduction of their functional units. This enormous plasticity of the brain corresponds with the abovementioned behavioral adaptation and optimization processes, particularly in relation to cultural developments.

However, in addition to the specific ability of shared intentionality, the human being is capable of preserving once acquired competences for the next generation which allows for further modifications (enhancements) of knowledge and skills over time. As mentioned, the exceptionally rapid growth of the human brain has required not only biological but also cultural inheritance mechanisms for explaining human cognitive development. Accordingly, it is considered that cooperative behavior, as well as social and imitative learning processes, has made the accumulation and stabilization of cultural knowledge possible. It has been demonstrated, that such cultural learning processes show a clear indication for the co-dependency of genetic and cultural transmission processes, resulting in the coevolutionary understanding of human development. Or, in other words, the human behavior is a result of two interdependent evolutionary processes, the genetic process and the cultural transmission process, the latter being determined through criteria of purpose and intention based on communicative ability of the human.

In this context, it has been suggested that, in particular, the linguistic ability plays a crucial role for intra-human communication. The genesis of language and the associated generation of meta-representations are based on a socio-cognitive adaptation competence and hence, enable the human being to develop a theory of mind. This form of meta-communication is based upon the ability to understand the perspective of others and oneself leading to forms of dialogic thinking on an abstract level; it is this ability, which optimizes problem-solving strategies within social groups significantly.

Against this background, it seems evident that cultural performance and social behavior are closely related to each other and that both have had a significant impact on the evolutionary development of the human cognition. Hence, within this thesis, references to *socio-cognitive* criteria are made when the relationships between the cooperative, creative and cognitive abilities of the human are examined.

In view of what has been said above, the following assumptions are relevant for Part II of this thesis:

- If the human ability for cultural innovation refers to his ability of imitation and shared intention;
- if biological *and* cultural criteria play a crucial role for the generative and creative ability of the human; and
- if innovation and knowledge generation refer to human social and cognitive abilities:

Then it can be argued, that a socio-cognitive analysis of human creativity contributes to the understanding of variation, selection and transmission of innovative impulses within knowledge generation processes.

For this purpose, creativity is understood as a cognitive competence largely based on communicative ability and social behavior. Emphasis is put on aspects related to cooperative problem solving strategies, the generation and stabilization of knowledge during cultural human development.

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PART II CREATIVITY: COOPERATION AND COGNITION

7. Creativity: A Multicausal Phenomenon

The research field of creativity can be regarded as a rather heterogenic one and thus difficult to evaluate qualitatively. Traditionally, the stereotyped picture of creativity as a gift that is reserved for isolated geniuses that produces outstanding ideas has prevailed. According to Vogt (2010), this limited but, nonetheless, popular understanding of creativity, first of all implies that creativity is restricted to numbers of individuals only. Vogt, furthermore, points out that, from this perspective, creativity is related to rather unsystematic processes at individual level which tend to occur randomly (Vogt, 2010, p. 9).

Current research has, however, opened up for more comprehensive approaches. With a view to showing the development from individually based approaches towards a multi-causal understanding of creativity, a brief overview of the heterogenic field of creativity research is provided below.

7.1 Scientific Perspectives on Creativity - An Overview

From the *biographical* perspective, the predominant approach with regard to research on creativity has been to study the biographies of persons who have been regarded as exceptionally creative. As examples of representatives of this approach Simonton (2009) and Terman (1925) can be mentioned. By analyzing the individual characteristics, social conditions, historical and biographical information of such persons

reference to the origin of creativity can be made. Such nomothetic approaches are typically based on both *quantitative* and *qualitative*[11] analysis and aim at detecting regularities of creative development of historic individuals, presenting an individual perspective of creativity research (Vogt 2010, pp. 97-98).

Furthermore, the works of Freud (1923) have given raise to the *psychoanalytical avenue*. Within this perspective, it is considered that tensions, potentially even conflicts, between the consciousness and unconsciousness constitute the main sources for creativity. Freud's psychoanalytical model explains creativity as an ability that is determined through unconscious and suppressed impulses. Vogt (2010) points out that Freud's perspective implies that creativity is a psychopathological phenomenon that is not too far from psychological illnesses. From this point of view, creative products (works of art etc.) are to be understood as results of the unconsciousness and, potentially, psychopathological processes which have enabled the individual to reduce the tensions between the conscious level and unconscious impulses (Vogt, 2010, p. 91). Analogous to the above-mentioned approaches, also this one is characterized by a distinct perspective on the individual.

However, within the *psychometric path,* creativity is considered as a mental trait that can be evaluated by testing methods. By means of certain instruments, the creative potential of individuals is measured under controlled conditions. The overarching aim is to select particularly creative individuals, who are capable of finding multiple creative solutions to one given task. This testing method refers to the idea of *divergent thinking* developed by Guilford (1968). In his studies on the structures of the intellect, Guilford distinguished between *convergent* and *divergent* forms of thinking. Contrary to the convergent production of ideas, where there is a given solution for each given task, the divergent approach implies that various forms of solutions are possible, i.e., the flexible nature of creative thinking is underlined here. According to Finke, Ward, and Smith (1992), Guilford "regarded creativity as consisting of a combination of primary abilities: sensitivity to problems, fluency in generating ideas, flexibility and novelty of ideas, and the ability to synthesize and reorganize information" (Finke, Ward & Smith, 1992, p. 10).

[11] Scholars of the quantitative perspective tend to claim that creativity comprises a sequence of similar factors, which occur in humans with varying degrees of intensity. Scholars of the qualitative perspective, however, regard creativity as a unique process, which differs clearly in each creative person or in each creative performance (Mayer, 1999, as cited in Vogt, 2010, p. 27); Vogt (2010) concretizes that the quantitative perspective implies that, within creative processes, the identical cognitive instruments are used.

It should be noted, though, that the validity of these tests has not been confirmed, as it has not been possible to repeat the results outside of the highly controlled environment they were conducted in. Accordingly, it could not be ascertained that those who performed well in the test, in fact, would be more capable than others with regard to finding excellent creative solutions under normal life conditions (Vogt, 2010, p. 93). It should be noted that this approach is not based on an individual understanding of creativity but tries to locate relevant processes (sensitive, flexible, synthesizing ability) of creative behavior.

The *pragmatic approach,* however, is not concerned with the development of scientific theories. Instead, it is strongly geared towards identifying "hands on" techniques and programs for improving the creative behavior of people. This approach arose in the 1950s as a result of an increased demand in the military, the industry and the educational sectors for creativity and innovation, to some extent, a result of the cold war situation and the related competitive situation between the Soviet Union and the USA. This perception generated the pressure to be innovative and a quest for the best ideas. Referring to Vogt (2010) the perhaps best-known representatives of this period are De Bono (1967), the founder of lateral thinking, Gordon (1961) who invented the Synectics-approach and Osborn's (1963) Brainstorming (Vogt, 2010, p.85).

The research field of *artificial intelligence* also departs from the individual perspective of creativity referring to more of a cognitive model used for analyzing creativity:

> Everybody needs to be somewhat creative simply to get through a typical day and deal with the innumerable shifts from the ordinary that arise. These small acts of creativity, though they differ in scope, are not different in kind from the brilliant leaps of Einstein. Creativity is commonplace in cognition, not an esoteric gift bequeathed only to a few (Schank & Cleary, 1995; as cited in Vogt, 2010, p. 94).

The aim of this avenue is to transform theoretical principals of cognitive understanding into computer programs. In this context, creativity is regarded as a process that allows for modifications of knowledge structures when the prevailing circumstances require that. Such modifications require access to both the current knowledge structures *and* related instruments (artifacts). Creativity in this sense refers to the process of knowledge

modification, based on complex and various forms of realization. It describes basically the process of modifying previous concepts and the implementation of the newly gained achievements (Vogt, 2010, p. 94). This approach is closely linked to the understanding of *creative cognition*.

Furthermore, the *neuro-scientific avenue* should be mentioned. It is primarily focused on the physiological criteria for analyzing creativity. Martindale (2009) summarizes that during creative processes, such as problem solving, the brain activity is measured and the physiological conditions (activity in certain anatomical (cortical / frontal lobe) areas of the brain) are evaluated. Results showed coherence between creativity and a mental status, where attention is defocused, associative thinking dominates and a large number of mental representations are simultaneously activated. From a physiological point of view, it is considered established that a broad cortical and defocused stimulation on a low level facilitates creative thinking. This explains for example the so-called flash of inspiration during relaxation phases (e.g. when taking a shower or during jogging). It appears that certain areas of the brain become inhibited when it is exposed to a high degree of stimulation. Due to this, the capability of associating, which is essential for creativity, is significantly hampered (Vogt 2010, pp. 95-96). Also this approach emphasizes the importance of a cognitive understanding of creativity for the purpose of analyzing it from a physiological perspective.

In addition to the biological perspective, also the *evolutionary one* offers explanations with regard to the understanding of creative processes. Accordingly, not only the biological but also the cultural evolution describes the basis for this analysis. In this respect, Lumsden's (2009) suggestion that, creativity, culture and evolution are interrelated deserves to be mentioned. He regards the evolution as a creative process that has been triggered by diversity and natural selection. Hence, culture constitutes a subsequent process which increases the variety of inheritable material and "(h)uman creativity is the fire that drives gene-culture coevolution. From creativity flow innovations, the raw material of cultural diversity" (Lumsden, 2009, 160). From this perspective, a distinctive feature of human evolution exists in the interdependency of genetic and cultural information processes, where creativity, as a principle of evolution, constantly, provides new cultural information and, hence, is linked to the interrelation between individual, society and behavior. In this

context, Vogt (2010) refers to Csikszentmihalyi who states that applying evolutionary theories on creativity can contribute to position evolutionary metaphors such as variety and natural selection as potential explanations of the creative process. In this context, survival of the fittest refers to the acceptance of the best idea (Vogt, 2010, p. 97;).

Within the *cognitive approach,* the creative process is understood as an application of cognitive instruments. From the point of view of *cognitive psychology,* the creative process is, in fact, understood as a whole range of such processes. The primary goal in this context is to decompose and identify these processes in order to analyze their comprehensive interplay (Vogt, 2010, pp. 225-226). Within cognitive psychology, the research field of *creative cognition* has become largely accepted. Specifically, it is concerned with analyses of the cognitive structures of creativity. In this respect, it is very obvious what position advocates of the creative cognition perspective take within the debate about the creative genius: According to studies of Finke, Ward, and Smith (1992), a normal set of cognitive instruments is a sufficient basis for creative achievements. However, some individuals are better skilled in controlling and optimizing these instruments. In other words, each individual has a certain cognitive ability and carry, thus, a potential for creative achievements (Vogt, 2010, p. 195). This perspective presents one of the current research standards within the field of creative science and is of high relevance for this thesis.

7.2 The Socio-Cognitive Avenue

The historical overview provided above has demonstrated that: i) creativity developed into an independent area of research only during the past 50 years, ii) theories developed during the most recent two decades suggest that a mere individual perspective is insufficient in order to gain a comprehensive understanding of creativity, and iii) accordingly, a *process* oriented approach is currently considered state-of-the-art.

In his contribution to the *Handbook of Creativity*, Mayer (2009) summarizes the status quo as regards the research on creativity as follows: "In summary, there is some consensus in the creativity research community concerning what to study: creativity occurs when someone creates an original and useful product. However, there is a lack of consensus on such basic clarifying issues as whether creativity refers to a product, process, or person; whether creativity is personal or social; whether creativity is common or rare; whether creativity is quantitative or qualitative" (Mayer, 2009, p. 451).

Similar to Vogt (2010), who emphasizes, that creativity is a multi-causal phenomenon which, in particular, is influenced by social attributes, this thesis focuses primarily on a cognitive and process-based perspective on creativity and, secondly, on the potential impact of creativity on the social environment. In the field of *cognitive science,* efforts have been made to provide evidence, on the basis of empirical data, that creativity is related to the cognitive set of the human being and that individuals who tend to be regarded as creative are simply exceptionally capable of utilizing these cognitive instruments. Especially within the field of the *creative cognition* has it been attempted to evaluate the applicability of creative outcome on the basis of cognitive processes and structures. It appears, though, that an isolated focus on cognitive elements leads to a fragmental picture of creativity. From this perspective, creativity is not regarded as a mere cognitive processes; it entails also a social dimension which is largely determined through environmental conditions, such as social options and restrictions. In this context, Vogt refers to the term *rational creativity*, i.e. ideas and actions that, in contrast to the prevailing habits and concepts, contribute to generating new and creative outcomes which, in turn, might lead to improvements of the living conditions (Vogt, 2010, p. 10).

In Part I of this thesis the interrelation of human evolution and culture generation (creative problem-solving strategies) was analyzed on the basis of cognitive and social criteria. In the present part, however, creativity is examined from the perspective of its inherent potential as regards generation of human culture. To this end, focus is placed on social and cognitive criteria, while having an evolutionary perspective in mind. This approach is considered beneficial in terms of gaining further insights on knowledge generation within a social context.

Exemplarily, two theories will be examined closer. First the systemic approach of Csikszentmihalyi (2009) is introduced, which describes mainly a social but also touches upon an evolutionary avenue of creative understanding. Secondly, the works of Finke, Ward, and Smith (1992) on *creative cognition* are referred to as a plausible example for a cognitive and creative understanding of knowledge generation.

For the purpose of this thesis, creativity is understood as a principle of human behavior, which stands in a multifunctional relationship to individuals and the surrounding society; it is implicit that social factors are crucial for successful creative processes. Creativity is, furthermore, regarded as a potential trigger of cultural development.

In the present part, however, the focus lies slightly more on the pure cognitive approach. The objective is to allow for a broad understanding of creativity and the question how culture and knowledge can be generated, also referring to processes from a social and evolutionary perspective. These approaches are unified in their focus on criteria for assessing the originality and applicability of the creative product within a social context.

8 The Relevance of Social and Individual Structures for Creative Outcome

In this chapter focus is placed on the interrelations of creative achievements and social requirements. Questions such as how creativity influences processes of knowledge generation within groups and how social structures such as institutional frameworks, bias creative individuals and their creative outcome are being raised. Three factors are examined closer: i.) The individual and its creative achievement, ii.) the task of society regarding acceptance and acknowledgement processes of the creative product, and iii.) the process of retention of the creative product in the respective knowledge pool (cultural relevance).

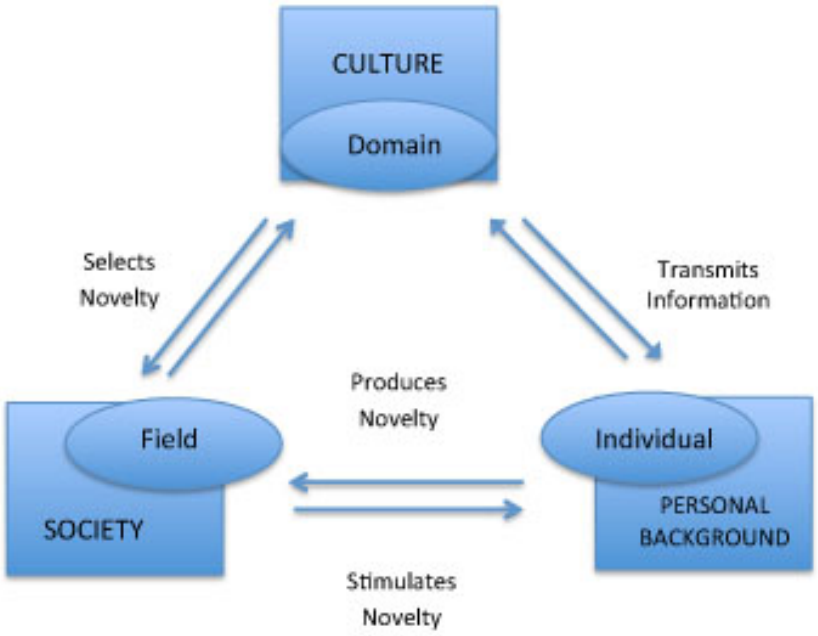
8.1 The Systemic Approach: The Individual-Domain-Field Model

Like several other of the scholars referred to in this thesis, Csikszentmihalyi (2009) argues that concentrating on mere individual aspects is too limited when analyzing creative achievements and that "variables external to the individual must be taken into account" (Csikszentmihalyi, 2009, p. 313). According to Csikszentmihalyi, cultural and social aspects should be given equal weight when analyzing how creative products are generated and manifested within a cultural context. In other words, he does not regard creativity as the result of individual actions only but as a highly complex phenomenon, which needs to be studied within a social-historical context of cultural development.

Csikszentmihalyi (2009) refers to creativity as an outcome of systemic elements of the sociogenesis and presents a systemic model for analyzing creative performance. To this end, he refers to creativity as a "phenomenon that is constructed through an *interaction between producer and audience*. Creativity is not the product of single individual, but of social system making judgments about individuals' product" (Csikszentmihalyi, 2009, p. 314). On the basis of this systemic approach, Csikszentmihalyi defines three criteria referring to the environment the creative individual operates in and from:

Figure 1:

Implications on a Systems Perspective on Creativity (Csikszentmihalyi, 2009, p. 314):



Csikszentmihalyi (2009) considers that social institutions - he refers to them as *field (1)* - assess the individual products. This field entails the criteria which are considered relevant to this end within the given social context. This type of evaluations is based on the established cultural knowledge structures within the group or society. Csikszentmihalyi refers to such structures as *domain (2)*. A domain encompasses the accumulated knowledge-base and communicational instruments of the group or society. Thus, it constitutes reference points for the evaluation of creative achievements. It should be borne in mind, though, that it is the *individual (3)* who provides the impulse in the first place.

