Aalborg University Copenhagen

Department of Medialogy

Semester: MED 10

Title: Communication, empathy and nurturance and gameplay experience changes on ecosystems of mixed realities

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Project period: Spring 2010

Semester theme: Master Thesis

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Copies: 4
Pages: 116
Finished: 1 July 2010

Abstract:

The pervasiveness of technologies drives users more towards anthropomorphist tendencies. Guided from the curiosity on the subject and the mind duality human-animal, this project has investigated how believability for human and animal agents express a qualitative communication, in relation to emotions. Using the theory for believability on humans and animals, is of an help on understanding how differently the intelligences and human capacities should act accordingly to other living beings aptitudes, expressed as differences on ways of playing and learning. Clever hypothesis can justify doubts on attributing intelligence to persons acting against a proper ecology of living beings, as it is the case for games with destructive goals – the example bloodsports. Living on a time period where technology is ubiquitous to our 24h/24 of the day, direct interactions tends to be reduced, giving more chance to phenomena of anthropomorphic interaction. With this hypothesis, interactions of users on computer games for simulations are proximal to the level of a natural interaction, while for the same action of playing that specific computer game involving an interaction between non-conspecific can be of training for understanding general attitudes of interaction with that creature. With the hypothesis that aggressiveness is an undesirable affective component, this thesis investigates the role of aggressiveness induction and gameplay experience changes within the same scenarios as lowering of quality of the overall other expressed emotions, and as contrasting the desirable altruism, good communication, empathy and nurturance, as it is expressed on pet caring.

Acknowledgments

None of this work would have been possible without the precious presence and assistance of the colleagues of the 10th semester of Medialogy at Aalborg University Copenhagen, and without the advices of Luis Emilio Bruni, Lise Kofoed and Lars Reng.

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Introduction

Starting from a research interest based on the pervasiveness of the theme animals care giving, and on the base of the rating area which contemporarily is represented from digital pets nurturing games, it was decided to conduct a theoretical work of research on the ecology of human-animal attitudes, affectivity as in relation to brain science, anthropology of robotics. The natural outcome of this research was on assessing which factors represents for the human individual in the daily relational context the duality human-animal, how the elements of play and learning are characterized among the two worlds, the state of art of electronic tools and computer games for realism and believability on simulations of the intended worlds area.

It is intended as a measure of realism as how the experience of playing with an electronic media appears transparent to the player experience, while believability as the way the player experiences credible the interactions and communications occurring along that play experience. Inside the electronic experience, this can be achieved with a humanified hardware, meaning an instrument which is capable of transmitting sensorial cues aligned to the perceptual and cognitive readiness of the players, and in software terms as synthetic worlds, agents, and mechanic elements which can portray outwards (of the digital world) non-mediated realities with high level of fidelity.

Believability takes as well as meaning for computer animated characters of organisms, which is their semiotic freedom. (Mateas, 2002) defines these agents as having consistent autonomy of agency (self-motivation, capable of expressing the illusion of life and perceive the world around) and emotional (capable of emotions, having a personality, capable of change and having social relationships).

Together with understanding how simulations can achieve believability, it is also another aspect to understand how humans-computer interaction, within the contents of this research, can be evaluated regarding affection and empathy, with understanding their natural tendencies towards this area of research, their personality attributes, focusing on understanding the relation of nurturance to aggressiveness and altruism.

This report will start with presenting theories of brain and mind for the human and animal world, and computational theory for artificial agents. This as an initial investigation, premise to the final problem area.

Analysis

This chapter presents the initial decision regarding the problem area to cover, then follows the analysis of literature on human-animal mind world, ending with an analysis of the origins of computation in regard to agent models. This investigation prepares for the final problem statement. The interested reader is invited to follow the order of the paragraphs, as to have a coherent idea of the analysis here conducted.

Initial problem statement

With the initial investigation decision, as to explain how human and animal neural systems have commonalities, the following initial problem came up:

"How do theory of human-animals communication has been effectively represented on computer games?"

In order to cover coherently the investigation, it started the analysis of the human and animal mind. Different theories have been proposed, according to how certain components of attitudes are prevalent for communication and action on the human brain. This analysis will start with a triadic definition of the human mind.

A theoretical way of understanding the human brain world takes three components of mind: cognition, affect, and conation. Cognition defines how perceptual stimuli are recognized, affect consists on the way of classifying and categorizing what is cognified, conation as the way of formalizing reasonably motivations for accomplishing desires (Huitt, 1999), which is in itself the emotive requirement of a believable character, as from (Juma, 2008). In order to understand the dichotomy human - animal's mind on the base of affectiveness, the framework of (Panksepp, 1998) will be used as it is explained on the following sections.

Behaviour, cognition, and affective neuroscience among humans and animals

It is known that affective neuroscience tries to understand how emotions are generated on the human and animal's brain; human brains are capable of generating many thoughts, ideas, and complex feelings, have a unique capacity of extensive behavioural generation and capacity of layering learning and culture (Panksepp), perceive, elaborate and act. (Panksepp) has evidenced some of the open questions regarding the way the functioning systems of the two entities human and animal operates distinctly. It is asked whether generally animals are "capable of dreaming, anticipate, enjoying food and other consumption, feeling anger, fear, love and lust, maternal acceptance, grief, play, and joy and an awareness of the self. Dolphins have fathom capacities of generating thoughts; other mammals have superior sensorial capacities: bats have the capacity of self-orientation by perceiving ultrasounds, rats and dogs have a richer olfactory life, eagles have keener eyes". The way of investigating affectively human as animal, from (Panksepp) unifies a behaviourist and ethological approaches: the first exploring the learning of the being as an entity which

acts on an artificial environment, ethology as to observe natural interaction of the animal. There, where ethology assists on understanding how a natural interaction is encompassed between breeder and animal, behaviourism helps on assessing believability for the represented character in the artificial environment.

(Panksepp) has investigated what mammals' shares, from a neurological point of view, on their emotional and motivational systems, which is resumed on six features:

- Self control in terms of behaviour related to sleep and waking mechanisms

- Expectations and motivations

- Physiology and environmental incentives towards the goals

- Emotions related to self defence and offence

- Emotions with Self physiological preservation

- Social emotions

Behaviour, control and emotions

As from (Panksepp), brain scientists have investigated the way brain activity on mammals is related to cognition, as for instance in regard to the self ability to handle mentally timing shifts and events. By electroencephalogram (EEG), it is possible to distinguish the patterns of activity in which the brain alternates between waking and sleep states.