Csikszentmihalyi (2009) considers that these systemic conditions should be regarded as prerequisites for a creative outcome: "For creativity to occur, a set of rules and practices must be transmitted from the domain to the individual. The individual must then produce a novel variation in the content of the domain. The variation then must be selected by the

field for inclusion in the domain" (Csikszentmihalyi, 2009, p. 315). According to this approach, creativity is always subject to the evaluation of a third party. Hence, the output of the individual presents merely "creative recommendations", which are evaluated by institutions, or the field, according to the terminology of Csikszentmihalyi (Vogt, 2010 p. 106).

8.2 Social Preconditions for Creative Processes

This chapter discusses the relevance of the findings of Csikszentmihalyi's (2009) theories with regard to processes related to information and knowledge generation, with an emphasis on social conditions. In this context, Vogt (2010) summarizes some of Csikszentmihalyi's hypothesis to explain the interrelation between culture, domain and creativity. Culture is understood as systems of *connected domains* whereas the cultural symbolic system represents the cultural knowledge of a social group (Csikszentmihalyi, 2009, p. 317).

Firstly, Vogt refers to the domain aspect:

- The better and more sustainable storage of knowledge within a culture is organized the easier it will be to accept new information and to use them for further creative developments.
- The better access to information is organized, the more persons can participate in the creative process.
- Differentiated and sophisticated organizations of domains lead to specific forms of information and hence to better innovative conditions.
- The more open and intensive information to other cultures is organized, the more likely innovation will occur (Vogt, 2010, p.112).

Secondly, Vogt (2010) outlines the relationship between innovation, society and fields:

- Societies, which use most energy for self-preservation, are not open for innovation generation and do not create a creativity-friendly environment.
- Accordingly, societies, which do not appreciate and support creative behavior, will not produce innovations.
- External threats and internal conflicts within a society increase the receptivity of innovations
- Social differentiation influences the frequency of innovation.
- The field can only value and develop creative activities within a society, when material or immaterial incentives (social status) are set.
- If the field is too dependent on the assessment of other fields (as e.g. politics, economy, religion) creative achievement is not to be expected.
- Only if criteria for creativity and innovation are declared within the domain (also described as cultural knowledge) creativity can develop. However, too strict as well as to wide criteria hinder creative output (Vogt, 2010, pp. 113-114).

Finally, Vogt (2010) refers to the individual and his ability to modify domain knowledge through creative input. This ability is, however, dependent on both personal environment (social conditions) and personal qualities.

- The family and the direct environment need to convey cultural knowledge (and ideally specific domain knowledge)
- Within the family and the direct environment exists a supportive attitude for learning and creativity
- The degree of independency of an individual vis-à-vis social, ethnical, economical and religious aspects impact his ability to question social norm and patterns.
- Personal qualities such as the cognitive abilities of fluent and flexible thinking and a basic openness towards new perspectives, promote creative processes (Vogt, 2010, pp. 114-115).

In conclusion, Csikszentmihalyi (2009) presents a model that is closely related to the social sciences. Its systemic approach aims at integrating interlinked aspects, such as personal qualities, social conditions and cultural prerequisites. Csikszentmihalyi argues that creativity does not only depend on the number of creative individuals within a field, who try to vary and modify domain knowledge. A supportive attitude among the members of the field is also required. Furthermore, he underlines that the availability of open learning and educational structures provide a basis for innovative developments within a society:

> [C]reativity cannot be recognized except as it operates within a system of cultural rules, and it cannot bring forth anything new unless it can enlist the support of peers (….) the occurrence of creativity is not simply a function of how many gifted individuals there are, but also of how accessible the various symbolic systems are and how responsive the social system is to novel ideas. Instead of focusing exclusively on individuals, it will make more sense to focus on communities that may or may not nurture genius (Csikszentmihalyi, 2009, p. 333).

In other words: „It follows that if one wishes to increase the frequency of creativity, it may be more advantageous to work at the level of fields that at the level of individuals“ (Csikszentmihalyi, 2009, p. 327). Accordingly, domain knowledge can only be modified and varied when the field has been established in a cultural embedding of innovative openness and the necessary instruments are provided. It is crucial, though, that the (creative) individual understands the cultural settings of the domains he lives in, in order to question, modify or completely vary cultural standards.

8.3 Knowledge Generation within Social Systems

Csikszentmihalyi (2009) emphasizes that innovations depend on social acceptance processes and, thus, cannot be attributed to products of individuals only: “As long as the idea or product has not been validated, we might have originality, but not creativity” (Csikszentmihalyi, 2009, p. 321). As mentioned above, individuals with a creative intention need to relate to their cultural symbolic system (domain). The field determines which knowledge will be added to the domain and which will not. It is worth noting, though, that the recognition of a new product as creative often occurs through the implementation of new standards and changes to evaluation methods within a society.

According to Csikszentmihalyi (2009), a further decisive element for the implementation of creative products is the aspect of persuasion. He stresses that the individual might have to convince the members of the relevant field of the benefits of his idea. Their acceptance is required in order to classify the idea as social relevant, since the society at large tends to trust the respective fields (specific areas of science, art etc.). Csikszentmihalyi illustrates his hypothesis with the example of the Italian Renaissance. During this period, the wealthy and culturally interested parts of the population typically belonged to circles which were highly committed in supporting scientific and artistic developments. Hence, creativity is not necessarily “a random event, but a calculated, conscious policy on the part of those who had wealth and power“ (Csikszentmihalyi, 1988, p. 336; as cited in Vogt, 2010, p. 109).

As further discussed in Part III, the idea of systemic conditioned creativity does not restrict the autonomy of the creative process. The point is that processes of this nature are inherently embedded in social structures and thus underscores the non-autarky of such processes.

In this context, it should be noted that knowledge gain through creative processes refers to differentiation processes of the given cultural achievements. “The better strategy is to

recognize that in science as well as in arts, creativity is as much the result of changing standards and new criteria of assessment, as it is of novel individual achievements" (Csikszentmihalyi, 2009, p. 321). For the purpose of the present thesis, it can be concluded that Csikszentmihalyi (2009) presents a model for cultural development, which is applicable for an evolutionary perspective on creative processes and knowledge generation.

8.4 The Evolutionary Perspective: An Integrative Model

Csikszentmihalyi (2009) complements his aforementioned systemic approach with some related evolutionary hypotheses. In this context, he refers to the cultural development as output of creative processes and, thus, presents an interesting perspective on cultural evolution.

Csikszentmihalyi's (1988) considers that creativity forms part of the cultural evolution, or, in other words, that the cultural development is interpreted as a creative process. He refers to universal Darwinist principles and transfers biological principles, such as variation, selection and transmission, to the cultural evolutionary process. Applied to the field of creativity, this implies that it is the individual who *proposes the variation* within the domain. At field level, the new idea or product might be *selected* (accepted) into the domain pool and, thus, integrated into the pool of established cultural knowledge with the potential of being *transmitted*. In this context, transmission implies that a new variation is accepted through the field *and* becomes part of the accumulated knowledge within the domain. Furthermore, Csikszentmihalyi (2009) considers that a variation within the symbolic system of a culture can be regarded as creative when it has social implications (impact on behavior of individuals), be it only in the form of internalizing new information as part of the knowledge of the domain-pool. As Vogt (2010) stresses, this approach focuses on two essential aspects of a creative product; how innovative it is and what impact it generates. In other words, *originality* and *usefulness* are key criteria for the creative outcome (Vogt, 2010, p. 109).

Csikszentmihalyi (2009) recalls that, in contrast to the biological evolution, the cultural evolution is not triggered by variations of genomes but through the transmission of cultural patterns. As Dawkins (1996) and Blackmore (1999)[12] also Csikszentmihalyi refers to these patterns as *memes* which are transmitted from one generation to the next one. Corresponding to Part I of this thesis, also Csikszentmihalyi refers to the transmission of memes as a process of learning and imitation: "Memes are similar to genes in that they carry instruction for action (…) the instructions contained in memes are transmitted through learning" (Csikszentmihalyi, 2009, p. 316).

Csikszentmihalyi (1988) is of the view that *memes* are related to structured and memorized information that has been established within a social context on the basis of its usefulness. To that effect, a domain consists of a number of related memes which are subject to an ongoing process of change. Vogt (2010) points out that, in this context, memes could be regarded as carriers of internalized (accepted) behavior and, hence, as products of creative processes. Ergo, the creative action could be regarded as a process of meme-formation and variation. In other words, any variation of existing memes or creation of new ones can be regarded as outcomes of creativity (Vogt, 2010, p. 110).

However, the aspect of cooperation is being decisive for creative achievement *and* cultural evolutionary processes. Vogt (2010) refers in his analysis of Csikszentmihalyi's (2009) systemic approach to Lumsden (2009), who specifies this process of cooperation by distinguishing between biological and cultural evolutionary processes: Genome variation is considered as a *random* process, while culture variation takes place through *intentional* processes of the human being and manifests itself as added or varied knowledge in the domain pool (Vogt, 2010, p. 111). In this regard, creativity can be understood as a process of interaction or negotiation between the individual and the social field, which members control the access rules of the domain. Hence, an individual who is seeking acceptance for proposal may attempt to influence the process of acceptance. In this respect and analogues to findings from Tomasello (2000) as presented in chapter 4, it could be argued that also Csikszentmihalyi's (2009) model indicates a strategic orientation of human behavior based on shared intentionality in order to implement the best idea.
On the basis of his systemic approach, Csikszentmihalyi's (2009) strives to present an integrated hypothesis for the understanding of creativity within a social framework. To this

[12] cf. replicator theory in chapter 3.2 and 3.3

end, the interdependencies between individual behavior and social structures are regarded as connected. It needs to be recalled that Csikszentmihalyi's (2009) evolutionary approach is based on the understanding that creativity is the trigger for cultural development. It should be noted, though, that "[t]he notion of evolution does not imply that cultural changes necessarily follow some single direction or that cultures are getting better as a result of the changes brought about by creativity (...) evolution in this context means increasing complexity over time" (Csikszentmihalyi, 2009, p 320).

It has to be stressed that, in this context, creative processes enable the development options which, in fact, could have an unbalancing effect on the structures of the domains: "In this sense creativity does not always support cultural evolution. It generally contributes to differentiation, but it can easily work against integration. New ideas (…) often break down the existing harmony between different domains, and thus might, at least temporarily, jeopardize the complexity of culture" (Csikszentmihalyi, 2009, p. 321).[13]

In summary, Csikszentmihalyi (2009) underlines the importance of an integrated focus on the interdependency between individual behavior and social structures when analyzing creative processes. One of his main concerns is related to the question of how new domain-knowledge can be generated and preserved over time. To this end he emphasizes that creativity is related to processes of changing practices, standards etc. as well as criteria for assessing creative products. Csikszentmihalyi has, no doubt, provided valuable insights to this question from a social science point of view. It would seem plausible, though, that findings from the cognitive field could be of specific relevance analyzing information generation in more detail. In this respect, the following cognitive analysis provides a path for analyzing some mechanisms of knowledge generation, on the basis of human ability for the formation of synthesis, memories and analogies.

[13] The question to what extend creative deviations and criteria of noise might lead to de- and re-stabilization processes of cultural knowledge-structures is discussed in more detail in Part III of this thesis.

9 Creative Cognition: Cognitive Structures and Mechanisms

The field of cognitive psychology is concerned with human information processing. The term cognition, in the broadest sense, refers to a wide range of processes and structures such as perception, memory, recognition, imagination, idea, concept, but also to assumptions, expectations, plans and problem solving. Correspondingly, for the purpose of this thesis creativity is regarded as an aspect of cognition. Furthermore, it is considered that methods and theories of the cognitive psychology can be applied to the creative process. The underlying assumption is that each individual possesses a certain potential for being creative, i.e. to generate something new on the basis of already acquired information. Seen from this perspective, qualitative differences between the creative achievements of different individuals can be explained by more or less successful utilization of the cognitive instruments that each individual, in principal, has access to (cf. chapter 7.1).

Vogt (2010) emphasizes that after the breakthrough of cognitive psychology in the late 1960s, it still took decades until creativity gained due attention within this discipline. Initially, the experimental approach of cognitive psychology seemed pertinent for analyzing creative processes. Focus was put on which cognitive processes and structures are predominant with regard to creativity. Scientists in the field of the *creative cognition* tend to pursue two objectives in particular: First, the transfer of theories, methods and concepts from the cognitive psychology to the creative research field and, secondly, the focus on general findings from human cognition in relation to his generative (creative) competence. Correspondingly, within cognitive psychology, creativity is not determined through a single process, but through a whole series of cognitive processes. Compared to previous approaches, i.e. the *synthetic thinking*[14], creativity is not to be reduced on a single mental mechanism (Vogt, 2010, pp. 193-195).

Within the discipline of creative cognition, scholars aim at decomposing creativity into separate cognitive processes and determining the functionality of these components within the overall process. Particularly, distinctions are made between the cognitive process and the mental structure it affects on, and, moreover, between the creative process and the

[14] cf. divergent thinking by Guilford (1968) in chapter 7.1

potentially resulting creative product. For this investigation, specific experimental methods have been developed for analyzing the cognitive factors of creativity. Furthermore, the importance of knowledge structures and motivational, situational, or time related components is acknowledged (Vogt, 2010, p. 194). The strategic objective is to develop an integrated approach which allows for combining cognitive and non-cognitive aspects. Current research, however, tend to be concentrated on the basic, cognitive, processes. It is anticipated that identifying these processes will facilitate the process of reaching the aforementioned objective. In this respect, findings from the field of creative cognition can contribute to the development of practical methods which describe how individual and social conditions can impact creative processes in various ways. Notwithstanding that this discipline is primarily geared towards basic research, the inherent focus on applicability is worth noting (Vogt, 2010, pp. 194-195).

Within this thesis, particular attention is paid to the work of Finke, Ward, and Smith (1992), who jointly developed methods for analyzing processes that are specifically relevant for knowledge and innovation generation and applicable for the fields of art and science. It is beyond the scope of this thesis to provide an exhaustive description of their method but a few remarks deserve to be made. The main and most challenging questions are how creativity of participants should be measured, who should decide whether or not a product is creative and which pre-gained knowledge is essential for creative processes? In contrast to the classical experiments of cognitive psychology, there exists no objective answer as to how these issues should be addressed within the field of creative cognition. However, with the assistance of panels (skilled judges) Finke, Ward, and Smith have tried to evaluate test results on the basis of both the originality *and* usefulness of creative products (Vogt, 2010, p. 196).

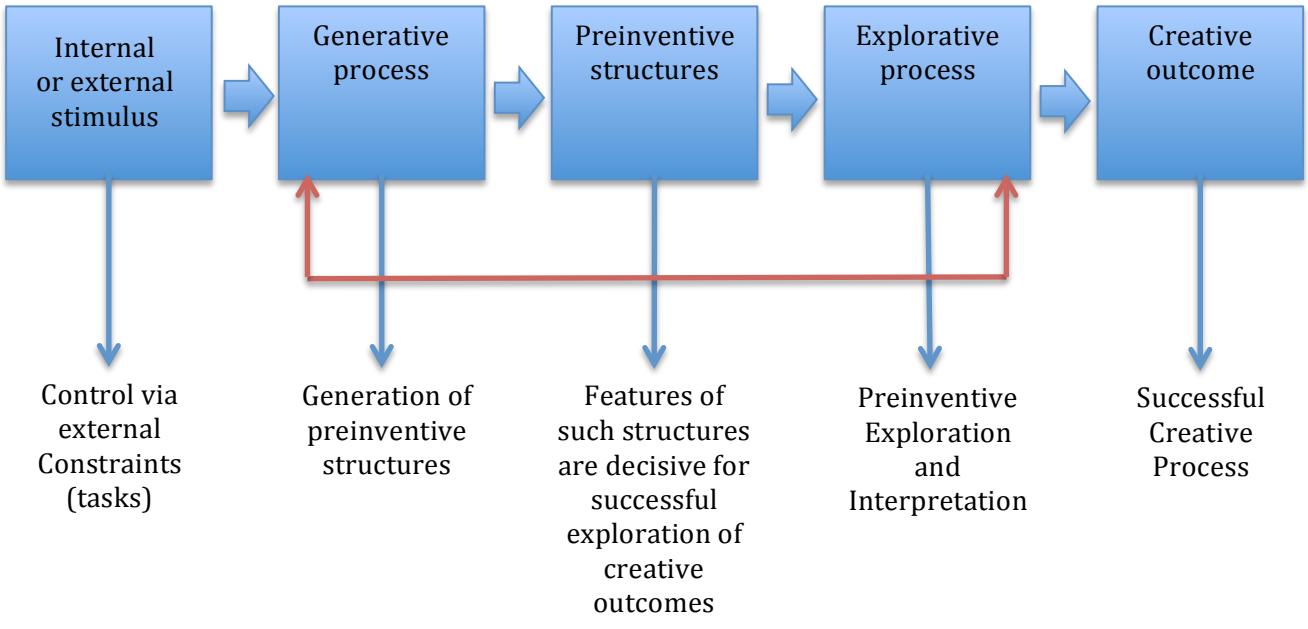
Another essential aspect with regard to analyses of creative processes, according to Finke, Ward, and Smith (1992), is related to the potential impact of existing knowledge structures (experience, memory etc.). The question to what extend knowledge prevents or facilitates the generation of innovation is of particular importance in this context. Moreover, Finke, Ward, and Smith developed the *Geneplore-Model*, which aims at distilling those cognitive components that can be regarded as relevant for creative processes. This model distinguishes between the *generative* and *explorative* phase of creative processes and

presents a broad approach for analyzing creative outcomes in various contexts, one of which is particularly pertinent for this thesis: "One advantage of this characterization is that it allows us to address diverse aspects of creativity, such as *artistic creation and scientific discovery* [emphasis added], within the same general approach" (Finke, Ward, & Smith, 1992, p. 19).

9.1 The Geneplore-Model - Its Applicability on Information Generating Processes

In response to the above said, the Geneplore-Model of Finke, Ward, and Smith (1992) aim at formulating a general model for information-generating processes that allows for i.) evaluating diverse aspects of creativity under the same conditions and ii.) analyzing creative products in the broadest sense, distilling the relevant cognitive processes and mechanisms explicitly (Finke, Ward, & Smith, 1992, p. 17):

Figure 2:
Structure of the Geneplore Model (Finke, Ward, & Smith, 1992, p. 18; Vogt, 2010, p. 197)



The Geneplore-Model consists of two sequential processing phases: the generative one, followed by the explorative one. Within the former, raw ideas, i.e. the preinventive structures, are created. These are further refined and tested during the exploratory phase: "In the initial, the generative phase, one constructs mental representations called preinventive structures, having various properties that promote creative discovery. These properties are then exploited during an exploratory phase in which one seeks to interpret the preinventive structures in meaningful ways" (Finke, Ward, & Smith, 1992, p.17).

In this respect, the preinventive structures carry a certain creative potential which, however, can develop in different manners: To what extent such an idea will provide a concrete solution or contribute to the development of a new product etc. is unknown at this early stage. These structures can either stimulate or hinder further creative exploration, eventually resulting in multiple re-modification processes: "These preinventive structures can be thought of as internal precursors to the final, externalized creative products and would be generated, regenerated, and modified throughout the course of creative exploration" (Finke, Ward, & Smith, 1992, p. 17).

Moreover, Finke, Ward, and Smith (1992) argue, the creative process should not necessarily be understood as a single sequence of generative and exploratory phases. Instead, it should be regarded as a dynamic interplay between these phases until the process of creative generation is either completed or interrupted. The overall aim of the Geneplore-Model is to provide a tool for analyzing creative thinking on the basis of cognitive processes and mechanisms defined as terms of *processes*, *structures*, *properties* and *constraints* (Finke, Ward, & Smith, pp. 191-192). Providing a comprehensive picture of all components involved would exceed the scope of the present thesis. A high-level overview is, however, available below:

Table 1:

Examples of Cognitive Processes, Structures, Properties, and Constraints in the Geneplore Model (Finke, Ward, & Smith, 2010, p. 20):

Generative Processes	**Preinventive Structures**	**Preinventive Properties**	**Exploratory Processes**	**Product Constraints**
Retrieval	Visual patterns	Novelty	Attribute finding	Product type
Association	Object forms	Ambiguity	Conceptual interpretation	Category
Synthesis	Mental blends	Meaningfulness	Functional inference	Features
Transformation	Category examplers	Emergence	Contextual shifting	Functions
Analogical transfer	Mental models	Incongruity	Hypothesis testing	Components
Categorical reduction	Verbal combinations	Divergence	Searching for limitations	Resources

To sum up, this thesis is focused on cognitive processes that are related to knowledge and innovation generation within the fields of art and science. Hence, the presentation of the Geneplore-Model provided is strongly geared toward aspects that are of relevance from that point of view. This analysis refers not only to findings of Finke, Ward, and Smith (1992) but also to the subsequent analysis of Vogt (2010), who formulates a condensed version of the Geneplore-Model including individual and social aspects of creative processes. In the following chapters, a short overview of relevant definitions of the generative and explorative phase is introduced.

9.2 The Generative Phase: Search for Ideas and Options for Interpretation

Within the generative phase, Finke, Ward, and Smith (1992) define special types of generative processes which trigger various forms of preinventive structures. A common characteristic of the preinventive structures is that they emerge without ex ante evaluation of the applicability. The usefulness is only assessed in the explorative phase; in the generative phase ideas are generated but no such evaluation takes place. The following generative processes, as there are *retrieval, association, mental synthesis and analogical transfer,* are introduced shortly:

The most basic types of generative processes are *retrieval* of existing structures from memory and the formation of *associations* among these structures referred to: "A particular word or object (…) could be recalled from memory and then reinterpreted during the exploratory phase (…) or could be retrieved and then associated in novel ways, resulting in new, simple types of preinventive structures" (Finke, Ward, & Smith, 1992, p. 20).

In addition to the basic processes *of retrieval and association*, the generative process of *mental synthesis* leads to various forms of *mental blends*: "[P]arts can be mentally rearranged (…) and forms can be altered in shape to make interesting or useful structures. Single concepts can be combined to form more complex concepts" (Finke, Ward, & Smith, 1992, p. 20).

By means of *analogical transfer* further possibilities for generating preinventive structures come into play as follows: "[A] relationship or set of relationships in one context is transferred to another, resulting in preinventive structures that are analogous to those that are already familiar" (Finke, Ward, & Smith, 1992, p.21). Furthermore, Finke, Ward, and Smith (1992) mention the generative process of *categorical reduction,* which allows forms of diminution to more general categories (e.g. birch - tree - plant; Rottweiler - dog - animal) „In this sense, one ends up with a shape that is less loaded categorically and can function more broadly as a preinventive structure" (Finke, Ward, & Smith, 1992, p. 21).

In addition to the preinventive processes Finke, Ward, and Smith (1992) define the following preinventive structures which they consider as relevant for creative exploration and discovery: *Visual patterns, object forms, mental blends, category exemplars, mental models* and *verbal combination*. The category of *mental blends* is of particular relevance as it illustrates how generative structures impact at various levels. Finke, Ward, and Smith (1992) consider that mental blends refer to a cluster of structures, which can occur at a visual level as *images* or at the language-conceptual level as *conceptual combinations* or *metaphors*. "What they have in common is that two distinct entities have been fused to create something new"(Finke, Ward, & Smith, 1992, p. 22).

The emergence of preinventive structures can be described as a rather open and uncontrolled process where specific features either facilitate or prevent further creative exploration. Finke, Ward, and Smith (1992) specify six *preinventive properties*, which impact on creative processes in different ways: *Novelty, ambiguity, meaningfulness, emergence, incongruity,* and *divergence*. The higher the number of such properties that are detected within the preinventive structures, the higher the likelihood that a creative product materializes at the end of the exploratory phase (Vogt, 2010, p. 198). Considering that these properties describe relevant characteristics for further creative exploration, they are worthy of a closer look at:

When elaborating on the specific properties, Finke, Ward, and Smith (1992) initially mention *novelty*, thereby emphasizing that "[a]llthough a common, familiar structure might still be interpreted in creative ways, the possibilities for creative discovery should be much greater if the structure is relatively uncommon to begin with" (Finke, Ward, & Smith, 1992, p. 23).

Secondly, they underscore the importance of the property *ambiguity,* as it constitutes an advantage for subsequent creative explorations; the more ambiguous structures are, the easier they are to interpret and explore in diverse directions. Wisniewski and Gentner (1991), however, argue that "[a]mbiguity contributes to discoveries that are made in many types of concept combination as well" (as cited in Finke, Ward & Smith, 1992, p. 23). Whereas Finke, Ward, and Smith (1992) conclude, that "[f]or these reasons, one might wish to avoid imposing narrow interpretations onto the preinventive structures when the structures are fist being formed" (Finke, Ward & Smith 1992: p.23).

Thirdly, Finke, Ward, and Smith (1992) suggest the attribute of *meaningfulness*, which constitutes a „general, perceived sense of ‚meaning' in the structure. This sense of meaning, which can be fairly abstract, is related to a preinventive structure's potential for inspiring or eliciting new and unexpected interpretations" (Finke, Ward, & Smith, 1992, p. 23). In other words, they refer to an implicit and inherent meaning of such (potential) structures.

Fourthly, they refer to the property of *emergence*, which emphasizes unexpected features that "becomes apparent only after the preinventive structure is completely formed. This is a common property, for example, of preinventive structures that result from mental synthesis" (Finke, Ward & Smith, 1992, p. 24). Accordingly, these characteristics are related to the unforeseen and hidden elements of a preinventive structure.

The fifth property is referred to as *incongruity*. It is related to conflicts and divergence between elements within a preinventive structure: "More recent studies have shown that incongruous components in conceptual combination may result in greater opportunities for originality and discovery than when the components fit together readily" (Finke, Ward, & Smith 1992, p. 24). It should be noted, though, that the tensions that may arise through incongruity do not necessarily bring about such creative opportunities, also the *opposite* is possible, i.e. that restrictions are imposed.

Divergence, the sixth property, is closely related to ambiguity although it does not refer primarily to the meaning of the structure as such but to the variety of potential possibilities as regards the application: "A hammer, for example, is a relatively unambiguous form but can be used in a variety of different ways - as a tool, a paperweight, a weapon, and so on" (Finke, Ward, & Smith, 1992, p.24). As shown, this property is related to the diverse and manifold interpretation-possibilities of the very same structure.

The rather detailed description of the categories above has been provided on the basis of the hypothesis that the concept of preinventive properties can be applied also to the field of art. It would need to be explored, though, which of these properties are of particular relevance for artistic outcomes. At first sight, ambiguity and incongruity appear promising; they are further presented in chapter 9.5.

To sum up, within the generative phase creative products are generated and evaluated on the basis of their originality. During the explorative phase these creative proposals are tested according to criteria related to usefulness and applicability.

9.3 The Exploratory Phase: Application and Potential Solutions

The key task for Finke, Ward, and Smith (1992), in the context of the exploratory phase, is to identify which explorative processes result in the final, creative, product. On the basis of the given preinventive structures they define the following processes: *Attribute finding, conceptual interpretation, functional interference, contextual shifting, hypothesis testing* and *searching for limitations*.

Within the process of *attribute finding*, the output of the preinventive structures is systematically scanned for emergent and new characteristics during the explorative phase. For example, as a result of a combination of various *mental images,* a new (varied) image may occur in the generative phase and subsequently evaluated in the exploratory phase (Finke, Ward, & Smith, 1992, p. 24).

Secondly, during the process of *conceptual interpretation*, it is explored whether the preinventive structures give raise to new application possibilities. Such an evaluation can be described as a broad process which trigger abstract, metaphorical or theoretical interpretations "representing a new concept in medicine, an idea for the plot of the story, an extension of the theory of relatively, or a theme for a musical interpretation. More generally, conceptual interpretation can be thought of as the application of world knowledge or naive theories to the task of creative exploration" (Finke, Ward, & Smith 1992: p. 25).

Functional inference constitutes another exploratory process. In the context of it the functionality and usability of preinventive structures are tested. In concrete terms, the focus is put on the development of products and their potential application. This leads to a process which "is often facilitated by imagining oneself actually trying to use the object in various ways" (Finke, Ward, & Smith, 1992, p. 25).

Contextual shifting - another exploratory process - occurs when preinventive structures are applied to different contexts "as a way of gaining insights about other possible uses or meanings of the structure (.…) this process often helps to overcome fixation effects and other obstacles to creative discovery" (Finke, Ward, & Smith, 1992, p.25). For example, a structure which after a first interpretation process is analyzed as a material tool, could in other contexts function (e.g. doorstop etc.) (Vogt, 2010, p. 200).

Moreover, preinventive structures can also be assessed through *hypothesis testing*. In this case structures from the generative phase are appraised from the perspective of their potential for providing potential solutions to a given problem, for example in order "to explore the implications of these structures for solving the problem" (Finke, Ward, & Smith, 1992, p. 25).

Finally, within the exploratory process *searching for limitations,* preinventive structures can be identified and evaluated on the basis of whether they contribute or hamper further explorations. As Finke, Ward, and Smith (2010) explain: "Discovering limitations can help to restrict future searches and focus creative exploration in more promising directions" (Finke, Ward, & Smith, 1992, p. 25).

The above-presented cognitive processes present criteria for assessing creativity, which, on the one hand side, relate to processes of human cognition and, on the other hand side, to their potential applicability (within a given social context). It is important to note that the notion of originality is linked to the interpretation of the innovation within the prevailing context, and that the perception of whether or not a product of an individual is regarded as innovative depends on the purpose of the product. In this context, the terms applicability and originality are always closely connected to the development and impact of creative processes, operating on a wide range of interpretation possibilities. Hence, the cognitive analysis of Finke, Ward, and Smith (1992) can be regarded as a good overview for such a wide understanding of creative exploration as being relevant for the field of art *and* science.

In summary, by means of the Geneplore Model of Finke, Ward, and Smith (1992), they offer a scientific method for developing (mainly cognitive) criteria for the generative and explorative phases of creative cognition. Preinventive structures (generative phase) and the applicability of function (exploratory phase) are in the foreground here. A key aim of this approach is to define which influences might hinder or facilitate creativity. Thus, it can add considerable value for creative training and organizational development projects. Furthermore, their analysis presents a broad perspective on information generation based on cognitive processes of the human and is thus applicable to knowledge generation aspects (Finke, Ward, & Smith, 1992, p. 192; Vogt, 2010, p. 201).

For the purpose of this thesis, however, the elements of Finke, Ward, and Smith's (1992) research that relate to the understanding of emergence and knowledge generation, in particular with regard to science and art, are of high relevance.
It seems plausible that the processes of *contextual shifting, hypothesis testing* and *conceptual interpretation* are particularly relevant for the process of art making, since they allow for a considerable degree of openness vis-a-vis uncommon (creative) outcomes, potentially leading to paradigm shifts. Related aspects are further elaborated in chapters 11.3 and 13.4. However, for the purpose of providing an example of information processing and knowledge generation, the concept of *conceptual synthesis* is introduced already in the following chapter.

9.4 Examples of Knowledge Generation Processes

Finke, Ward, and Smith (1992) apply their Geneplore-Model to a wide range of cognitive processes, such as: *Creative Visualization, Creative Invention, Conceptual Synthesis, Structured Imagination, Forms of Insight, Fixation*, *Incubation* and *Creative Strategies for Problem Solving*. As also Vogt (2010) emphasizes, findings within the field of cognitive psychology related to the themes of *concept* and *categorization* are of particular relevance for the understanding of information processing, knowledge generation and the creative process.

9.4.1 Conceptual Synthesis / Creative Concepts

According to Vogt (2010), a *concept* constitutes a *class of objects*, i.e. a concept contains the typical characteristics of those *objects* that comprise the specific *class*. Hence, the concept "tree" combines the characteristics trunk, branches, leaves etc. Concepts allow an economical handling of the cognitive resources: "By treating different objects as members of the same concept, we reduce the complexity of the world that we have to represent mentally" (Atkinson, Atkinson, Smith, & Bem, 1993; as cited in Vogt, 2010, p. 191).

A *categorization* can be described as the attribution of objects to a concept. During the process of categorization, an object is - as soon as it has been added to the class or respectively to the concept - treated as holding all other characteristics of the respective concept. Accordingly, on the basis of the concept, characteristics are added to the new object, even though that may not be immediately apparent. As an example, Vogt (2010) refers to characteristics such as stem, branches, and leaves etc., which are automatically attributed to the concept tree. At the same time, though, characteristics such as roots, annual rings etc. are understood even though they are not directly retrievable. In general, concepts can develop to enormous complex and abstract formations as the examples of religion, lies, and politics show clearly (Vogt 2010: 191).

According to Vogt (2010), categorization is better understood as the *process of categorization*, i.e., an automated transfer of characteristics to a class of objects. From an evolutionary perspective, this describes a very economical and effective process within human cognitive development. Furthermore, the ability of human beings to develop complex and abstract concepts is a strong indication for their generative and creative potential. As Vogt (2010) points out, concepts are determined through their upgradeability, i.e. their potential for triggering further developments of a concept: „[N]ew ideas, even highly creative ones, often develop as minor extension of familiar concepts“ (Ward, Smith & Finke, 2009; as cited in Vogt, 210, pp.191-192). One challenge, though, is that concepts tend to be firmly established in social life. This may make it rather difficult for a single individual to question or ignore social borders within the prevailing culture, which, however, is precisely what is required in order to create windows for further development (Vogt, 2010, p. 192).

In this respect, so-called *open concept structures* can facilitate creative developments. Art could be regarded as such a structure, as art, indeed, carry a significant potential for providing a pool of ideas, concepts and categories, which are not necessarily based on ordinary established constructions and perceptions of the world and, thus, are more open for influencing other fields.

To sum up, Finke, Ward, and Smith (1992) introduce the process of *conceptual synthesis* for the purpose of describing the development of new concepts through the combination of already existing knowledge structures. Furthermore, it should be noted that the blend of existing concepts can lead to the phenomenon of *emergence* because the combined concepts may provide characteristics, which are not found in the former components. The idea of conceptual synthesis is helpful in terms of contributing to explaining innovative developments within abstract concepts related to knowledge fields such as physics, religion, music, literature, art, biology, medicine etc. and, thereby providing proficient models for knowledge generation processes.