During waking states EEG shows high frequency and low amplitude beta waves (beta waves is the way those type of brain waves are named, and are distinguishable based on their parameters), which symbolize that the brain is under a processing activity. By going towards sleep, the cerebral cortex shows slower waves with larger amplitudes, which goes to the minimum when the Slow Wave Sleep (SWS) is reached, which is followed from Rapid Eye Movement (REM) phase, where deep form of sleep is activated, cortical arousal, muscular paralysis, vivid dreaming. SWS reflect processes of body reparation, dreaming sleep active information reintegration within the brain.

Emotionality and dream are not two entities which run separately. Elevated amount of REM sleep exists for individuals who are confronting stressful situations and new environments, which is the case for young organisms. Experience shows that lack of REM does not influence recognition of simple emotional patterns (fear approaching a dangerous event). Artificially created environments of dualistic emotional circumstances (should evoke a quick shifting between two emotions) are a test set which shows how complex emotions have a different outcome on the brain dreaming of the individual, which consists of a huge amount of REM phase for the complex case.

REM sleep is charged of emotions, this is experiencable on animals with damaged atonia mechanisms (body and brain circuits are normally not bounded along the REM

sleep, when normally the body is atonic) below the locus coeruleus (a nucleus in the brain stem which is involved with physiological responses to stress and panic), which act out their dreams along the REM phase instead of being immobilized. On cats this is observable with 4 behaviour patterns: exploration, fearfulness, anger, grooming behaviours (self cleaning, etc). On humans, the complexity arises from knowing that on damaged frontal cortex of brain, which is the motor side as well as the part which contains neural circuits that helps planning, REM experiences are not vivid as described from the same individual awake, which poses the question whether REM experiences are to be dependent on motory functions more than on perceptual ones. REM is important for emotions and moods, as good quality of sleep allows restoring of brain desipramine receptors (NE), which is a control system for norepinephrine, a stress hormone which affects the parts of the brain where attention and responding actions are controlled as well as it acts as antidepressant and painkiller. Known is that REM sleep conduces to negative affect cognition, with the consequence that REM deprivation acts as an antidepressant; in contrast, some antidepressants equally provide quality enhancement of NE activity as REM sleep plus provides the effect for which they are meant.

A final concept about sleep and wakefulness regards dreams memories. It is well known that humans have difficulty on remembering their dreams, which appears paradoxical knowing that during REM sleep information processing which regards acquired emotional information are on execution and solidified from temporary to a long term memory. However, the amnesia encountered after the dream, is attributed to the weak NE activity during the dream period, which would have facilitated the consolidation of memories (i.e.: making short time memories going to long time stores). It is questionable then in which form of consolidation will be going dream memories (if they are so easily forgiven), which hypothesis suggests on habitues outside conscious awareness (Panksepp).

Expectations and motivations

Afar from the doubts which regards REM sleep, plausible proofs exists regarding the role of REM sleep within the mechanism of rewarding and with appetite. In particular, laboratory experiments described from (Panksepp) have showed that rats deprived of REM sleep, and self-stimulated during this period of deprivation, decrease interest on recovering REM sleep. A suggestion to the dilemma says that the activation of self stimulation acts as release of psychic energy. The mechanism of *appetite* relates to anticipation with self-stimulation, as the way mammalian executes foraging, exploration, investigation, curiosity, interest and expectancy. Which is they act to fulfil primary needs (survival). The interested area of the brain is the extended lateral hypothalamic (LH) corridor, which is from the ventral tegmental area to the nucleus accumbens (Illustration 1):
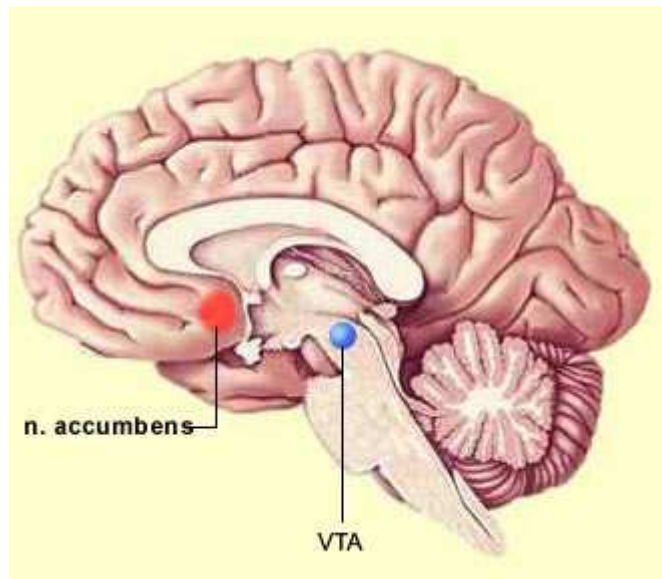
Illustration 1 - The extended lateral hypothalamic corridor

Rewarding can be described as how the psycho-motor functions of the individual are changed according to external stimuli, as for instance when we react in front of a scenario which evokes bad memories. While trying to explain the possible outcomes of such situation, the brain searches for a previous mental image of a similar context, which is to say, will create a hypothesis in relation to the perceived stimuli. Multimodal recordings of these experiences shows physical reactions of fear, anger, or specializations of these emotions, which is a body response made to avoid an unpleasant experience or to make a change to a prevedible negative outcome. The mechanisms of memory and reaction to stimuli have had new developments, since the initial work on classical conditioning (same stimuli – same responses) (Pavlov). (Bindra) has investigated on how causal relations to stimuli tailored to physical responses are concerned in regard to memory and context. This is, with the event of recognizing as rules those causalities on contexts which are similar to the ones evoked, is usually an incentive to report the same psycho-physical responses. (Bindra, Morgan, Stellar) have formulated a conceptual framework which unifies emotions and motivation, defined as the *central motive state* (CMS) (Illustration 2):