9.4.2 Complex Conceptual Combinations: Schemas, Scripts and Mental Models

In their analysis of *conceptual synthesis* Finke, Ward, and Smith (1992) stress the importance of "interpretive processes and preinventive structures that are more abstract" (Finke, Ward, & Smith, 1992, p. 91). This approach allows for a broad and complex analysis relevant for the cognitive understanding of knowledge generation and creative processes. Of particular relevance for the scope of this thesis, however, is the question how conceptual combinations are interlinked to characteristic of ambiguity and incongruity. Below, Finke, Ward, and Smith (1992) elaborate on aspects related to this question:

> We focus on subject's interpretations of preinventive object forms in terms of abstract ideas or concepts and consider more complex preinventive structures such as mental blends, schemas, and mental models. We also focus on conceptual combinations and metaphors as two kinds of abstract mental blends and consider their emergent properties, and we examine how properties of mental blends such as ambiguity and incongruity can be viewed as general properties of conceptual combinations and metaphors and how those properties relate to the emergence of *unexpected features* [emphasis added] (Finke, Ward, & Smith, 1992, p. 91).

As Vogt (2010) emphasizes, describing cognitive efficiency only through knowledge-representation mechanisms on the basis of singular concepts is not sufficient. Nevertheless concepts can be regarded as the basic material within the creative process, which are represented within complex forms of *conceptual combinations*. As Vogt points out, the mechanisms of conceptual combination increase the cognitive efficiency of the human as they enhance the capacity for memorizing and, thus, the handling of huge volumes of information. Moreover, they facilitate reliable retrieval of once acquired strategic behaviors (problem solving) or social behavioral patterns. Hence, they significantly contribute to making the natural and social environment comprehensible and predictable (Vogt, 2010, p. 220).

In this context, Vogt (2010) refers to *schema*, *script,* and *mental model* as forms of conceptual combination, whereas it needs to be mentioned, that Finke, Ward, and Smith (1992) relate these terms to the category of *structured imagination*. In general, they "propose that imagination involves the generation and experience of ideas and products that go beyond what is currently known" (Finke, Ward, & Smith, 1992, p. 114). However, the use of *schemes* constitutes one possibility of depicting complex bundles of concepts and their conceptual relation towards each other. As Finke, Ward, and Smith point out, the schema "for a living room might contain not only chairs, televisions, paintings, and other discrete categories but also the typical relation among them" (Finke, Ward, & Smith, 1992, p. 134).

Another form of conceptual synthesis is the so-called *script,* which relates to schemes representing a typical sequence of action. For example, a walk in the forest could be described along the following sequences of a script: car ride to the forest, parking, leaving the car, walking up to the forest hut, etc. (Vogt, 2010: 221).

The advantage of such forms of conceptual synthesis is that *coding of knowledge* through schemes and scripts can increase the efficiency and security of the information-processing, ease the complementation process of missing information and allow for presumptions as regards the likelihood that a certain event materializes (Best, 1995; Wessels, 1994). As Finke, Ward, and Smith (1992) summarize, they "structure the encoding of new information, the retrieval of old information, and inferences based on that information" (p. 134).

In addition, using schemes and scripts can facilitate security of information processing and routine practices. With regard to the latter, it should be noted, though, that such practices tend to be perceived as suitable. Hence, alternatives may not even be considered: „Scripts make our lives easy, and so we continue to do things the way we have always done them, even when better ways might exist (….) One problem with schemas is their inflexibility (….) Although they are helpful in unusual situations or when violations of the routine occur" (Finke, Ward, & Smith, 1992, p. 135). From a creativity point of view, this security reduces flexibility and can lead to reduced creative outcome.

In contrast to the rather static and inflexible forms of schemes and scripts, *mental models* represent a dynamic and fluid form of conceptual combinations for structuring high volumes of complex information. With the benefit of mental models, individuals formulate expectations and make predictions (hypothesis testing). "Thus, they provide a way of thinking how one might make new discoveries" (Finke, Ward, & Smith, 1992, as cited in Vogt, 2010, p. 222).

According to Finke, Ward, and Smith (1992), mental models constitute a type of cognitive structure that operates effectively and efficient within creative processes: „ Mental models are complex enough that one can use them to describe how imagination operates in complex endeavors such as engineering design and scientific discovery" (Finke, Ward, & Smith, 1992, p. 135). In summary, the advantages of mental models lie in their dynamic nature and their broad representation option of world perception. "They can be thought of as active constructions that represent the current or desired state of affairs, as well as information of how to get from one state to another. As such, they involve the interplay between many pre-existing schemas and categories. (…) mental models provide a way of representing the interaction of information from different knowledge domains (and) go beyond the generation of single, new exemplars" (Finke, Ward, & Smith, 1992, p. 135).

Mental models allow for combining and integrating information from various sources as well as a constant updating-process. Occasionally, they are generated through analogical transfer and are specifically helpful when testing different hypothesis and solutions, thereby trying to combine existing elements. Hence, they provide good conditions for further creative exploration (Vogt, 2010, p. 222).

In summary, concepts represent the basic material within creative processes. Conceptual synthesis implies that several concepts and their respective properties merge, potentially resulting in several new properties. In this respect, schemes, scripts, and mental models represent complex combinations of concepts allowing constant adjustment towards new environmental situations, whereas the concept of *mental model* displays most flexibility for knowledge generation processes.

9.5 Emergent Criteria for Conceptual Synthesis: Ambiguity and Incongruity

When new concepts are accepted within a cultural framework, they tend to lose their preinventive character and become established as new knowledge structures. In this respect, the underlying questions of the works of Finke, Ward, and Smith (1992) are: How do creative solutions emerge and how can they be accepted and integrated into the prevailing cultural knowledge structures? With reference to the research of Finke, Ward, and Smith, Vogt (2010) illustrates of how new concepts emerge and become established with the example of the computer mouse:

It is obvious, that hundred years ago there would have been no use for the term computer mouse since there where only mice and no computers then. More precisely formulated, the understandable concept *mouse* combined with the - at that time - incomprehensible concept *computer* would have led to the inexplicable concept *computer mouse*. No more than fifty years later, though, the term fulfills the criteria of a preinventive conceptual structure. Mice still existed and the computer was in the process of becoming an established concept, but what about the combination of computer and mouse?
As Vogt (2010) points out, the creative exploration of this conceptual synthesis is possible, because the term carries *incongruity* as well as *ambiguity*. Questions that could arise during the generative phase are: Does the mouse provide some service to the computer, does the computer control the mouse, does the mouse steer the computer, or is computer mouse a computer-simulation of a real mouse? Even though the two concepts as such are clear and easy understandable, it is evident that the concept *computer mouse*, nonetheless, provides a wide range of interpretation and creative exploration options, at this stage holding central characteristics of a preinventive structure (Vogt, 2010, p. 213).

The initial perception of ambiguity and incongruity as regards this term has gradually declined over time and, since the late 1980's, it can be regarded as well spread. Eventually, the previously separated concepts merged completely, thereby establishing a collective understanding of the new concept. As of that time, the concept computer mouse is not created over its two components, but accepted and stored in the human memory as a

self-contained concept, whereby it also becomes part of a new cultural knowledge structure (Vogt, 2010, p. 213). As a result, the potential for further creative exploration, the characteristics of ambiguity and incongruity plus the flexibility as regards interpretation declines.

In general it can be said, that both *incongruities* and *ambiguities* support creative processes: "Incongruity of components and the related property of ambiguity may result in more creative cognitions precisely because they do not lead to a single obvious interpretation, as is normally the case with highly congruent and unambiguous combinations" (Finke, Ward, & Smith, 1992, p.108). Accordingly, when combined concepts do not lead to a sufficiently clear understanding of the new concept, interpretational mechanisms kick in triggering creative performance. In this respect, Finke, Ward, and Smith (1992) point out, that „[i]n terms of the Geneplore model, an initial synthesis of components would result in preinventive structures of varying ambiguity. If the structure is highly ambiguous, initial attempts to understand the compound would not lead to a single satisfactory interpretation. In an attempt to make sense of the compound, exploratory processes such as conceptual interpretation would then come into play. Among other things, this would include the application of world knowledge or 'naive' theories to the task of exploring the structure" (Finke, Ward & Smith, 1992, p. 99). As Vogt (2010) stresses, ambiguity tend to increase the number of interpretation options and thus the probability of emergence. In this context, the aspect of emergence plays a key role within the approach of creative cognition. Even though it cannot be predicted which new characteristics will emerge through a given creative process. After all, the general conditions that stimulate emergence can be identified (Vogt, 2010, p. 214).

One example for the phenomenon of emergence can be illustrated by a study of Kunda, Miller and Claire (1990). Participants were asked to describe characteristics of individuals who belonged to a specialized category, for example the *Harvard Educated Carpenter*. As a result, the participants came up with unexpected descriptions of a carpenter as e.g. a "non-materialistic one", even so this information was not given neither in *Harvard educated* nor in *carpenter*. Kunda, Miller, and Claire assumed that this surprising and apparently non-fitting category of a Harvard educated carpenter led to a wide range of explanation and interpretation search.

The following questions were raised: Why is there a Harvard educated carpenter at this university? Are carpenters trained in Harvard? Or does it imply that someone who had been educated in Harvard became a carpenter there later on? Are conclusions towards an alternative conception of the world possible? Or does a person of this category refuse to follow standard career opportunities?
It becomes clear that the counter intuitive combination of concepts lead to a wide range of interpretations and to uncommon and thus very creative results in this case. Furthermore, this simple example illustrates that searching for explanations and forming hypothesis are an integral parts of creative processes (Vogt, 2010, 214-215).

In summary it can be said, that within the process of conceptual combination following components do facilitate creative findings. First of all, the combination of unusual concepts promotes creative exploration. Secondly, it is beneficial if single components feature a wider range of interpretation-possibilities (ambiguity, incongruity). And, thirdly, flexible framework conditions foster creative outcome (emergence): „An image displays emergence when its parts or features are combined such that additional, unexpected features result, making it possible to detect new patterns and relations in the image that were not intentionally created“ (Finke, Ward, & Smith, 1992, p.50)

9.6 Influence of Knowledge Structures: Previous Knowledge

In addition to the aspects that have been discussed thus far, previous knowledge plays an important role within creative processes: “We have developed the idea that much of creative cognition is structured, in that existing knowledge bases guide and often restrict the form that imaged creation can take” (Finke, Ward & Smith, 1992, p. 143). The considerable impact of prior knowledge-structures is for example visible in automatic behavioral-processes, which ease daily life considerably. Theses processes are conducted unconsciously and mostly beyond creative control. They help to save cognitive resources, and support efficient utilization of these resources. Accordingly, retrieving available categories and concepts seems more reasonable and efficient compared to embarking on

new potential developments. Studies on *recently activated knowledge structures* have indicated that such structures may have an immense impact on creative processes. In view of this, it has been suggested that also rather static knowledge structures, i.e. as memory-based knowledge, may have a significant influence on the creative output (Vogt, 2010, p. 216).

Vogt (2010) considers that the following experiment of Smith, Ward, and Schumacher (1993) underpin this hypothesis: Participants were asked to develop new forms of toys. One group was not provided any guidelines at all, whereas the other one received different examples of specific characteristics as a ball and an electronic device. Even though those in the second group were instructed not to relate to the items that had been provided, the result of their efforts showed a significant resemblance with the examples provided (Vogt, 2010, pp. 215-216).

The fact that creative processes seem to be strongly related to existing cognitive structures suggests that the traditional idea of creativity as an exploration of something completely new, based on an unsystematic and coincidental process, is invalid.
Advocates of the creative cognition approach, however, consider that human thinking, in general, follows clear structures and apply these patterns to processes of creative thinking. Typically, they refer to *mental images* when analyzing creative thinking, the underlying assumption being that if the human beings possess comparable knowledge structures then the characteristics of their respective mental images must relate to exactly these knowledge structures. „The term we use to refer to the impact of existing conceptual knowledge on imagined entities is *structured imagination*“ (Finke, Ward & Smith 1992: 114). In this context, it is worth noting, that Finke, Ward, and Smith (1992) refer to creative processes often as creative imagination or creative visualization. “There is considerable evidence that much of our everyday thinking is based on the formation and transformation of visual images (….) Moreover, there are many accounts (…) of the role that visualization plays in the creative process” (Finke, Ward & Smith, 1992, p. 45). It should be kept in mind that the terms *creative imagination* and *visualization* refer to thinking processes.

As the quote above indicates, creative processes are related to both, human cognition and existing information structures. In this context, Vogt (2010) underlines that the conceptual

and categorical knowledge of the human, which is primarily gained through learning and making experiences (beside the congenital structures), leads to a logical structuring in the emergence of creative output. Accordingly, there is a certain probability that characteristics of these existing structures will occur during creative processes (Vogt, 2010, pp. 217-218).

Awareness of the structuring and, potentially, restricting effect on which previous knowledge structures can have on processes of creative exploration helps to develop techniques for mitigating these consequences. “One possibility is the attempt to make implicit assumptions explicit or raise them to consciousness (.…) For example, if one becomes aware through exploration that an implicit assumption (…) has influenced the generation of an initial form (…), one can deliberately overcome that assumption” (Finke, Ward, & Smith, 1992, p.139). This means tasks that have been formulated on a more abstract level tend to provide a wide range of interpretation options during the generative phase of creative exploration. For example, if engineers were to be asked to develop a new hammer, the *concept hammer* and the related attributes are likely to have a significant influence on the development-process and the end result is likely to be rather close to the current form of this tool. However, formulating the task in a more open manner, for example, to design a tool that allows sharp small object being inserted into solid material could generate ideas of completely new concepts of the hammer (Vogt, 2010, p. 223).

In summary, studies of structured imagination suggest that creative output is influenced by previous knowledge, which may structure creative outcome considerably. These structuring processes occur mostly on an unconscious level and can lead to restrictions of the potential for creativity, which implies that „encouraging people to move to more abstract problem characterizations will lead to more innovation“ (Ward, Smith & Finke, 1999, p. 198). Reversely, this implies that the more open, abstract and general an instruction (concepts/categories) of creative exploration is, the higher the probability that the outcome will be creative.

10 Summary of Part II

In summary, it can be concluded, both from a social and a cognitive perspective, that creativity is not related to individual performance only but to the standard cognitive skillset as well as constituting a social phenomenon. Furthermore, both of these approaches allow for an understanding of creativity that is applicable to information and knowledge-generation processes, for example in the field of art and science. These perspectives are by no means mutually exclusive. Rather, they complement each other and, thus, jointly lead to an increased understanding of creative developments.

For the purpose of this thesis, the following questions could be useful when applying these avenues for the purpose of exploring creativity:

- How can existing knowledge and information be exploited, re-coded and developed into new forms (*cognitive avenue*)?
- Which social (cooperative) processes ensure that the output can be preserved and, thus, available for further developments (*social avenue*)?

The influence of the social system *as a whole* is crucial for the acceptance and utilization of the outcome of a creative process. More specifically, individual achievements are only regarded as creative if they are acknowledged as innovative *and* useful by the social environment. Accordingly, a positive evaluation at the level of social structures is a pre-requisite for the embedding of a creative product in the knowledge structures of the prevailing culture. This can be described as a process based on co-operation, shared intentions and values, as well as forms of strategic behavior, with the aim of ensuring that only the best *fit* ideas are implemented within the relevant knowledge pool. In this respect, the creative outcome is the result of the interaction between the individual presenting the innovative product and the environment which tests and evaluates it on the basis of criteria that are considered relevant within the prevailing culture.

As described above, *individual* strategies and *social* assessment processes constitute interdependent factors of the process of manifesting creative products. In this respect, it is

considered that knowledge generation through creative processes is possible when the creative product is considered to fulfill criteria related to originality *and* usefulness. These findings are of particular relevance for this thesis as they allow for an understanding of the creative exploration as both a cognitive, based on criteria of innovation, *and* a social process, based on criteria of applicability. Moreover, the interplay between the individual's products (which can be either concrete or abstract) and the evaluation of these products at the social level provides a basis for formulating an integrated hypothesis for the socio-cognitive approach.

The cognitive avenue refers to cognitive processes of creative exploration and is, thus, considered to be applicable to various forms of knowledge generation. Within the field of creative cognition it is attempted to providing a standardized avenue for analyzing creativity in a broad sense. i.e. covering artistic achievements as well as scientific explorations.
With reference to the presented Geneplore Model (Finke, Ward, &Smith, 1992), a distinction is made between the two phases of the creative processes, each entailing various cognitive processes and structures which collectively constitute the creative process on the whole. The first one - the generative phase - is determined through a rather open process-structure that aims at emergence of creative structures under rather uncontrolled conditions, thereby focusing on searching mechanisms. Only in the second one - the explorative phase - the rather unstructured creative outcomes of the generative phase are tested, evaluated and structured according to the given requirements. In short, the generative phase is linked to the originality and the explorative phase to the usefulness of a creative product.

Studies on conceptual synthesizes suggest that an open and dynamic information-processing facilitates creative outcomes. Thus, such models provide good conditions for creative explorations. Within this thesis, special attention was given to the aspect of ambiguity and its potential of generating multi-dimensional possibilities for interpretation as well as the disturbing element of incongruity - both might have a considerable impact on the creative outcome.

Findings in the field of structured imagination indicate that also recently activated knowledge (previous knowledge structures) might have a considerable influence on

creative processes by restricting the creative outcome. In this respect, the creative ability can be regarded as linked to the human intention of deliberately altering already established knowledge concepts aiming at particularly innovative outcome.

It is no contradiction to state that, while the creative process belongs to the structured cognitive instruments of the human, it simultaneously profits from open, even opposing and controverting structures which support emergent results during the generative phase. Whereas the cognitive avenue is mainly related to observations of individual creative behaviors, the exploratory phase of creative processes refers to its applicable and thus social function. During the generative phase, innovative and original ideas are developed; in the explorative phase, the potential of these ideas for gaining acceptance within social environment is explored. This refers to a creative ability of the human based on generating, exploring, accepting and memorizing mechanisms, which, in turn, are based on both, cognitive and social conditions.