Unconditioned Response
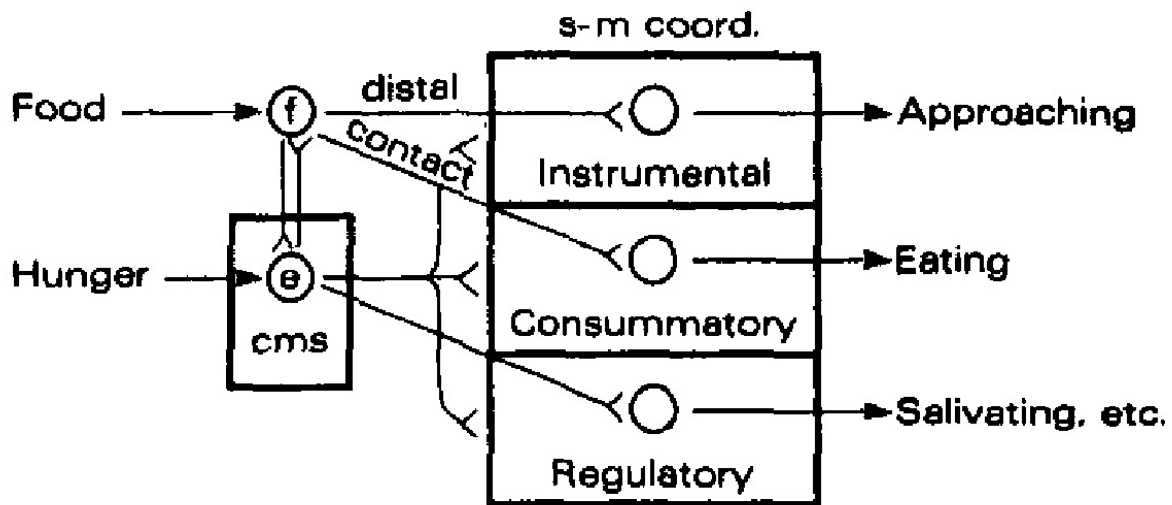
Illustration 2 - The central motive state (Bindra)

The central motive state is then generated by organism-state conditions which represents the motivation and appetite on incentive stimuli from environmental objects, as the emotion. The response to the incentive stimuli is sensory-motorial, and it takes three components (s-m coord), as in (Illustration 2). The regulatory mechanism consists of the viscerosomatic reactions, the transactional of consummatory or rejectional acts, the instrumental of locomotion and skilled actions.

(Panksepp), on the other hand, proposes a different conceptual framework for understanding motivations and emotions as acting independently from organism-state variables and environment, called *seeking system.* In this system, the circuits of dopamine (DA), acts as regulatory for the motor and thought functions. Appetite corresponds to arousal for the LH brain area, while low neuronal activity occurs for rewarding. There are some aspects which justifies how the seeking system has the nature of emotional system:

- the seeking system is not dependent on higher brain functions

- it works also on individuals with higher cognitive mechanisms surgically removed

- damages along the LH corridor are a serious threat for the survival of the individual, which explains how it is indispensable

- it is responsible for organizing behaviours

- altered states of this system affects perception

- the neural activity lasts longer than the perceived stimuli

- emotive circuits can come under the conditional control of emotionally neutral environmental stimuli

- emotive circuits have reciprocal interactions with brain mechanisms that elaborate higher decision-making processes and consciousness

Another consideration is reserved for the brain mechanisms which relates to delusion. Delusions are described as increased salience of common events, which is connected to excess of dopamine release in response to social events.

Physiology and environmental incentives towards the goals

The social and anticipatory aspects are relevant on how brain parameters' values are to determine the health of the body. From (Sterling), historically physicians have accepted the theory which justifies health conditions as on keeping as constant the body parameters which relates to their consuming behaviours (*homeostasis*), which is based on research from (Bernard). He explains therapies based on sensing the errors, and producing a diagnosis based on restoring standard values which are for brain parameters. Recent developments have supported the idea of the necessity to integrate the existing model with other parameters, which are not the individual. A clever example of the necessity to review that approach is showed from therapies for hyper tense individuals. In medicine is accepted that locating and preventing erratic conditions, is of a support to avoid hypertension, more than regulating artificially the internal mechanisms of the brain. Excess of salt consumption is cause of hypertension; to use artificial treatments (antihypertensive drugs) a way to restore normal conditions; analysing the social causes connected to the illness of the individual, when the diet is not the problem, and when the circumstances allows that, it is a valid alternative and a natural approach to lose hypertension.

Brain regulatory needs are affected from levels of oxygen, glucose, temperature, and osmotic pressure. Determining critical values for them would not be coherent with keeping to a certain steady condition their values, as they depend on the individual life style (athletes keeps on different values from sedentary workers) and the capacity to adapt to different working conditions. The brain acts with reparatory mechanism to stress conditions affecting the body, by directing its signallers such as to allow a flexible shift among the variant conditions, which otherwise would create sickness. Ordinary life sees that we face alternating values of blood pressure, while we are still feeling perfectly fine with it. The brain acts on recurring stress, by reinforcing signals and their mutual effectors, and suppresses opposite mechanisms of feedback, keeping the system in health through different variable values. (Sterling) has identified some principles which define this brain mechanism of keeping stability through change. They are resumed as:

- *organisms must be efficient*: our brains is meant to regulate body functions according to ordinary conditions of energy consuming, as to minimize energy expenses, and for longevity

- *efficiency requires reciprocal trade-offs*: to keep efficiency and stability, the brain regulates the distribution of energy among the body, keeping constantly what needed for the brain section, scheduling energy distribution based on perceptual priorities. The brain also informs the body when overload choices are done, by a negative feedback which follows that action (i.e.: a urgent muscular effort after a rich meal easily provokes vomit)

- *efficiency requires predicting what will be needed*: the energy distribution schedule prediction could not match always the real necessities of the body. That's why, for instance, the neural mechanisms of insulin can provoke excessive levels of glucose in the blood when predicting an intense muscular effort which is not, after, consumed

- *prediction requires each sensor to adapt its sensitivity to the expected range of input*: body sensors organize their output response according to probability distributions, calculated based on expected inputs. Sensors adapts parameters of accuracy and speed according to predictions on the most likely state which would occur, and the timing spent within it

- *prediction requires each effector to adapt its output to the expected range of demand*: this is best explained as with skeletal muscles, that with training conditions adapts themselves to the expected range of the sensors. Internal receptors and their number acts also accordingly, and slowly as it is for skeletal muscles and other effectors. A problem of overload exists for receptors, meaning that the prolonged detection of peak values signalled for their ligands (i.e., insulin and insulin receptors) for prolonged time causes lost of sensitivity and number secretion of receptors, provoking instability in the body

- *predictive regulation relies on complex behaviour whose neural mechanisms also adapt*: it is possible to observe that behaviour in a group of people, in a desert context, going from A to B. Oasis available during their path, with limited water resource. In order to survive for all of them, their prefrontal cortex and the rest of the brain needs to decide how to use prior knowledge (a previous progress which resulted positive), multiple emotions (the anxiety of finishing all the water collected at the oasis will let them decide among drying themselves till dead or resisting drinking opportunely), perception, planning (consulting the map to the next oasis), cooperation (divide their carried weights), and altruism (the stronger taking more weight for himself).