In summary, the social avenue is focused on the interplay between the individual and society. In this context, emphasis is put on the implications of this interplay with regard to processes related to creativity and innovation, with a focus on the impact of social structures when evaluating outcomes of creative processes. It has been demonstrated that this idea of systemic conditioned creativity does not necessarily restrict the autonomy of the creative process, but underscores its non-autarky as it is inevitably dependent on social structures.

In the context of the cognitive avenue, on the other hand, creativity is regarded as a feature of the general cognitive settings of the human being. It has been shown that research from the creative cognition allowed for a knowledge generation model with regard to processes of evaluation and paradigm shifts. This model can be applied to both science and art. On this basis, it has been demonstrated that creative outcomes are based on previous knowledge structures, which potentially restrict innovative outcome. Particularly so-called *open concept structures* might facilitate creative developments. It has been suggested that art could be regarded as such a structure, as art carries a significant potential for providing a pool of ideas, concepts and categories, which are not necessarily based on ordinary established constructions and perceptions of the world.

Specific attention has been drawn to the factors noise and disturbance (ambiguity, incongruity) which carry a significant potential for positively influencing a creative process by contributing to overcoming previous knowledge fixations.
Furthermore, an exploration of the interdependent factors of the socio-cognitive avenue has revealed that knowledge gain through creative processes presents a model for cultural development, which seems to be applicable to an evolutionary perspective of creative processes.

With reference to the scope of the present thesis, this raises question how social and cognitive aspects of creativity are potentially related to the creative process of art making.
In conclusion of Part I and II, therefore the following assumptions are predominant:

- If the ability of human creativity is defined through social and cognitive processes relevant for knowledge generation;
- if the creative outcome can be defined with the criteria of originality and usefulness;
- if human creativity can be understood as the basis of innovation and therefore cultural variation; and
- if the creative product is also defined through social acknowledgment processes:

Then the questions can be raised i.) to what extend the term art could potentially refer to knowledge generation processes which are of social relevance, and ii.) is there evidence that artistic outcome refers to cultural development processes of the human being with evolutionary impact.
It should be recalled, that within this thesis, creativity is understood as a cognitive competence largely based on communicative ability and social behavior and that particular attention is paid to processes related to knowledge generation and retention.

PART III CULTURAL VARIATIONS AND ARTISTIC PROCESSES

Parts I and II were focused on social and cognitive aspects of the creative potential of the human being. More specifically, this ability was analyzed from the perspective of processes related to innovation and knowledge (culture) generation based on social aspects. In Part III, the question how a socio-cognitive understanding of creativity can be applied on the production of works of art is explored. Three aspects are in the foreground in this context:

Firstly, the question to what extend art is related to methods of research and processes of knowledge generation is in the foreground.

Secondly, coevolutionary aspects of knowledge generation, which can be considered as related to mechanisms of variation, selection, and transmission, are looked at. Moreover, re-coding effects on knowledge structures and aspects of social relevance are explored.

Finally, hypotheses of how artistic outcome might have an effect on processes of knowledge-retention, human behavior, cognitive processes are introduced, whereas also a sociobiological impact is touched upon.

11 Art and Research - Process of Knowledge Generation

For the purpose of this thesis, the process of producing art refers to a definition of Thomas Junker (2010), who regards this process as closely related to the general cognitive and cross-cultural abilities of the human and, as such, as a fundamental asset for acquiring and nurturing new knowledge. In this context, the artistic competence of the human being relates first of all to the ability of re-coding and generating of knowledge structures in a creative manner and, secondly, to acknowledgement processes of new information within social groups (Junker, 2010, p. 91).

In this thesis it is, furthermore, argued that the creative process of art-making is based on both biological and genetic settings of the human being. From this perspective, the capacities required for producing works of art are not regarded as fundamentally different from those required for intellectual tasks, for example mastering a language. Quite to the contrary, these capacities are considered to be based on the same biologically predetermined human abilities (Bierwisch 2008, Hauser, Chomsky, & Fitch, 2002; Snowdown, 2001; Junker 2010). It is important to note, though, that phenomena such as language, moral or art can only occur if preconditions in terms of adequate genetic codes and environmental aspects (i.e., structures for systemic knowledge-transfer, e.g. education) have been met (Junker, 2010, p. 92).

In summary, Part III refers to the overall socio-biological (partly coevolutionary) approach of this thesis, primarily focusing on processes of knowledge-generation through the one of art making. It should be noted that analyses of natural (survival of the fittest) and sexually selective mechanisms triggered by artwork are not in the foreground.[15] However, this thesis rather operates on the question if art making provides relevant outcome for knowledge generation. More specifically and according to Schmidt (2010), this question is related to the visual representation of abstract thinking inter alia aiming at aligning potentially controversial contents and, eventually, leading to shifts of paradigms (Schmidt, 2010, p.18).
Part III of this thesis provides one perspective on these generative mechanisms, with the aim of allowing for a socio-cognitive understanding of art-making.

11.1 Biological and Cultural Aspects of the Artistic Process

As hinted above, this thesis departs from the assumption that art is created by eccentric geniuses only. Instead, it is suggested that the origin of the artistic ability is not only a product of historical and cultural developments but also to be found in the genetic settings of the human brain. As Wilson (1998) points out, the human cognition and cultural

[15] Comprehensive studies on these subjects have been made by Dissanayake (1995; 2002) and Menninghaus (2011).

developments are based on structured and influential biological mechanisms of genetic evolution (Wilson, 1998, p. 291).
Wilson (1998) is, however, convinced that the exceptional development of the human brain and, in turn, the capacity to produce art, can be derived from processes related to genetic-cultural coevolution. This, Wilson argues, is the most plausible explanation, taking into account the full spectra of findings in the fields of neuroscience, psychology and evolutionary biology (Wilson, 1998, p. 291).

As discussed in chapter 9, it is in particular the discipline of creative cognition, which focuses on identifying and analyzing cognitive mechanisms and processes of creative thinking, being applicable for fields such as art and science. It is suggested that these cognitive processes, in principle, follow comparable patterns, irrespective of which discipline they are related to.

To this end, Wilson (1998) points out that the human brain seems to be programmed for searching for the most adequate formula of patterns. Wilsons refers to Rothstein (1995), who argues that art and science in fact deals with similar subject matters. Wilson, furthermore, suggests that, within both of these disciplines, the epistemic approach is based on comparison and detection of patterns and analogies to already known knowledge structures. Eventually, these structures are transformed and metaphors, new principles or abstractions, are created. Rothstein points out that cultural achievements, such as mathematics or music, over time, tend to become more abstract und influential in cultural life. Rothstein suggests that strive for knowledge and understanding constitute universal principals, irrespective of the research field. In this respect, Wilson echoes this point of view by emphasizing that art and science are unified in the sense that they both aim at developing new perspectives on the world (Wilson, 1998, p. 293).

In view of the aforesaid, it seems clear that a socio-cognitive analysis of creative processes, whether for the field of art or science, is closely linked to the questions of how new ideas emerge (variation), innovation is accepted (selection) and knowledge is established (transmission). Moving further, the question arises to what extend research methods and concepts from the field of science lend themselves for exploring the field of art.

11.2 Research Aspects on Works of Art

Generation of knowledge through creative processes constitutes an illuminating example of the interplay between cognitive and social aspects. When analyzing this phenomenon questions such as these arise: How are new ideas generated, how do they relate to old and new knowledge structures and how are they influenced by social structures such as institutions?
As Weisberg (2009) points out, "little has been said about how knowledge is extended to new situations"(p. 246) and further states that knowledge and its relation to creativity could constituted as a "prerequisite for creative functioning" (p. 227) not only by providing the "basic elements, the building blocks out of which are constructed new ideas" (p. 226) but also by "modifying one's past experience to make it fit the unique aspects of the present situation" (p. 243).

Accordingly, Weisberg (2009) emphasizes that a creative outcome, e.g. a new idea, always is related to previous knowledge structures. He, furthermore, states that innovations are not only linked to previous cultural achievements but also to processes of social acknowledgement: "Without some sort of reference to the past, there would be no coherence: The product would make no sense to us" (Weisberg, 2009, p. 246). Analogous to the systemic approach of Csikszentmihalyi (2009), Weisberg stresses that specific domain knowledge is required to enforce innovations or, as he avows, "if one does not know the discipline, one cannot go beyond it" (Weisberg, 2009, p. 247). In this context the creative performance is understood as a process of knowledge modification and refers to both, the process of alteration and evaluation within a social environment.

As stressed in the context of the exploration of creative cognition, creativity is referred to as a process of thinking. Correspondingly, for part III of this thesis the question is raised to what extend the term *research* is appropriate when analyzing creative outcome and related knowledge generation. In this context, questions related to the applicability of scientific perspectives on works of art are in the foreground.

According to Reder (2004), the artistic process is related to methods of *research thinking* ("forschende Denkweise") that refer to subjective criteria of the artist. He argues, that art,

in this sense, aims at processes of transformation, precision, complexity, and leads to the acceptance or the breaking of rules. Contents of art, Reder emphasizes, deal with the incomprehensible and the undefined, presented through the artist's individual work of art. It is worth noting that also Reder refers to the creative performance as a recoding process, which is based on cultural relevant production (Reder, 2004, p. 7). Reder focuses on the complex and multiple working and thinking methods of the artist when analyzing research component of artistic outcome. In this context, it should be noted that also John (2004) defines artistic research via working methods of creative processes, specifying that the aesthetic competence of the human is related to the ability of producing contextually alien associations applicable within social system.

Both Reder (2004), and John (2004), consider that the creative process of art making comprises knowledge generating processes (Reder, 2004: p.7; John, 2004, pp. 3-4). Reder, furthermore, refers to art as an arena for reflection where different forms of interpretation (the artist's one, the observer's one) meet which may lead to the establishment of new knowledge synthesis and/or making existing ones obsolete (Reder, 2004, p. 10).

A distinction should, however, be made between artistic research and the classical, strictly scientific form of research. Compared to traditional science, artistic research is neither bound to standardized paradigm of world perception nor to definite methods of scientific approaches. Within artistic research, the subject as such is the decisive element and the artist defines individually, which aesthetic criteria he finds useful for the construction of world images (John, 2004, pp. 2-3). In this respect, Schenker (2004) emphasizes that, even though the scientific perspective is highly influential - not to say dominant - in today's society, knowledge should not be reduced to scientifically verified findings only. From his point of view, knowledge is being generated within a wide range of areas that are no less important than the strictly scientific one - they all form part of the knowledge-generation at society level (Schenker, 2004, p.1).

Correspondingly, Schenker (2004) emphasizes on the aspect of transdisciplinarity. Strictly speaking, scientific research tends to operate within its respective field only. Due to the rapid development of compound knowledge structures and the need for complex solutions in today's society, however, it could be argued that such a perspective is insufficient. This goes along with the strive towards transdisciplinarity within the scientific context. As

Schenker stresses, in today's society, the traditional understanding of progress as only chronological and linear processes has become obsolete. Contemporary research tends to be based on synchronic, parallel existing, knowledge-structures. According to Nowotny (1997), the decisive mechanisms for innovation lies in the moment of *attention*, which she refers to as *cross-border perception ability* required for today's manifold context of life (Nowotny, 1997; as cited in Schenker, 2004, p. 6). In this context, Schmidt (2006) underlines that art carries a significant potential for creating such attention via its inherent dialectic potential (Schmidt, 2006, para. 5). Schenker, however, suggests that the notably increased use of transdiciplinary approaches within the scientific context can be regarded as an expression of the fact that unilateral approaches are no longer considered sufficient for a comprehensive picture of knowledge generation in today's complex world (Schenker, 2004, p.6).

In this respect, an artwork might present an open perspective of perception on a diverse content level. As Schenker (2004) stresses, one might understand a work of art as an instrument for enabling specific experiences or provoking specific forms of action or reflection. In the narrower sense, the result might influence a related discourse or formulate a new art concept. In a broader sense of life practice, an artistic impulse might alter prevailing perspectives on the world.

As mentioned at the very beginning of this thesis, knowledge is not only "stored" in individual brains (internal representation), it is also represented in social structures, material artifacts, external representations and environmental structures (external means) (Laland et al. 2012, p. 2; cf. chapter 1). Knowledge, however, is regarded as the capacity of individual or collective problem-solving by means of creative cognitive competences. As Tomasello (2000) points out, the artifact refers to human's "culturally based cognitive skills with a social collective dimension" (p. 7) or in other words "the human holds the social-cognitive key to the historically constituted cognitive products of her social group" (p. 8). Correspondingly, the art-work (artifact) can be regarded as one instrument for sharing knowledge among individuals within a social group. In this respect, it can be stated that the process of knowledge generation through artistic research is based on complex cognitive and social abilities of the human. More specifically, this describes the human competence of modifying and recoding previous world images, by interpreting various

options for perceiving the given environment. In this respect, also Part III follows a socio-cognitive approach and aims at divulging some of those mechanisms that enable knowledge generation through artistic processes.

11.3 The Socio-Cognitive Avenue - Concepts of Systemic Art

Within this thesis, the socio-cognitive perspective on artistic performance and related outcomes aims at establishing a bridging hypothesis for a sociobiological understanding of art. Rather than defining (socio-cognitive) criteria related to creative performance, Part III focuses on questions that address the relevance of social (cooperation), cognitive (memory) and socio-biological (behavior) factors with regard to works of art. The understanding of artistic performance as a process is in the foreground of this thesis, posing the overall question what relevance artwork potentially holdsin relation to knowledge generating and retention processes within the social context.

In line with the coevolutionary approach of this thesis, it is understood that developments such as language, moral and works of art can materialize only when both biological *and* social pre-requisites have been fulfilled (cf. chapter 11). Simply put, the former is related to the necessary genes and the latter to adequate structures for systemic knowledge transfer (education etc.). As Junker (2010) points out, the development of the supplementary concepts of evolutionary theories, such as the *extended phenotype* of Dawkins (1989)[16] or the concept of *Theory of mind* (cf. chapter 5.3), have allowed for coevolutionary analyses of art (Junker, 2010, p. 93).
In this respect, this thesis does not deal with aesthetic rules and symbolic meanings of specific art concepts but focuses on the fundamental abilities of the human to creatively recode and transmit knowledge structures. Definitions of art as presented in the following paragraph refer to such understanding, deliberately omitting philosophical and art historical aspects.

According to Faßler (2005), art is related to the general intellectual capacity of the human being, in particular to the ability of meta-representation (abstract) and re-codification of ways of perceiving and interpreting the world. This competence is directly related to the specific human ability of intentional and target-orientated thinking methods; besides, it allows for fictional interpretation of world understanding (Faßler, 2005, p. 139).

[16] cf. also Boyd & Richerson (1985) chapter 3.2 and 5.2)

Wilson (1998), however, refers to a motor that drives art according to the following formula of *imitation + abstraction + intensification*. He suggests that this motor has been developed during the human evolution for the purpose of structuring the "confusion" (complexity), which the human intelligence can bring about (Wilson, 1998, p. 294). To some extent, this formula refers to socio (imitation) and cognitive (abstraction, intensification) aspects, which potentially lead to knowledge-generating relevant for the fields of art and science.

Another approach that is of relevance for the socio-cognitive approach of this thesis is John's (2004) concept of *systemic art*. The aim of his *critical-aesthetical* understanding of production of art is to trigger reflection at a relevant social level with *aesthetic* means. John regards art as a process-orientated practice whereas *critical* refers to the process of evaluation[17]. Analogues to Csikszentmihalyi (2009), John (2004) underlines the social relevance of artistic outcomes, thereby rejecting subjective appreciation of the artwork as an object only. Analyses of artistic performance, he argues, should focus on exploring the *value-adding attributes* of the aesthetic criteria and its impact on the social environment. Accordingly, such analyses should explore cross-linkages of findings from various disciplines, in order to either reveal or reject diverging perspectives (John, 2004, p.2).

With regard to the socio-cognitive approach, it should be noted, though, that in the present chapter, social criteria refer to the artistic process and its impact on social structures (society). With cognitive criteria such processes are meant, which refer to generative aspects of knowledge gain (modification) through artistic processes. It should be underlined, that this approach does not allow for a strict distinction of the terms social and cognitive, but focuses on integrating questions such as:

- To which extent can processes of variation, selection and transmission contribute to increasing the understanding of the generative aspects of artistic processes in relation to knowledge modification? To this end, special attention is paid to processes of cultural contextualization, social relevance and re-codification; whereas a co-evolutionary perspective is touched upon.

[17] here: *critical* does not refer to moral or ethical aspects of art work.

- Can the impact of artistic outcomes on cognitive mechanisms and behavior of the human be verified on the basis of examples? Special attention is drawn to mechanisms related to memory (via noise), cooperation (open process structure) and mental representation (hypothetical testing).

- Does the socio-cognitive approach allow for combining a socio-biological understanding of artistic performance with an evolutionary perspective?

In summary, Part III aims at developing some bridging perspectives with a transdisciplinary focus for further discussion.

Referring to Part II of this thesis, findings from the field of creative cognition indicate that knowledge generation processes inter alia are related to processes of *conceptual synthesis*. As discussed in that part, the transformation of established mental concepts into new conceptual combinations, respectively rejection of such concepts of the knowledge domain, is a delicate process which poses several challenges. Given that knowledge structures are determined by social processes, once established knowledge tends to be deeply integrated, well accepted and usually not questioned within the social system.