The parts of the nervous system and neuroendocrine which are interested on heterostasis are:

- hypothalamic-pituitary-adrenal axis (HPA)

- autonomic nervous system (ANS)

- cytokines

It is now known, that bodies are able to keep a system balance which is based on changes more than on steady conditions. It is then time to understand what happens internally when reactions to certain events are triggered. The observed body changes are better described as feelings, emotions, and moods; (Juma, 2008) explains their differences lying on duration, arousal and orientation. Her conclusions on emotions being that they consists of stimuli (the ones perceived from the emotional agent), arousal (due to perception of certain stimuli), and cognitive processes (reasoning and memory). There are some hierarchies of emotions (primary, secondary, tertiary), the basic ones can be grouped as in the following, derived from the taxonomies of (Tomkins, 1962), (Plutchik, 1980) and (Eckman, 1992):

- incorporation (reception of external stimuli)
- protection (fear) and aggression (anger or rage)
- anguish
- reproduction (joy) and deprivation (sadness)
- rejection (disgust)
- shame
- sorrow
- research (interest) and acceptance
- orientation (expectancy and surprise)
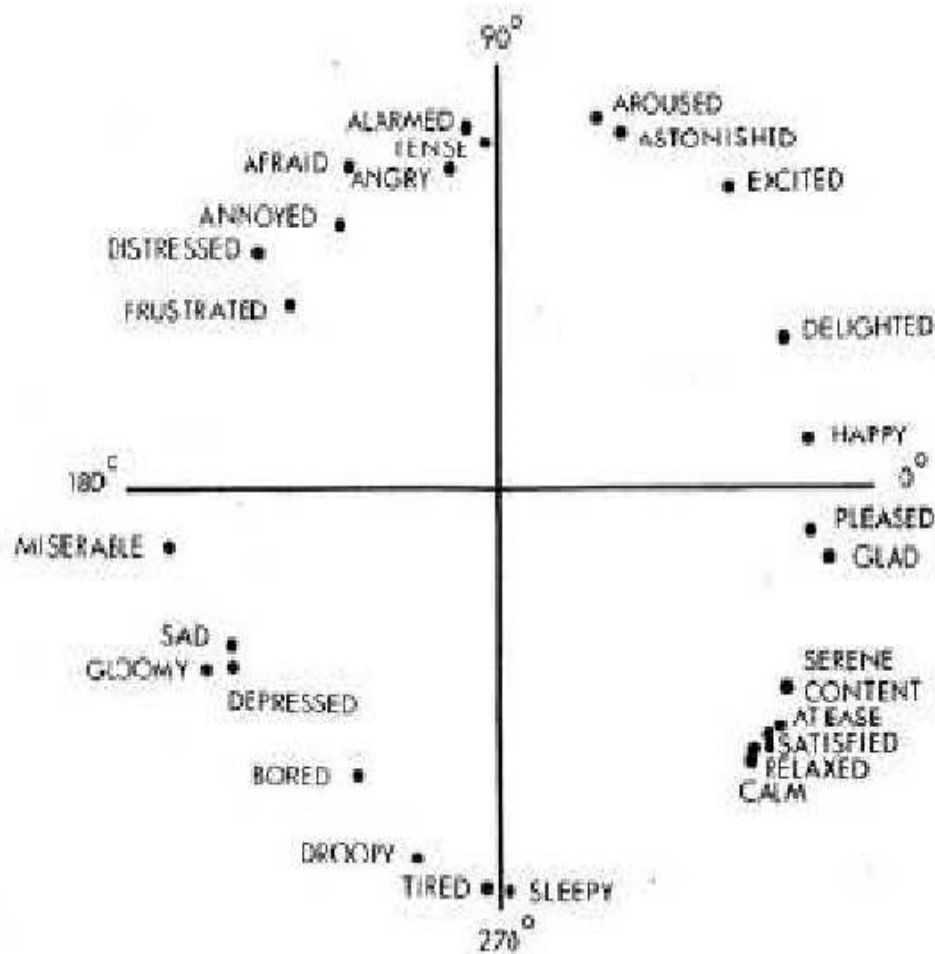
Illustration 3 - The map of basic emotions to valence and arousal (Russell)

As some emotions theorists dropped the idea of a discrete vision of them, as (Lang, 1995) and (Schlosberg, 1954), (Russell, 1980) proposed an approach, in two dimensions of feelings, to map the continuous emotions to discrete ones. The dimensions are arousal and valence (Illustration 3); arousal (up-down axe) as the degree of intensity of the emotional response, valence (left-right axe) as positive or negative dimension of the feeling.

For the purposes of the report, it is needed to investigate the way emotions are concerned among humans and animals. (Panksepp) analysis on affective neuroscience is useful in this sense, as he also argued in regard to the neural circuits. From (Plutchick)'s taxonomy of basic emotions, it will be started the investigation on how incorporation relates to aggression and protection.