With reference to the research field of creative cognition (Finke, Ward, & Smith, 1992), the aforementioned suggests that already accepted knowledge structures (cf. process of conceptual synthesis chapter 9.4 and 9.5) are hard to dissolve. Nonetheless, it is important for an innovative, progressive society to be open for new ideas. In that respect art or, more precisely expressed, artistic research can be regarded as an established function in society, which offers a window for generation of non-fixed conceptual structures that are relevant for knowledge generation.

The more open a knowledge domain structure is towards new impulses (cf. chapter 8.2 and 9.4.2), the higher its potential for social and cultural innovation and growth. The following questions are key in this context: How can *variation* (cf. *conceptual synthesis, mental blends* in chapter 9.4.2) be generated within the artistic process? Which *values (criteria)* are relevant for such modification triggered by artwork? Exploring these questions in an exhaustive manner would exceed the scope of the present thesis. An attempt to distil relevant aspects and thus provide avenues for further exploration is, however, made.

12.1 Variation - Cultural Contextualization

Schenker (2004) suggests that artistic research should not be limited to representative questions only (i.e., art reduced to an object). Both John (2004) and Schenker argue that artistic research constitutes a potent instrument for triggering (provoking) reflection within a social context. In a narrow sense, the result of artistic research might enrich artistic discourses or contribute to the development of new artistic concepts. On the broader level, though, the *artistic intervention* might go beyond formula and criteria of so far perspectives of world perception and thus trigger progress at the society level, potentially even contributing to paradigm shifts (Schenker, 2004, pp. 1-2).

The *critical-aesthetic* approach of John (2004) could be mentioned as one option for a methodological approach to the artistic process relevant for knowledge modification. John emphasizes that the process of art making, to some extent, is always linked to the prevailing social context and should contribute to differentiating knowledge structures and modifying cultural values. The term *aesthetic* is here related to a broad range of qualitative contextualization (atmospheric, sensual etc.) based on the ability of aesthetic perception as a means for differentiating relevant contents. The term *critical,* however, refers to processes related to evaluation and differentiation of given (previous) and newly developed knowledge structures. According to John, artistic research exploits art's potential of generating abstractions and associations which may lead to intensifications or even provocations and, eventually, to unexpected and distracting outcomes.

In contrast to the classical scientific approaches, which usually aim at isolating phenomena and identifying those factors that are relevant for the reproduction of them, the artistic research approach typically deals with a broad set of research criteria simultaneously. Rather than being limited to singular questions this approach aims at a rather multidisciplinary analysis. It is important to take into account, though, that artistic research should neither be regarded as some type of general self-discovery process, nor as naive visualization of symbolic elements. According to John (2004), artistic research should be

concerned with *critical subjective (artistic) methods* and aim a developing transdisciplinary orientated strategies in order to create effective results of contents, which can be regarded as *contextually alien* to previous knowledge structures (John, 2004, pp. 4-6).

In summary, the practice of systemic art operates independently from specific disciplines and is based on a transdisciplinary (conceptual) synthesis of knowledge structures (John, 2004, p.4). Accordingly, Schenker (2004) emphasizes that works of art can be based on a broad range of influences such as social theories, scientific findings or philosophical or literary texts. In this context, work of art can either fulfill the function of a role model or of provoking positions, navigating between a variety of stimulating ideas and perceptions when trying to narrow the object of research. Furthermore, Schenker stresses that by making an artwork public, the artist is implicitly claiming that it goes beyond existing knowledge structures. Accordingly, the artist may well anticipate that his work will be subject to discussion. This underlines the inherent intentional approach of the artistic process (Schenker, 2004, p. 2).
In this context, it is worth noting that John (2004) suggests that his theory of *systemic art* should not be regarded as restricted to artistic research only but in principle is applicable wherever knowledge is being generated in an innovative manner.

It is important to note that this approach underlines the autonomy of the art making process while nonetheless, considering that works of art are non-autarky vis-à-vis the social system they are created within. In this context, art can be considered as a principle of *interference* which operates independently from social rules while, nonetheless, being related to its social context. Analogous to the creative process, criteria such as originality (interference) *and* usefulness (social relevance), as defined within the field of creative cognition (cf. chapter 7.2 und 8), appear to be highly relevant also for the artistic process. Within this thesis noise is regarded as a key trigger of interference and, thus, given special attention in chapter 13.1.

12.2 Selection - Social Relevance

The definition of systemic art of John (2004), presented in chapter 11.3, gives raise to the questions to which extent works of art can be assessed on the basis of social relevance and how such evaluations could be conducted. To this end, John postulates that artistic research should be focused on perceptual aspects rather than on design-related issues. More precisely he refers to the term aesthetic as a perception-related characteristic, whereas the artistic process as such should focus on a social context ("Relationierung"). John stresses that it is the task of the artist to address questions related to the perception of his work, combine diverse meanings and values and integrate them within the artistic process. John criticizes production of art that is mainly focused on the presenting of objects within an excluding art-context (art market) and argues that the creative process needs to be positioned within a broader social and cultural context (John, 2004, p. 3).

Along the same vein, Schenker (2004) considers that an *aesthetic-ethical*[18] *relevance* should be regarded as the decisive criterion with regard to artistic processes. He recalls that existential issues and questions related to values and perception have always had strong bearing on production of art. Notwithstanding the strong economical influence on the art market of today, he argues that this should not distract the focus from the fundamental values of artwork (Schenker, 2004, p. 3).

As demonstrated in chapter 8.1, Csikszentmihalyi (2009) considers that creative processes are of relevance *only* when they can be related to a social context, thereby recalling the following quotation: „Creativity is not the product of single individuals, but of social systems making judgments about individuals' products" (Csikszentmihalyi, 2009, p. 314). Accordingly, the process of art making tends to be closely connected to various cultural fields such as economy, politics, and science. The transdisciplinary component of art is shown in the overlapping projection of diverse contents which might attract attention of experts of various knowledge fields.
Having different profiles, these experts may arrive at incompatible but nonetheless related points of views with regard to a particular work of art. In this respect Schenker (2004) considers that both the artists themselves and relevant experts (art critics etc.) contribute to

[18] ethical aspects of artistic outcome are not of relevance within this thesis

the discourse on the potential acknowledgement of the artwork. More specifically, the artists tend to take a justifying position vis-à-vis the critical one of the experts. The end result of such processes may well be a consolidated view on the relevance of the respective artwork.
In any case, this exchange of views and perspectives (based on communication and cooperation) is central to the process of validating the social relevance of works of art. In contrast to traditional science, the contributions of artistic research tend to be of a rather diverse and non-conforming nature, typically providing new options for perceiving and understanding the world. Nevertheless, Schenker (2004) suggests that both scientific and artistic research carry a significant potential for generating knowledge (Schenker, 2004, pp. 2-3).

One may argue that the cultural knowledge of today is a result of the growing complexity of highly developed societies, which are characterized by the accelerating plurality of cultures, life styles, discourses, institutions, languages etc. Accordingly, life of today is highly influenced by transdisciplinary forms of communication and cooperation, which link various and diverse forms of social fields of a society and lead to manifold forms of social cohesion.
Correspondingly, Schenker (2004) refers to a growing cross-fertilization of art and science, which strongly indicates the social relevance of artistic outcome (Schenker, 2004, p. 6).

In this respect, John (2004) refers to the "function" of art whereby he emphasizes the impact of artistic research rather than the applicability of an artwork. John argues that only artwork that is considered to have a social relevance can trigger knowledge-generating processes within the society (John, 2004, p. 2). In this context, it is worth noting that Schmidt-Wulffen (1993) regards art as a process from *originality to discourse*. Schmidt-Wulffen is thereby focusing on the idea of art as a form of *social engineering*, i.e., the artist is regarded as a catalyst for the development of social processes.

12.3 Transmission - Re-Codification

As mentioned in chapter 11.2 and 11.3, from a *critical-aesthetic approach*, artistic research can be understood as related to methods of knowledge generation. In addition, Schenker (2004) points out that artistic research primarily aims at creating *variation options* for world perception (i.e., broadening the range of *options* for understanding the world). According to a transdisciplinary understanding of the art work, a wide range of variations are possible to this end, e.g. related to perception of space, objects or time or human interaction etc. In this sense, the "content" of a work of art can be regarded as a stimulus for various interpretations, which, eventually, might become accepted as new knowledge structure (Schenker, 2004, pp. 4-5).

In this respect, *variations* can be regarded as a principle of *re-codification* because they imply modifications of previous knowledge structures. With reference to Faßler's (2004) theories on coevolution, this leads to the question to which extent cultural developments contribute to the self-preservation of human kind. This, very broad, question could be narrowed down to exploring how cultural variations can influence human codes of behavior, i.e., can it be argued that works of art which have been created on the basis of an aesthetic-critical approach carry a potential for impacting human behavior? With reference to the scope of this thesis, this question could be taken further by exploring the interdependencies between genetic codes, the cognitive abilities and social behavior with regard to cultural life. It should be noted that questions of this nature are also related to the question of epigenetic-influence triggered through culture and art (Faßler, 2009, p. 4).

With reference to the *Dual-Inheritance-Theory* of Boyd and Richerson (1985), it seems evident that on the one hand, the genetic selection as such has an influence on the cultural development of human kind, and on the other hand, cultural transmission processes follow *cultural* principles for such transmission, not genetic ones (cf. chapter 5.2). Accordingly, Boyd and Richerson(1984) refer to the autonomy but non-autarky of cultural transmission

processes compared to genetic ones and thus indicate epigenetic transmission: „Culture is information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation" (Boyd & Richerson, 1984, p. 2). In this context, parallels to the definition of Junker (2010) are shown, who suggests that the process of art making is related to genetic codes and the environmental pre-requisites, e.g. in terms of educational institutions, enabling knowledge transfer (Junker, 2010, p. 92).
Moreover, also Schmidt (2001) considers that cultural transmission processes can operate autonomy but are non-autarky vis-a-vis the given environment. With regard to the artistic process as such, he argues that there is no contradiction between stating that the creative process of making art should, as far as possible, be exempted from constraints, while it, at the same time, is inheritably bound to biological and cultural conditions.

In this context, Junker (2010) emphasizes that, from an evolutionary point of view, supplementary approaches from the socio-biology and cognitive sciences, such as the concept of *Theory of Mind*, the *Handicap-Principle* of Zahavis (1975) or the idea of *extended phenotype* of Dawkins (1989), constitutes a pre-requisite for analyzing the complex process of making art: These approaches underline the interdependencies between biological determination, cooperative behavior and cultural influence on the human evolutionary development (Junker, 2010, p. 93).

Summing up, Junker (2010) recalls that different evolutionary theories on art do not necessarily lead to the same outcome. The examples he provides include the following: For example Eibel (2004) or Pinker (1997) understand art as an evolutionary side-effect of biological adaptation-processes; the actual benefit of art for the human development is questioned. Tooby and Cosmides (2001) compare art with the principles of game-theory which they consider relevant for the maturation and development of brain functions. They reject the idea that the artistic process is applicable to normal life practices, because of the fictional character of art. Miller (2000), on the other hand, considers art as a fitness indicator for sexual selection. Dissanayake (1992) and Boyd (2005), though, emphasize on the cooperative aspect of art and its contribution to social cohesion (Junker, 2010, pp. 96-98).

Junker (2010) raises the question whether community building is more effective if it is related to the complex and allegedly wasteful constructions of imaginary world perception. He suggests that art should be regarded as an instrument which facilitates the communication of (unconscious) needs, wishes and intentions within a community. To this end, he argues that the artistic process allows for synchronization of mutual forms of behavior. In line with Tomasello (2000) and Dawkins (1989), Junker states that art, in the form it is known today, would not have been possible unless the human being had started to relate to patterns of behavior and artifacts of other individuals (cf. principle of shared intentionality, theory of mind in chapter 4 and 5.3), in other words to accept them as part of their extended phenotype.

In this respect, art can be regarded as a form of evaluation of cooperative values which, in turn, engender beliefs, ideas at group and society level. In this sense, art can be regarded as a collective platform for imagining and perceiving the world. It is based on a recodification process which might impact social cohesion (criteria for social identification).

With reference the scope of this thesis, it seems reasonable assurance that the creative ability of the human is interlinked to his abilities of modifying previous knowledge structures (also in forms of artifacts) and, thus, leading to various forms of innovation. With regard to the artistic process, it has been argued that it potentially impacts social cohesion. It should be borne in mind, though, that creativity can be either of a destructive or constructive nature. To this end, Baecker (2009) makes the following point: “Creativity seems to mean exploiting evolutionary mechanisms with respect to facilitating retention. That is why it often comes with innovation, even though creativity might encompass the possibility of guaranteeing retention by negatively selecting among variations” (Baecker, 2009, p. 63).
From an evolutionary point of view, this implies that the process of variation (cultural modification) might have either *re-* or *de-stabilization* effects on developments of human cultures. In other words, as such, the evolutionary process has no inborn strategic direction; it merely provides mechanisms for development. In view of this, Faßler (2009) suggests it may be more appropriate to refer to a process of re-codification than advancement when discussing evolutionary developments (Faßler, 2009, p.4).

This leads to the question, which factors of cultural transmission are applicable to the process of making art and the potential of art to generate knowledge. The aforementioned indicates that the process of retention should be in focus when recoding mechanisms of knowledge generation are analyzed. For the scope of this thesis, perspectives on re- and de-stabilization criteria through artwork are relevant. More specifically, the question to which extent creative outcomes which can be characterized as interfering or disruptive can impact socially relevant knowledge retention processes is discussed in chapter 13, which also presents some options for further research.

13 Potential Applicability of the Artistic Process

As discussed in chapter 8, a creative achievement of an individual can be integrated into the knowledge domain (culture) upon acceptance at group and society level on the basis of being regarded as sufficiently relevant, original, and useful for the related field (society).
The question how artistic outcomes can influence the knowledge structures of a society is of particular interest for the mechanisms of retention triggered through art. According to the aesthetic-critical approach (cf. chapter 11.3) of John (2004), this thesis commences from a systemic understanding of art, whereas the aspect of *noise* is given specific attention.

13.1 Retention through the Impact of Noise

When dealing with questions of norm and deviation within the creative process, findings form the field of linguistics can help to understand such processes. Within this research field, the term *norm* refers to the general, stable and accepted linguistic structures within a domain, while *deviation* is related to elements such as rarity, curiosity and values of surprise. Still, current linguistic research refrains from a strict model of norm and deviation.
Bunia (2009), however, disagrees with such general approach and specifies, that there are no norms within language systems, but only stable, recurrent structures. Deviations, he argues, should rather be referred to as variations, considering that they contribute to constructing new linguistic options on the basis of existing language structures. Bunia furthermore states that such variations can gain acceptance through the process of selection, which is closely connected to the one of understanding. The underlying mechanisms of such process can be described as a form of *re-stabilization* (Bunia, 2009, pp. 45-46).

Bunia (2009) further emphasizes that, from an evolutionary point of view, communication constitutes a selective process, which is based on *irritation and interference*. It should be noted that a true variation requires not only that an expression is accepted; it must, in the best case, offer new linguistic options. Provided that these criteria are met, a variation can be regarded as successfully selected. Moreover, a linguistic variation does not only vary options of perceiving the world but also creates new options for alternatively thinking and, thus, behavior. Correspondingly, communication can be regarded as a means for structuring the perception *of* and interaction *with* the world (Bunia, 2009, pp. 46-47).

The question arises whether Bunia's (2009) theories related to noise and interference within linguistic processes can be applied on the field of art. It is worth mentioning that Bunia stresses that a disturbed perception may contribute to enhancing communicative processes on a long-term basis. *Noise* and *blurring* seem to be key for linguistic and thus creative developments, because they provide parallel options of understanding and thus facilitate *semantic shifts*. Bunia considers that noise and disturbance within communicative processes significantly increases the probability that structures, which are constitutive for comprehension, are identified. However, the process of retention can, according to Bunia, be regarded as a form of re-stabilization, on the basis on repetition and abstraction. It is based on both, uncommon and familiar elements, which refer to previous and new knowledge structures. Accordingly, noise increases the emerge of innovative structures when already accepted knowledge structures are referred to in parallel (Bunia, 2009, pp. 50-51).

In this context, mechanisms of the artistic process could be regarded as closely connected to the linguistic ones, since they refer to creative processes of communication. In view of the above, it could be argued that the process of deviation is key for the understanding of the artistic process. Accordingly, it could be assumed that art represents a medium to raise *attention of noise*. The relevance on such attention lies on elements of irritation, provocation and disturbance.

It could be further discussed to which extent the artistic process is related to intentional manifestation of noise with the implicit aim of triggering variations of world perception. Referring to Uhl's (2009) argumentation of media influence, it could be estimated that also art presents a *more of attention generating contents* creating diverse interpretations options. This new information is created on a fictional basis, constituting a "difference that makes a difference" (Bateson, 1979; as cited in Uhl, 2009, p.192).

In this context, Van Den Berg (2009) refers to the artist as a producer of contingencies (selection of possibilities), who (implicitly) has been assigned to the task of providing societies with new, forceful, and, potentially, controversial, ideas and perspectives (Van Den Berg, 2009, p. 215). In this context, the *originality* and *usefulness* (cf. chapter 8 and 9) of an artwork can be understood as a communicative process resulting in relevant social discourses. Van Den Berg considers that, from a social perspective, art-making can be regarded as a non-target orientated experimenting which, nonetheless, aims at interference and disturbance (Van Den Berg, 2009, p. 219).
Analogous to the field of creative cognition, also Van Den Berg tries to define criteria for assessing the originality *and* usefulness of works of art, i.e. the mere fact that an artwork is regarded as innovative is insufficient. Furthermore, she argues that, in order to trigger diverse forms of imaginations and thinking processes, a work of art needs to both, blurring and ambiguous while, at the same time, retain *sustainable* qualities (Van Den Berg, p. 221).

To sum up, via interference and blurring, art carries a significant potential for contributing to the development of viable options for interpreting the world. Accordingly, the artistic process can be regarded as related to the mechanisms of knowledge generation and retention. Furthermore, the process of art making can be regarded as based on participatory artistic practices being relevant for the generation of collective imaginations of world understanding. This leads to the question how methods of art making processes that are based on the concept of noise, can impact various fields of culture (as science, politics, economy etc.).

13.2 Options for Cooperation: Aesthetic-Critical Practices

On the basis of his definition of systemic art (see chapter 11.3) John (2005) argues that a critical (evaluative) and perception-orientated (aesthetic) art-making process might facilitate cultural developments throughout various areas of life. Accordingly, new forms of cooperation may arise in various cultural fields and disciplines (John, 2005. p.1).

In this context, Heid and John (2003) argue that transdisciplinary discourses and related knowledge transfers have become increasingly important in today's society. They suggest that art may perform the role of a *transdisciplinary agent* to this end.
Accordingly, the artistic processes might also constitute a social relevant *practice which might* influence other fields of society. In this respect, art does not only foster aesthetic competences it might also may also trigger social relevant knowledge transfer.
According to Heid and John (2003), art can add considerable value in terms of critically differentiated findings (through artistic-aesthetic strategies) within the fields of science, politics and economy etc. (Heid & John, 2003, para. 1-3).

Furthermore, from a methodical perspective, Heid and John (2003) regard art as a non-arbitrary discipline which might widen the scope for the artist.
Nowadays, artists are no longer restricted to the rather static, object-orientated, art market only; it is not uncommon that they interact with agents in other fields with the result that new and dynamic forms of collaboration arise. Accordingly, artistic outcome can be understood as a promoter that triggers social, economical and scientific processes dynamically and provides critical (evaluative), innovative and sustainable impulses (Heid & John, 2003, para. 8). In conclusion, John (2004) refers to artistic activity, within the definition of *systemic art,* as a form of artistic research which is based on competence of contextualization (aesthetic) and its differentiated, value-orientated practice (critical) summarized as a *critical aesthetic* approach (cf. chapter 12.1). John emphasizes that the applicability of this perspective is not necessarily limited to artistic actions only. To the contrary, it may also be transferred and applied to other field of society. On a general note, *critical aesthetic* can be regarded as a set of qualifications based on interdisciplinary evaluations and *context-alien* associations (John, 2004, p. 4).

As discussed above, alienation and disassociation can be regarded as central elements of the production of art. These elements are related to the aforementioned cognitive processes and their preinventive properties (cf. chapter 9.2), such as ambiguity, incongruity, divergence etc. and constitute a cognitive fundament for the generation of noise. More precisely put, by generating and transmitting elements of noise and thus creating irritation, provocations etc., a significant potential for expanding the options for interpreting the world is possible. Eventually, this may lead to the establishment of new knowledge structures, which, however, *originate from blurring* rather than objectively defined criteria.

From an evolutionary point of view, it appears that art, potentially, can influence human behavior: Junker (2010) even refers to art as a an evolutionary technique which enables the modern human being to coordinate and communicate directly and intensively about objectives and emotions of a social group. In this sense, art can be regarded as a method for evaluating mutual objectives by coalescing unconscious and conscious beliefs and desires of various social groups. Junker even states that art potentially represents the answer of one of the biggest evolutionary problems relating to all groups of individual with different interests: The co-ordination and synchronization of divergent objectives within a social group as a pre-requisite for successful co-operation (Junker, 2010. p. 105).

In view of the above, the notion of art as a discipline reserved for certain geniuses only appears rather antiquated. Furthermore, it can be argued that the principles of art constitute a form of aesthetic practice which can be applied also to everyday life: John (2005) points out that the criteria of the systemic art approach can be shifted to the idea of the "Extended Cognitive Ability Through Cultural Contextualization" (para. 1) and makes the following point:

> The qualified involvement of artistic capabilities in reflection processes in economy and the sciences opens up an expanded contextualization and differentiated perception framework for ›constructions of reality/the world‹. (....) The artist is not a moralistic, warning figure, but rather introduces attitudes and action patterns specific to art, whereby complexity can be presented as primary experience and a capability to

> differentiate can be created. He or she is thus not a producer or supplier of tangible works of art, but rather an interventionistic advisor. (….) For critical cooperations that will produce substantial results, primarily those artists are needed, who consciously work in a process-oriented way, whose work is self-reflective and includes the systemic perspectives (John, 2005, para. 18-19).

In this context it is worth mentioning that Tomasello (2000) regards the abilities of shared intentionality and meta-representation as decisive for cooperation and culture developments (cf. chapter 4). Applying this perspective to Junker's (2010) position that art contributes to stabilizing social cohesion, it can be argued that communication *and* cooperation form an integral part of the artistic process.
Correspondingly, it seems plausible that methods of artistic processes, for example based on the aesthetic-critical perspectives, can influence communication and cohabitation within the society, potentially also at the sociobiological level.

13.3 Impact of Open Process Structures on Behavior

The relevant question for this chapter is whether a socio-cognitive understanding of the creative process can be applied to social and behavioral elements of human life in general. More specifically, in addition to the aforementioned systemic perspective (John, 2004) and in view of the significance of noise, the present chapter builds on theories on creativity related to artistic performance. That is, however, done with the purpose of distilling those aspects of the artistic process that could be utilized also in daily life. Accordingly, the artwork as such is of lesser relevance.

On the basis of Parts I and II, two main aspects could be discussed: a.) Findings from the creative cognition indicate that the understanding of the creative process is non-linear, circling from outcomes of the generative and explorative phases, b.) findings from the evolutionary science suggest that the generative and creative competence of the human being is based upon open process structures. From this perspective, the artistic

performance could be described as exemplarily fulfilling the criteria of non-linearity and open process structures (cf. multidisciplinary, evaluative approach, chapter 11.2, 12.1) of the creative process as closely as possible

Brater (2003), however, refers to the artistic process as a paradigm for *open acting processes* ("offene Handlungsprozesse") which he regards as relevant for meeting the challenges of normal life. To this end, Brater focuses on the process-related elements rather than on the outcome of the creative process. In this context, he refers to the artistic action as an example of coping with diffuse situations in normal (professional and private) life. He argues, that the complexity of today's life is actually less determined through application of rules but rather through noise (unexpected elements) (Brater, 2003, pp. 22-24).
Brater does not consider that regular working practices are directly comparable with artistic ones. However, there might be mutual substructures: Dealing with open process situations, modifying behavioral strategies (acting) and methods of thinking (deciding) on the basis of perception on the current, often unstructured status. On a general note, Brater argues that the artistic approach is helpful when dealing with unexpected and ambiguous situations; accordingly, he considers that the artistic methods are partly transferable to normal life (Brater, 2003, pp. 24-28).

The position of Brater (2003) in this context comes rather close to John's (2003) idea of *extended cognitive ability through cultural contextualization* (cf. chapter 13.2). It implies that the approach of systemic art is widened regarding the artistic practice as transferable on other forms of social cooperation. John (2003) considers that cultural values are essential for any form of cooperation and that the systemic art approach can help in terms of widening the "horizon of perception and realization" (para. 8) within the society. In this context, he refers to culture as "society-specific traditions, a canon of cognition and value-creating ritual and reflection: effectively, as a contract dealing with obligations of meaning, identity and mutual interaction" (John, 2003, para. 8).

Even though it exceeds the scope of this thesis, it is worth mentioning that John (2003) suggests that artistic methods (ability of cultural contextualization) can contribute to other forms of strategic thinking. In this context, he recalls that the artistic process is based on

"communication and contextualisation and aims at efficacy in relationship to social subsystems" (para.7) as e.g. strengthening the ability of *Corporate Cultural Responsibility* and *Corporate Social Responsibility*. Correspondingly, John refers to his systemic art definition as follows: "Systemic Art often renounces the creation of works of art in favour of a strategy of social construction of situations which do not aim explicitly at the system of art but rather at the complexity of interactions in the frame of reference" (John, 2003, para. 7).

In summary, both, Brater (2003) and John (2003) emphasize the process-related aspects of artistic work and its social relevance. However, whereas John focuses on the value-orientated dimension and the cultural contextualization of art, Brater is primarily concerned with the process of artistic practice in relation to private and working life. Brater suggests that the artistic practice as such and its inherent potential for exploring the unknown can be regarded as related to social action. More precisely put, he considers that artistic achievements may not only trigger modifications of cognitive abilities, such actions may even create fundaments for the development of strategies for dealing with the unknown (Brater, 2003, p. 31).

In this respect, art tends to be focused on generating new perspectives on the world which may influence social developments, including areas such as science and economy. In this particular sense, it can be argued that art, due to its fictional character, provides valuable prospects for further research.

13.4 Mental Representation: Hypothetical Thinking

In view of the above, it can be argued that art allows for creating hypothetical representations of the world, which from an evolutionary point of view, can be regarded as a highly developed form of human cognition, on the basis of symbolic communication.
In this context, Eibel (2009) analyzes the impact of meta-representations on human development. He considers that the human cognitive abilities, in the first instance, stem from behavioral needs and that, during most of its existence, the human genesis has been

driven by *instinctive* forms of behaviors. In fact, it is "only" two million years ago since, the abilities related to improvisation, reflection and thinking started to develop rapidly. Over time, these abilities have given raise to the significant cultural evolution of the human being. These developments have impelled the human being to adjust his strategies for survival in line with a shifting environment.

In this context, Eibel (2009) emphasizes that simple heuristics, rules-of-thumb, approaches that sufficed during the Stone Age tend to be insufficient in today's rather complex world. (Eibl, 2009, pp. 9-10). The more advanced stages the cognitive and, thus, cultural development of the human reaches, the higher the need for a mediating competence with regard to natural and cultural requirements. In this context, Eibel (2009) refers to the concept of *intermediate world* ("Zwischenwelt"), which he describes as a symbolically coded intelligent interface which coordinates and adjust the diversity and changeability of human environment (culture) and the comparable static evolved nervous system (nature). According to Eibel, the concept of *intermediate world* is determined through its constructional character, which allows for envisaging potential decisions in a fictional (hypothetical) manner (Eibel, 2009, pp. 19-11).

In this context, it is worthwhile to note that the ability of mental representation is of utmost importance for the human evolution. This raises the question why interest in a "non-reality" would constitute an evolutionary advantage. As Schwab (2004) points out, the progress of evolution does not occur on the basis of recognition of the truth but because of successful adaption of appropriate behavior. If a solution functions better compared to an alternative one, the former has a competitive advantage (Schwab, 2004, p. 168). In this context, particularly Tomasello's (2006) analysis of human adaptation processes during his ontogenesis (introduced in chapter 4) offers essential insights to the impact of culture and human evolution. As Tomasello stresses, one decisive distinction between the human being and the non-human primates (including children until the age of nine to twelve month) is the ability to interact at a symbolic level which, clearly, goes beyond mere self-referential representations. This inter-subjective process of sharing symbols with the other members of the social group constitutes the socio-cognitive fundament of the human being.

According to Tomasello, the abilities to imitate, communicate at meta-level, learn about other's perspective and ideas and preserve cultural knowledge during considerable periods of time (cf. ratchet effect, chapter 4.1) form the essence of the human being. These abilities distinguish the human being from the non-human primates and have contributed to the specific cultural development of the human being (Tomasello, 2006, pp.125-127).[19]

In view of the above, it seems plausible that the ability of creating mental images is decisive for the specific cultural development of the human being, bearing in mind both natural and cultural criteria are relevant for the human specific genesis. To this end, hypothetical thinking can be regarded as an example of an ability, which is related to both the cognitive-biological (cf. mental representation of "non-reality") and cognitive-cultural genesis of the human. In this context, it is assumed that art can be seen as representing hypothetical constructions of the world and is regarded as means for creating mental representations that allow for differentiated communication, including meta-level intentions. Schmidt (2011) contributes to this discussion by suggesting that noise and interference constitute necessary elements for the constructions of hypotheses, which, however, may or may not be applied to real forms of life. He emphasizes that this distinction is also relevant for art-making processes. In summary, it can be argued that the ability of mental representation and hypothetical thinking, which is based on interdependent genetic and cultural conditions, is decisive for a co-evolutionary understanding of the art-making processes.

[19] In this context, it is worth noting that Roth (2009) stresses the constructive character of human's perception. As an example he mentions the ability of the visual system of creating images that do not exist. (cf. example colour perception (Roth, 1997, pp. 70 -73); or examples of optical illusions: test image demonstrating the constructive character of human perception (Kast (2003), as cited in Uhl, 2009, p.147). Roth emphasizes that perception is an *active* process and not a mere reflection of the environment. He, nevertheless, argues, that perception refers to a systematic - although, extracted, emphasized or attenuated - representation of world within the human brain (Roth, 2009, pp.73-74). Accordingly, Ramachandran (2007) summarizes, that "the first step we must take towards understanding perception is to forget the idea of images in the brain and think instead of transforms or symbolic representations of objects and events in the external world" (p. 28).
In this context, Roth (1997) underscores that constructions of perception are not arbitrarily, but are either congenital, or have been acquired in early childhood or later on in life on the basis of experiences. He emphasizes that these constructions are not bound to subjective intention, which makes them to reliable construction for dealing with the environment (Roth, 1997, p.125).

13.5 Sociobiological Impact: The Epigenetic Question

In the context of such a coevolutionary perspective, it can be argued that culture is based on the human ability of constructing mental representation which may facilitate and, thus, optimize strategies for coping with complex forms of life. In this respect, it is worthwhile to recall the definition of culture which Boyd and Richerson (1985) use in the context of their dual inheritance theory: „By culture we mean the transmission from one generation to the next, via teaching and imitation, of knowledge, values, and other factors that influence behavior" (p.33) and „Culture is information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation" (p. 2; cf. chapter 5.2). Moreover, Boyd and Richerson stress that cultural transmission, primarily, is based upon social learning processes which facilitate transmission of social behavioral patterns through imitation or education. This type of transmission is based on genetically inherited disposition, leading eventually to inherent cultural transmission mechanisms.

Boyd and Richerson (1985) suggest four different variants of gen-culture-interaction:

1. Culture is partly a result of evolved biological predisposition and does create fitness advantages.
2. Such evolved biological predispositions are, in turn, determined through cultural norms and values.
3. Harmful cultural variation (cf. Dawkins (1989, 1996): parasitic memes) occurs and finds imitators.
4. Genes and culture have co-evolved in a sequence of mutually beneficial interaction (as cited in Schwab, 2004, pp. 49-50)

According to Schwab (2004), the latter variant seems to be the most successful one with regard to the development of human kind. The combination of individual learning (on the basis of hands-on experience) and social learning (observational learning) enables the individual to react quicker and, more appropriately, towards environmental changes compared to what a purely genetic adaptation process would allow (Schwab, 2004, pp. 49-50).

Furthermore, Lumsden and Wilson (1981) emphasize on the co-dependent aspects of the processes of gen culture coevolution. In the following quotation Lumsden (1999) describes the objective of their epigenetic approach, which also presents a perspective on the state of arts with regard to research in the field of creativity:

> The study of gene-culture coevolution is a development in sociobiology and evolutionary science that is intended to help create a network of explanation between biology and the social sciences. It is designed to include all cultural systems, from the protocultures of chimpanzees and dolphins to the heterarchical, protean cultures of human beings, as well as forms of culture previously conceivable only in the imagination. In pursuing this course, however, sociobiology runs headlong into human creativity as a force in history (Lumsden and Wilson 1981, Findlay and Lumsden 1988, Lumsden 1997, 1998). Our attempts to map the circuit of gene-culture coevolution, as it passes through the imagination on the way from biology to society and back again, has raised puzzling questions about the limits to sociobiological knowledge and a scientific understanding of mind in general (Lumsden, 1999, para. 5).

According to Schwab (2004), the epigenetic model of Lumsden and Wilson (1981) regards culture as a system of social learnable knowledge that is distributed among the members of a society. Lumsden and Wilson introduce the concept of *culturegen,* which manifests itself either in the form of transmitted behavior - referred to as *mentiffacts* (values, ideas, beliefs) - or *artifacts*. The epigenesis describes a process within the biological process, where genetic factors educe the development of the child under the influence of environmental stimuli. On that basis, Lumsden and Wilson (1981) refer to the *epigenetic rules* as *evolved constraints* of the human development, both in terms of social systems and individual needs. This implies that cultural values such as knowledge, attitudes and beliefs are linked to an evolutionary competitive cultural phenotype. This, in turn, may result in transmission mechanisms where some cultural elements are more likely to be absorbed and incorporated than others. The adjusted culture component (internalized culturegenes) becomes part of

the environment, influences the gen-frequency of the population and the - through gen - frequency generated - epigenetic rules[20]: "Gene-culture coevolution is a causal whirlpool in history, where culture is shaped by biological imperatives and genes shift in response to changing cultural opportunities" (Lumsden, 1999, para 4). Correspondingly, Lumsden and Wilson stress that thinking and behavior are not genetically determined only but stem from a combination of individual experiences and epigenetic rules (Lumsden, & Wilson, 1981; Schwab, 2004, p. 46).