Emotions related to self defence and offence

(Panksepp) maps emotions of aggression, protection and anger in the context of a circuit called RAGE. They express the *predator* personality, *intermale*, and *affective* attack. Affective connotes a defensive attitude, induced fear, protection; the description of animals affectively aroused is with piloerection, autonomic arousal, hissing, and growling during their attack. The predator instead appears as a methodical stalker, with well directed pouncing. The intermale aggressor occurs for territorial and sex-related aggression. In which brain areas do the RAGE system operates? The rage and defensive emotion is under control of a hierarchy which starts (from bottom to the top) from the medial amygdaloid areas downward to the periaqueductal gray (PAG) of the midbrain, passing through the stria terminalis to the medial hypothalamus. The (PAG) system is responsible to direct the overall system; each level is dependent on the one on top of it in order to give a response; basic irritations as hunger, hormonal/sexual influences are elaborated into the hypothalamus, while more refined ones into the amygdale (Illustration 4).
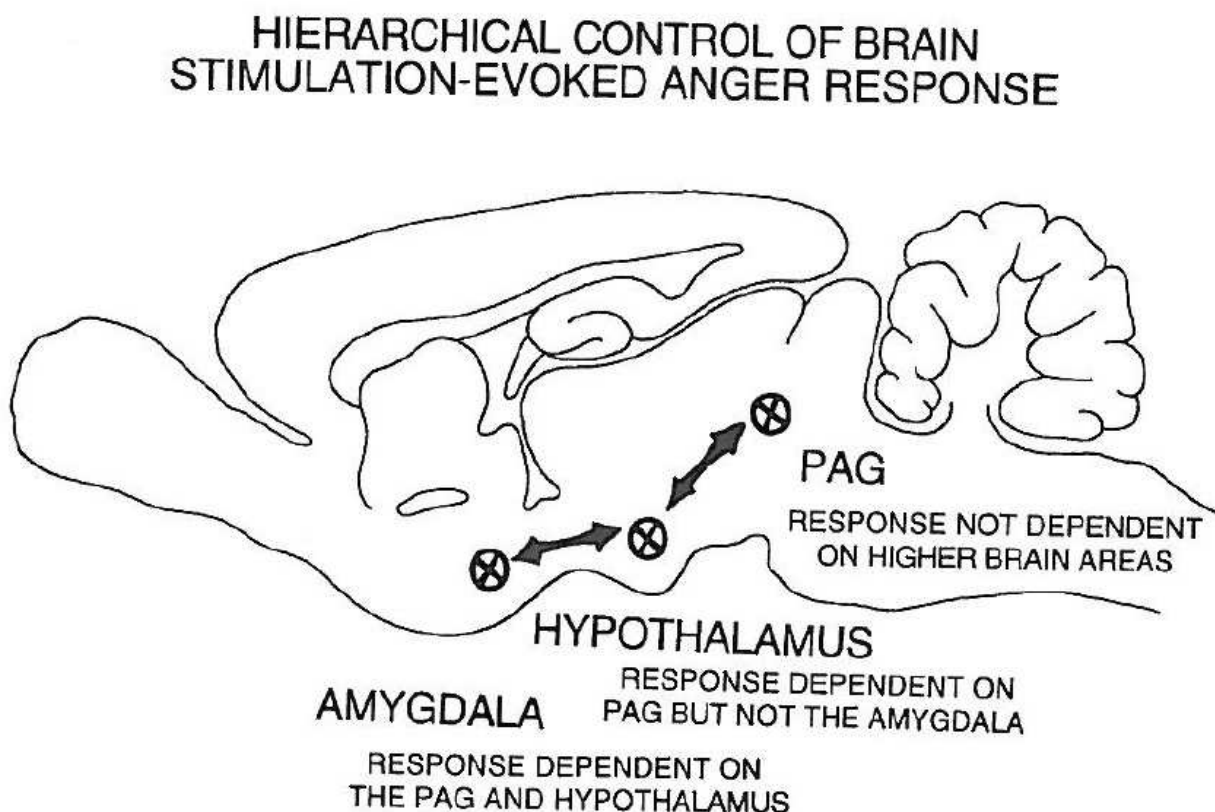
Illustration 4 - The RAGE system (Panksepp)

Predators stimulated, exhibits a sensitization of sensory fields, which is around the lip lines and around the snout. The area of sensitization increases with increasing stimulation intensity. At the brain site the predatory temperament occurs only on the side of the brain that is stimulated directly, as it is reflected in the sensitization of the corresponding visual field. The Intermale aggressivity relates mostly to the male side of animals (with the exception of spotted hyenas) and it expresses hugely the mediation of social play for the animal. Intermale aggression is generally represented from high density of testosterone receptors running from the medial amygdala, through the preoptic, anterior hypothalamic area, and down into the PAG of the brain stem (which is really different from the RAGE system).

Emotions with Self physiological preservation

The emotions of anxiety, terror and dread have for (Panksepp) another correspondent brain system, called FEAR. The main brain area in which the circuit courses is between the lateral and central nuclei of the amygdala, through the ventral-anterior and medial hypothalamic areas, down to the mesencephalic PAG. In the amygdala area then is quite close to the RAGE circuit, and an arousal on that area corresponds to highly manifested anxiety. The entire circuit is showed in (Illustration 5):
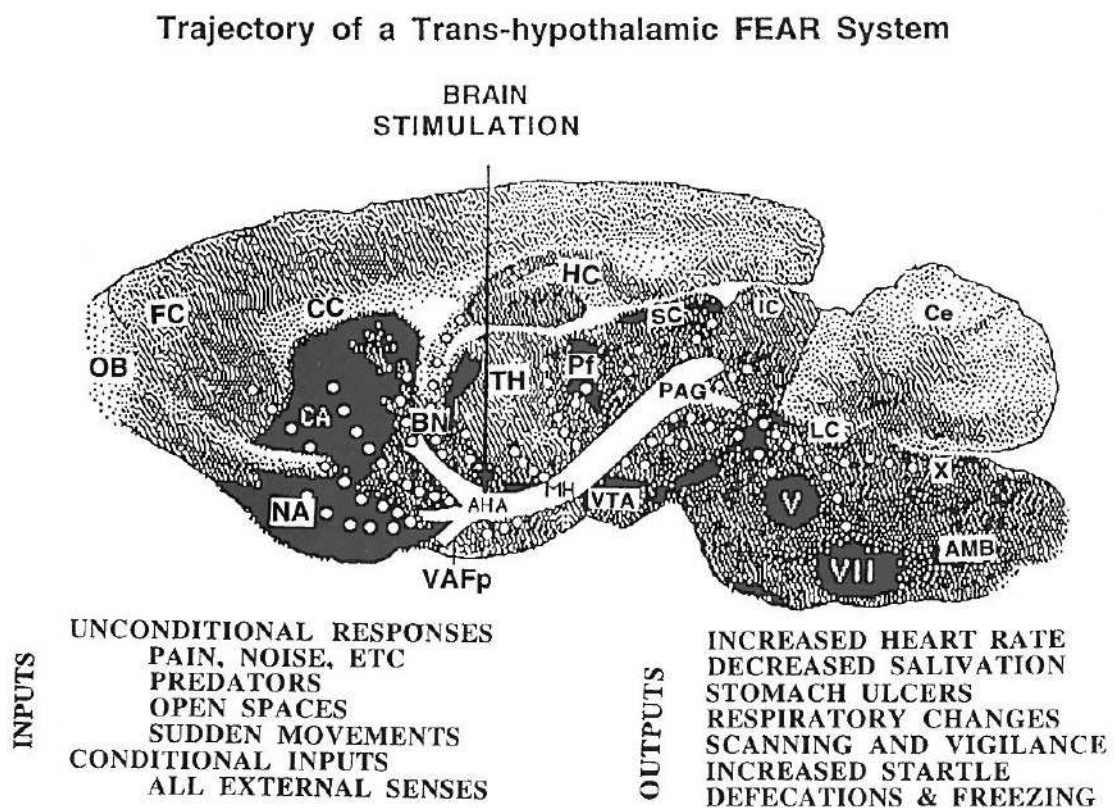
Illustration 5 - the FEAR system (Panksepp)

The FEAR circuit consists of recognition of some external threatening factors, and internal parameters in response to that cognition. There is association between fear internal and external manifestations. When an animal feels threatened, the physiological response of "fight-or-flight" is activated (Cannon, 1929). This response is described from Cannon, as the action of the sympathetic nervous system (SNS), and of the HPA: in response to stress, in the SNS occurs release of adrenaline and norepinephrine (this last one from the medulla of the adrenal glands). The release is triggered by acetylcholine released from preganglionic sympathetic nerves. These catecholamine hormones facilitate immediate physical reactions associated with a preparation for violent muscular action (Gleitman et al., 2004).

The observed behaviours for fear and anxiety are resumed in (Illustration 6):

	With Punishment	No Punishment
Learned	Active avoidance tasks Conditioned emotional responses Punished behavior tasks Passive avoidance tasks	Partial reinforcement extinction effect
Spontaneous	Freezing to shock Defensive burying Stimulation of fear circuits Responses to loud sounds (startle)	Open-field exploration Avoidance of bright lights Social-interaction tests Plus-maze test Predatory odors

Illustration 6 - Taxonomy of Animal Models of Fear (Panksepp)

The importance of amygdala for the FEAR system is showed from neuropsychological studies which have demonstrated that damage to the amygdala can reduce fear conditioning in humans and animals, and that those individuals are not capable to recognize facial expressions of emotions.

Social emotions

It is now time to conclude with the understanding of the affective mechanisms within neural circuits, which are about social emotions. Animals express some common features, which are on sexuality, love and nurturance, sorrow and grief, joy.

Sexuality

Male and female genders have distinct brain controls mechanisms; mammals develop masculinity at the fetal stage after the second trimester of gestation, which is not the same for birds. How the brain of mammals becomes masculinized? Specific groups in the anterior hypothalamus, grow larger in males than in females, while other areas remain smaller, such as the corpus callosum, which connects the tele. Homosexuality for men is attributed to earlier pre-natal testosterone secretion, which cannot be received as the ligand receptors are not available. Other attested cause is maternal stress which can retard conversion of testosterone to estrogens (because through estrogens the process of masculinization occurs). Higher prevalence of vasopressin circuits rather than oxytocin circuits, influences male behaviour from female behaviour. However, intranasal administration of oxytocin elicits sexual arousal on both sexes. Another source of sexual arousal is yohimbine, which has effect by blocking brain norepinephrine receptors of the alpha-1_A variety. Social factors influences sexual victory, winners of social encounters exhibiting elevations of circulating testosterone versus opposite tendency for losers. Psychosocial variables modify the physiological substrates of sexual and reproductive tendencies in females, as in the following observations:

- young females, human and animals, becomes sexually mature faster when strange males enter their environments

- social stimuli affects body production and deployment of sex steroids

- female primates, wolves and other animals, exert physiological influences over each other to control which animals will reproduce in the group (which is a social mechanism predominantly based on olfactory cues)

- Olfactory senses of the human beings can receive external influences such as to coordinate their sociosexual activities

Love and nurturance

The emotion of love is extremely controversial. Some people would say pervasive, complex, frustrating and addictive problem. It is known how difficult is to explain this emotion, problems which are evident on relations of mothership and on nurturance. How do we define those emotions? Nurturance has been categorized under the pleasures of mind (Kubovy), which are emotional objects that contribute to the outcome of certain kinds of pleasure. (Järvinen) on "The Video Game Theory Reader 2" describes such pleasures of mind, making an analysis of computer games which should elicit the pleasure of nurturing. What is it exactly the act of nurturing? The pleasure of taking care of living beings, children caring, gardening, nursing, or teaching (Järvinen). Their objects function as the objects of emotions. It is both a self

and empathic pleasure, as it depends on the fortunes of the all group. (Järvinen) explains as well that, in order to feel this mental pleasure, attribution and attraction emotions towards the act or the idea of nurturing is needed.

(Panksepp) evidences some qualities of human and animal nurturance, as:

- *cultural:* for human's modern society it would be criminal the tradition of Netsilik Eskimo of northern Canada that, finding impossible to couple their female babies, as no male partners of comparable age were born in the tribe, would be left to die in the snow, with little outward distress or remorse exhibited by the parents

- *economy:* children caring is a relevant invoice in the expenditures of families budgets

- *cognitive:* the urge, on rats, of feeling safety conditions for their infants, triggers mechanisms, goal based, of search and retrieval mental processes

- *influences the personality:* the baby which is raised under loving and supporting conditions, has the best chance to grow vigorous and independent in its adulthood

- *age:* while the Western society accepts a long period of childhood dependence, African tribes as the Digo of East Africa "wean" babies earlier; babies are toilet trained by 1 year of age, and soon they behave as independent members of their family group. Of course those children are not left on their own but the entire village takes care of them

How that does relate to the way our brain (and the animal one) works while feeling these emotions? How the social factor influences more than internal reasons the mechanisms of this emotion? (Panksepp) explains the nurturing effect as the "mere-exposure", meaning child preferences develops at a subconscious level without a full awareness. It is observable on the preference towards subliminal presentations of smiling faces from America students of Chinese characters, which would not match same effects for sad ones. Another aspect regards the easiness of feeling cognitive dissonance from children family-bound which are exposed to unfamiliar ideas. At last, the most valued hypothesis regarding social bound regards the role of opioids and oxytocin as anti-aggressive molecules.

Sorrow and grief

(Panksepp) explains sorrow and grief as emotions strictly related to music effects, which are felt the most from highly social people, described in the thrill experience. The total experience of the body feeling these emotions, is expressed as vasoconstriction, local skin contractions caused by piloerection, and perhaps changes in evaporative cooling at the skin surface (sweat, etc.), that can be measured through

galvanic skin response (GSR), which measures the skin conductance. What kind of music evokes thrilling and how that can occur? Above all, thrill should occur always to the person playing the music which is according to own preferences. However, it is more frequent through sad music on both sexes, while more prevalent on females subjects. The experience is described as coldness and social loss, which could be empathically felt through sounds of people feeling in the same way. In the brain system relates to the much opioids are not receipted.