With reference to the discussions on meta-representation and hypothetical thinking (cf. chapter 14.4) as one result of cultural cognitive development, and following the scope of this thesis, the question arises which impact works of art might have on cognitive and social conditions of the human. From this point of view, art represents an optional perception of world understanding. Typically, art does not aim at portraying the reality but at exploring new ways of perceiving it. This leads to the question whether there could be an evolutionary advantage in increasing awareness of the "non-reality". As Schwab (2004) points out, the ability of imagination (inner simulator) increased survival- and reproduction possibilities already during the era of the hunters and gatherers. According to this thinking, the key benefit of fiction lies in the *safe* exploration of hypothetical scenarios. The significant ability of the human brain to conduct such simulations is related to an evolutionary need of tailoring the behavior according to a shifting environment. Via fiction, a human being can project how he might have behaved and felt in a certain situation. Accordingly, fiction can be regarded as a means for understanding causal coherences and optimizing behavioral strategies (Schwab, 2004, p.168). As Oatley (1999) suggests, fictional images offer a "laboratory space that, relative to real life, is save and can make the relation of emotions to goals and action easier to understand"(Oatley, 1999; as cited in Schwab, 2004, p. 169).

In this context, Schwab (2004) emphasizes that production of art can both function as a platform for the individual for expressing and positioning himself within the social context he belongs to and functions as a trigger for discussions and confrontations at various social levels (transdisciplinary approach cf. chapter 11.2, 12.1), which may result in reshaping

[20] Definition of epigenetic rule: "Ed Wilson and I have introduced the specific term "epigenetic rule" to refer to the patterns of genomic expression that chaperone the individual mind's development (Lumsden and Wilson 1981, 1983). Epigenesis is the total process of interaction between genes and environment during the course of organismic development. Each epigenetic rule affecting mind and behavior is approached as comprising one or more elements of a complex sequence of events occurring at various sites throughout the nervous system and mind" (Lumsden, 1999, para 2).

(aesthetic) conventions. Schwab suggests that art tends to be focused on themes that are relevant from an evolutionary perspective, such as love, sexuality, battle, escape, cooperation, deception etc. In this respect, identifying different options for interpreting the world train our mental strategies, in particular with regard to decision-making processes related to social-relevant issues (Schwab, 2004, p. 171). Such options may, eventually, lead to culturally significant paradigm shifts.

In the context of an epigenetic approach, the study of Romanowska et al. (2010) is worth mentioning. Romanowska and her colleagues analyzed the health effects on managers who participated in two types of leadership programs. During a period of two years, these managers were randomized in two groups; one that attended a conventional leadership program and another one that attended an *art-based leadership program*. Romanowska et al. base their conclusions on results of standardized questionnaires and biological parameters (endocrine status):

> The art-based program built on an experimental theatre form, a collage of literary text and music, followed by writing and discussions focused on existential and ethical problems. After 18 months a pattern was clearly visible with advantage for the art-based group. In the art group (leaders and their subordinates together as well as for subordinates only) compared to the conventional group, there was a significant improvement of mental health, covert coping and performance-based self-esteem as well as significantly less winter/fall deterioration in the serum concentration of the regenerative/anabolic hormone dehydroepiandrosterone-sulfate (Romanowska et al, 2010, p.78).

The study of Romanowska et al. (2010) addresses questions related to the potential epigenetic impact of art. The positive effect of the art-based leadership program suggests that production of or exposure to art might have a direct socio-biological impact.
Even though it is beyond the scope of this thesis to analyze epigenetic aspects of art-based processes it is worth noting, that Bauer (2007) refers to epigenetic as a combination of biological and psychological impact and considers it proven that the biochemical configuration of the gene can be modified through environmental impact. Such modifications do not impact the actual text structure of the gene but epigenetic processes which might restrict, deactivate or activate gene sequences (relevant e.g. for the hormone

status of the human) (Bauer, 2007, p. 164). The so-called *epigenome* refers to such dynamic system, where epigenetic markers regulate the gene expression according to environmental conditions. Alterations of these systems may have a direct positive or negative impact on the respective individual.

In view of the above and with reference to an epigenetic question, it seems plausible that art, potentially, might optimize fitness criteria of the human and represents a certain status of an evolving, developed mind. In this sense, art could be considered as a form of adaptation which allows for calibration of behavioral strategies with social relevance. According to the concept of systemic art (cf. chapter 11.3), such strategies aim at facilitating unaccustomed communication and cross-border contextualization on the basis of critical-aesthetical values, potentially with sociobiological implications.

14 Conclusions

The theories on cultural evolution presented in this thesis suggest that the cognitive development of the human being is closely related to social aspects. On the basis of these theories, it can be argued that the specific cognitive abilities of the human to empathize with conspecifics and develop advanced forms of shared intentionality have allowed for new forms of cultural knowledge gains. This development can be described as an evolutionary adaptation-process, i.e., the human being has carved out his ecological niche on the basis of specific cognitive *and* social abilities (cf. social intelligence hypothesis).
The remarkably rapid growth of the human brain and the resulting increasing cognitive abilities has given rise to complex - over generations transmitted - forms of artifacts that characterize the cultural development of the human. Particularly, creative and problem-solving competences at group level have played a crucial role for the evolutionary development of the hominids. In this context, the ability to communicate - more specifically, to develop languages - has allowed for exchange of information at meta-level via shared intentionality (Tomasello, 2000). In short, the hominids distinguish themselves from other species through the ability to communicate at a symbolic level, developing and potentially enhancing cooperative and coordinative forms of cohabitation.

It appears that the intellectual ability of the human being is based on his creative and communicative competences, which, inter alia, allow for deriving problem-solving strategies that enhance social interaction and, thus, survival possibilities. In view of the aforesaid, it might be fruitful to analyze the creative processes on the basis of social and cognitive criteria related to sociobiological and coevolutionary factors. In this context, the social avenue presented in this thesis refers to the ability of meeting evolutionary challenges by enhancing behavioral strategies based on the ability of shared intentionality. The cognitive avenue, however, refers to the information-processing ability of the human brain and is focused on the development of creative and strategic competences, for example with regard to problem-solving. This creative ability is not linked to an abstract potential of dealing with environmental challenges, but to a concrete set of cognitive competences.

It has been suggested that the creative ability of the human is directly linked to knowledge-generating processes and, thus, constitutes the basis for cultural development. In this context, the question has been raised to what extend the term research (e.g. for knowledge generation) is applicable to the fields of science *and* art. It has been demonstrated that both of these disciplines are related to intellectual and cognitive abilities which, in turn, constitute pre-requisites for abstract thinking and communication at a symbolic level. Furthermore, it has been emphasized that the creative process and outcomes of it (knowledge generation) are closely interwoven with social structures. More precisely, such outcomes are typically based upon existing knowledge and need to be acknowledged as innovative and useful by the relevant group/society in order to form part of the accumulated knowledge. From this perspective, creative performance is regarded as a process of knowledge modification and related to the process of evaluation, alteration and stabilization within a social environment.[21]

The aforementioned leads to a question that is of particular relevance for Part III of this thesis namely whether it is possible to distil those cognitive and social factors that are directly related to the creative process of art-making. The questions to which extend art relates to the generation of knowledge (cognitive) and how art can be retained within a social context (social) have been explored. It has been indicated that the artistic practice tends to operate independently from specific disciplines and is based on a transdisciplinary (conceptual) synthesis of knowledge structures. Compared with classical scientific approaches, artistic research tends to apply multiple research criteria simultaneously. This approach allows for a multidisciplinary analysis in contrast to those singular discipline-specific questions which classical research tends to be focused on. Typically, an outcome of artistic research is regarded as a *contextual alien* vis-à-vis previous knowledge structures.

Especially findings from the field of creative cognition can contribute to increasing the understanding of the various facets of creativity, such as artistic achievements and scientific explorations by means of the same standardized avenue. It has, however, neither been the intention of this thesis to provide a new definition of art, nor to establish absolute cognitive and social criteria for artwork. The aim is a more modest one, namely to identify

[21] cf. chapter 6 and chapter 10

strings, bridging hypothesis and new perspectives with regard to cognitive and social manifestations of the creative process and present suggestions for further research.
It should be noted that the cognitive and social approaches of this thesis are both interlinked to an evolutionary perspectives on principals of knowledge-generation and that sociobiological criteria have been used for explaining (cultural) variation and (knowledge) generation processes with cultural impact.
In this context, references have been made to a systemic-art definition (John, 2004) with a view to providing options for an *integrative* model with a socio-biological perspective, which is based on a critical-aesthetical approach: The term *critical* underlines the evaluative aspect and *aesthetic* the exploration of the values attributes of the artistic process and the social impact of it. In this context, it has been argued that outcomes of the artistic process, potentially, can provide cross-linkages of knowledge findings from various disciplines, thereby underlining its transdisciplinary aspects and aptitude for differentiating valued based perspectives within the social context. Accordingly, this perspective puts an emphasis on a process-based understanding of art making, which, in itself, is understood as a dynamic process of reflection and evaluation and, thus, directly related to forms of communication and cooperation. Moreover, this approach is also fruitful for exploring the autonomy of the art-making process while at the same time taking the non-autarky of it into account, i.e. the importance of the social embedding.
On the basis of a socio-cognitive perspective, it has been demonstrated that such systemic perspectives on art on the one hand side, are related to knowledge generation processes (cognitive) with regards to acquiring and nurturing culture and, on the other hand side, to processes of social recognition (social) of new information, triggering questions of cultural relevance.

The exploration of the social implications on the creative process has shown that creative outcomes and innovative solutions are directly interwoven with the acceptance process of social groups and that the originality *and* usefulness of the creative product tend to play a decisive role. More precisely, a product is considered as creative subject to acknowledgement of the domain (culture) which it is related to (Csikszentmihalyi, 1988).
In other words, a positive evaluation at the level of social structures is a pre-requisite for the implementation of a creative product as part of a new knowledge structure.

Correspondingly, this process is based on cooperation, shared intentions and values, as well as strategic behavior with the aim of ensuring that only the "best fit" ideas are implemented within the relevant knowledge pool. In this respect, it has been argued that the production of art, potentially, can be linked to processes of *cooperation* (variation-communication), *coordination* (selection-social acknowledgement) and *social coherence* (retention-knowledge stabilization). *Cooperation,* in turn, is linked to communication of variations (newly introduced creative products/art works). *Coordination* is related to the selective processes of evaluating whether or not the creative outcome meets the criteria of the relevant knowledge domain. Subject to a positive evaluation - *social coherence* - the creative product is integrated into the knowledge domain and thereby retained. This may lead to new forms of social and cultural identification and, thus, potentially, stabilization of social groups.

From a cognitive point of view, it has been demonstrated that the artistic process is related to the general cognitive and cross-cultural ability of the human with a potential of generating culturally relevant fictional constructions of the world. On the basis of findings from the field of creative cognition (Finke, Ward & Smith, 1992,) it has been demonstrated that information and knowledge can be exploited, re-coded and transformed into new knowledge structures. Furthermore, it is essential that outcomes of creative (artistic) processes meet the criteria related to originality *and* usability.
The development of new forms (ideas) and the assessment of their applicability (implementation potential) can be described as a constant interplay. This involves exploring potential obstacles and the scope for social acceptance which is highly relevant for the artistic process. Moreover, findings from the field of conceptual synthesis (creative cognition) indicate that especially interfering factors such as ambiguity and incongruity during the generative phase might trigger creative outcomes and increase the probability of unexpected results (innovations).

In this context, it has been emphasized that noise constitutes an essential component for knowledge-generation through artistic processes. Accordingly, the potential of art as a catalyst for generating innovative information through blurring has been explored. To this end, it has been suggested that such interference might create signals that trigger special attention and, thus, functions as a demarcation signal with a significant potential for

generating new perspectives on the world. This type of blurring can manifest itself in a variety of ways: from vague, to provocative, irritating, unbearable or, even, peculiar etc. Moreover, it is suggested that the artistic outcome can influence mechanisms related to knowledge generation. To this end the question how new, potentially divergent and provoking, knowledge structures stemming from art can be integrated into knowledge domains has been raised.

In this context, special attention has been paid to the process of *retention* in relation to production of art. On the basis of findings in the field of linguistic research, it has been attempted to apply mechanisms of communication to processes related to the production of art. As mentioned above, *noise* and *blurring* constitute facets of communication that are essential for creative developments because they tend to widen the sphere of options for interpreting the world (semantic shifts). Accordingly, noise seems to be key for increasing creative and innovative outcomes. The process of retention, however, is related to re-stabilization and re-codification on the basis of both previous and new knowledge structures. It is important to note, though, that this type of retention which is of particular relevance for the artistic outcome, carries a potential for leading to de-stabilisation processes, leveling new knowledge structures as irrelevant. On a general note, it has been argued that art, via noise, has a significant potential for triggering the development of new interpretations of the world which might lead to an expansion of evolutionary relevant knowledge.

One of the evolutionary perspective on artistic performance that have been introduced in this thesis is the view that the intellectual capacity of the human being stems from his ability of symbolic meta-representation as it has enabled him to create hypothetical mental constructions. This idea refers to culture as a concept of intermediate world leading to better-adapted decision making processes based on mental construction ability of the human (Eibel, 2009). From this point of view, art represents an alternative way of understanding the world which does not aim at portraying the reality but at exploring new ways of imaging it. The question arises whether there could be an evolutionary advantage in increasing awareness of "non-reality" (Schwab, 2004). To this end, it has been argued that the key benefit of fiction lies in the safe exploration of hypothetical scenarios. The ability of imaging (inner simulator) increased survival and reproduction possibilities already during the era of the hunters and gatherers.

From an evolutionary point of view, fiction can be regarded as a means for understanding causal coherences and optimizing behavioral strategies. Transferred to the term of art, it has been suggested that artistic outcomes might trigger identification-processes and, thereby, reshape (aesthetic) conventions of social relevance. In this context, it has been discussed whether new perspectives on the world (through art) can contribute to cultural developments. From a socio-cognitive point of view such processes are linked to the congenital ability of shared intentionality (Tomasello, 2000). It is considered that the ability to communicate through meta-representative intentions is an essential factor for complex forms of knowledge generation and retention processes through culture.

The question whether artistic research may generate options for cultural variation and, thus, influence cultural evolutionary processes has been raised. In this context, it has been argued that the creative process of art-making is based on both biological and genetic settings. Furthermore, phenomena such as language, moral or art can only occur if preconditions in terms of adequate genetic codes and environmental aspects, such as structures for systemic knowledge-transfer (e.g. education), have been met. To this end, the interdependencies between biological determinations, cooperative behavior and cultural influence on human evolutionary development have been stressed. Specifically, the question has been raised whether community-building and social bindings are more effective if they relate to the complex construction of imaginary world perception.
To that end, it has been stated, that art can be regarded as a form of evaluation, i.e. a synchronization of cooperative values, which engender beliefs, ideas and goals at group level (Junker 2010). In this sense, art is an expression of the collective potential for creating new ways of perceiving the world. Subject to acceptance by the relevant group/society, the artist presents innovative perspectives which might spark re-codification processes which, potentially, impact social identification processes. In this respect, it has been suggested that the criteria for assessing the best (socially best adapted) idea tend to be based on cooperative factors which might influence cultural development of the human. Accordingly, it has been suggested, that the outcome of artistic processes might trigger cultural relevant knowledge generation processes with socio-biological relevance.

From a socio-biological perspective, there seems to be reasonable grounds for considering that interdependencies of cultural and genetic codes exist. The epigenetic model (Lumsden & Wilson, 1981) emphasizes that culture can be regarded as a system of acquirable knowledge that is distributed among the members of a society. From this perspective, culture is linked to an evolutionary cultural phenotype which may impact both biological and cultural developments. In this context, the influence of environmental stimuli on human genetic is stressed. Culture, in turn, affects the gen-frequency of the population and the related epigenetic rules. Accordingly, it is considered that cultural variations may not only impact cultural but also biological selective processes. The latter aspect leads to the question whether art can impact biological dispositions. Even though it is not within the scope of this thesis to analyze potential epigenetic impact of art, studies in this field have been referred to. On the basis of these studies, it appears that exposure to art might influence the hormone setting of the human being, i.e. the activation of gen-sequences may be altered through cultural influences.

In view of the above, it seems appropriate to regard art as a potent facilitator for cultural developments which may augment the conditions for knowledge generation within a group or society. In concrete terms: the pool of ideas within a social context can be expanded through the integration of art-based knowledge/information. From a coevolutionary point of view, art can be regarded as a cultural product that carries a significant potential for modifying cognitive abilities (beliefs, behaviour etc.). In view of this, prospects for further research have been touched upon: the question how art could potentially impact additional forms of social life, such as the influence of a critical-aesthetical definition on communication and cohabitation, and the impact of open process structures on behavior was raised.

In summary, applying the socio-cognitive approach to the creative processes of art-making is meaningful when analyzing such processes in relation to the communicative ability of cultural meta-representations. For the purpose of this thesis, the cognitive avenue has been applied to knowledge generation processes whereas the social avenue has paved the way to knowledge retention processes within social groups. In this context, noise was identified as key for re-codification and re-stabilization of knowledge structures that have been created through artistic performance while simultaneously, detecting diffuse and blurring contexts of life with a coevolutionary relevance for human coexistence.

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