Joy

Joy occurs in the phase of rough-and-tumble play. The benefits which are connected to that activity are well known, even if it needs deep investigation as on the way it differs among animals. Among them we have physical benefits (body changes, respiratory abilities, reinforce the immune-system). The instances of feeling joyfulness have also healing responses, as it can be seen on individual recovering out of their hospital convalescence throughout having fun. Play is an instinct, which characterizes youthful health, and the childhood period is a majority of the life more on humans than any other species. Play fighting gets inhibited by the maturation of the neocortex.

Adult play has a general prevalence on individuals committed to offspring nurturance, which has a cultural and neurobiological motivation, as explained in the previous subchapter.

After the investigation conducted on affective neuroscience, and having prepared the basis for an understanding of the physiological mechanisms of affection and that in relation to social factors, it will follow a description of a mind vision of human-animal, starting from the distinctions which exist among the two entities.

Mind theory of the animal agent

It is then, from affection in neuroscience for humans and animals, natural to ask the following question:

How human do differs from animals?

(Bateson), on his metalogue "What is an instinct?" from "Steps to an Ecology of Mind", gives a an answer to what is human and not animal, by saying that of human is *intellect, language* (with semantic congruence, as parrots does not hold this faculty, indeed are able to replicate human speech), *tools*. Exception from this rule is reported from the experiments of Georgia Linguistic Research Centre on a bonobo monkey, Kanzi, which has showed to be capable of the communicative and interactive capacities of a 2 years old child. Humans are capable to reach consciousness and objectivity through the use of their unique faculties (Bateson); they are capable to formulate vast discourses and generate thoughts; they are capable to process information, reflect about their own thoughts through autopoiesis, and communicate through messages their common understandings. Both human and animals are

capable of dreaming. (Bateson), from his analysis of animals, describes animal behaviour on humans together with non-human animals behaviour, which is a corpus that includes from instinct to shallow social relations. This is to say, that human animals are capable of emotionality and deep relations, while the shallow animal behaviour is in the extremes afore mentioned (Illustration 7).

Illustration 7 - Animal behaviour extremes

(Böll) proposes a behavioural concept of animal mind, assuming mind as a circle of systemic organizational layers of emotions which constitutes the self, of which bodily experience represents expressions. Humans are capable to adopt the tool of thinking, to use language to structure thought; animals have coherent selves, so to say their minds are served to their bodies' demands. (Illustration 8) shows how the two minds differ:
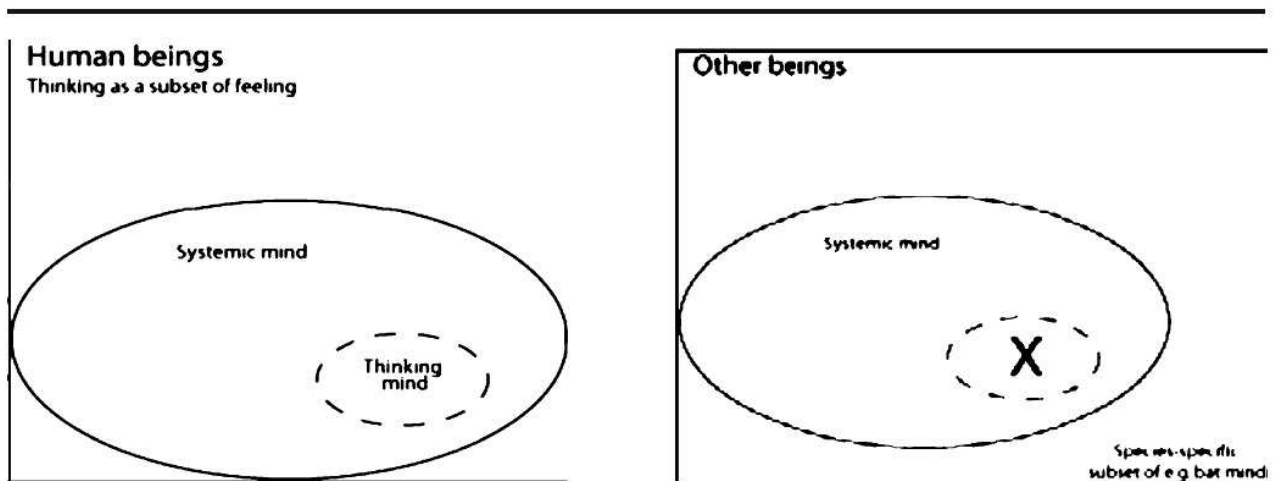

Illustration 8 - Animal systemic mind and specialized human mind (Böll)

Through animal play, (Bateson) attempts to elaborate further on the complexity of animal behaviour. An example exists on fight between dogs: justifications for fight consists normally on the necessity of defending territories, matters that regards sex, hunting for food, and some reasons which can often materially are observed. It is deceptive to give an immediate understanding of the pre-fight actions without understanding the context existing between the individuals; so to say readiness for fight is to be confused with assurance of neutrality. (Bateson) presents this concept, in the metalogue "What is an instinct?" as a conversation between a father and his daughter:

"Father: a puppy which lies on his back and presents his belly to a bigger dog. That's sort of inviting the bigger dog to attack. But it works in the opposite way. It stops the bigger dog from attacking.

Daughter: Yes. I see. It is a sort of use of opposites. But do they *know* that?

F: You mean does the big dog know that the little dog is saying the opposite of what he means? And does the little dog know that that is the way to stop the big dog?

D: Yes

F: I don't know. I sometimes think the little dog knows a little more about it than the big dog. Anyhow, the little dog does not give any signals to show that he knows. He obviously couldn't do that.

D: Then it's like the dreams. There's no label to say that the dream is dealing in opposites.

F: That's right.

D: I think we're getting somewhere. Dreams deal in opposites, and animals deal in opposites, and neither carries labels to say when they are dealing in opposites.

F: Hmm."

The concept of *second order umwelt* (the social umwelt of the animal) (Böll) which is established among the two individuals, is clarified through this scenario: canids bowing, which is the posture that assures an intention, which is fight or alternatively, neutrality. This posture is part of a meta-communication: the same posture is context dependent and would not be meaningful in other contexts, it is performed to maintain social play, to ensure play-mood, or as punctuations in order to underline the semantics of other signals (i.e.: assure an intention). The communication between the parts consists then of play signal of the bowing animal with the referred emotional intention and the interpreting formed in the mind of the second animal that realizes "play" when presented with the gesture (Böll).

Once introduced the dichotomy human - animal's mind, it is possible to start the analysis of how computing relates to artificial agents.

Computation and artificial agents

The vast process of evolution is represented from the accomplishment of developments of elements of the human mind as in relation to the inhabited world. (Bateson) lists two of them, as *totemism* and *animism,* which represents the self in relation to the ecosystem; (Bateson) as well suggests how social sustainability is necessary in order to allow survival for the systems themselves. Totemism is described as the mirror of the natural world in the structural organization of the human world, while animism represents the attribution of self features to the natural world, which is the process that the developing child executes in order to attribute meaning to play interaction with toys. It is a natural consequence to consider that the two afore parameters depends on the social constraint of sustainability, meaning that the natural world, human mind and the body of the society are all requirements for an ecological development, that must be considered commonly.

However the individual holds faculties as to interact in the world in which exists and to express ecologically the self. As introduced earlier, held human abilities are language, intellect, tools, which in utilitarian terms serves for engaging natural attitudes and deutero-learning towards goals. With these, humans have enriched the World with technology, art and science. Nonetheless, humans have concerned ecology as from domestication and wild life for non human animals.

History justifies the use of anthropomorphism for technological and artistic development. It is perhaps to disrupt the existent systemic order that (Da Vinci) made his drawings of "The Knight Robot" and "The Lion's robot", which indeed prefigured the development of robot technology and related applied disciplines (Illustration 9).
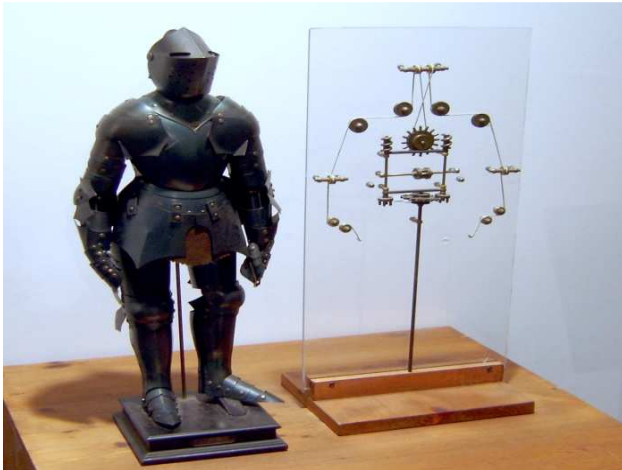
Illustration 9 - Models of robots based on drawings of (Da Vinci)

From (Da Vinci) to nowadays, it is possible to reach participative domestication of automate technology, which includes the need for more believable technology "life-like"; it represents partially the current challenge of conveying the authenticity of human social interaction to artificial beings. Into these steps, artificial intelligence has contributed by attempting to convey believability on synthesis of living organisms, which have to have the characteristics of autonomous agents and emotional agents, as from (Juma, 2008). An artificial organism is then, as from previously said, supposed to give the illusion of a life, being self-motivated, being emotional, rich of personality, be social, make changes during time. The mechanics of the artificial does not allow autopoiesis, the unique feature of living beings. Many examples along history have attempted to give proofs of artificial lives, as the case of the "Automaton Chess-player", which instead was a mechanical device played from a hidden chess master (Illustration 10).

Illustration 10 - Automaton chess-player

Several forms of intelligence have been attempted to be included on automate, which was trying to deploy the unique capacities of living beings inside bots. One of the most researched area, as it is so far the more relevant area comprising all the living beings on nature, regards emotional intelligence. The role of emotions on animals has been investigated since (Darwin), and the role of emotional intelligence has been explored, and it is described as the skills, the capacity to assess, identify, manage and control owns emotion as in relation to the others emotions. Moreover, analyses of traditional IQ intelligence have showed that this capacity alone is not capable of explaining interpersonal skills and fully explain cognitive ability. How, then, do we empathize? Studies from (Goleman), divides empathy intelligence among cognitive, emotional and concern. Cognitive intelligence relies on understanding what the others wants and expects, in some cases this intelligence exists to personalities which are "ignorant" of other's emotions: those kind of personalities are called "Dark Triad" or stone-heart: the narcissistic, Machiavellian, sociopaths. Emotional empathy has more to do with relationships, and it is explained as the capacity of understanding internally the feelings the other person has. Concern is a further concept, which is explained as the intentional desire to make changes to the negative emotions the other person is feeling such as to evoke positive emotions. How that is related to animals? The typical example of dolphins rescuing humans from sharks shows that this is an intelligence which is not just human. It is then of an interest to know how that can be represented computationally, which is the case of computer games. What kind of techniques are in

use or are suitable such as to represent empathy for NPC through AI, and more over for enhancing believability? (Juma, 2008) has listed AI techniques which are suited for representing computationally emotions, which are Neural Networks, Finite State Machine, Fuzzy Logic, and Reinforced Learning. Each one of them has its advantages and disadvantages, as it is known from Artificial Intelligence. The implementative parts of the software handling of the project, dispensed from the use of these techniques for representing a believable animal character.

Conclusions

After the previous dissertation on the topic of human and animal affection, cognition and motor functions, and how that has had historical developments on computing and automates, we will present the final investigation which regards animals play and learning, and how it is possible to use these tools such as to evaluate communication among the two entities on an electronically mediated simulation.

Final investigation

With the starting investigation, it has been possible to focalize on knowledge for the human-animal psychophysical dichotomy, which also related to historical analysis of computing and robotics. However that would not be sufficient such as to give a total understanding of communication among humans and animals, knowing the role of play and learning for the life of both entities. It is then required a second stage of research which, through exploring on literature the way the two key components are concerned, will be triggering of understanding of how that is to be related in the world of simulations computing, in order to create believable behavioural synthetic realities and credible interactions.

Play, games and learning among humans and animals

Illustration 11 – "Horses by the seaside", oil on canvas (G. De Chirico)

Play

It is uneasy to give a topocentric definition of play, and it is part of the struggles for performative arts, science and technology. (J. Hans) defines play as the structure, meaning, and location, of the activity, which is play itself, explaining play on how the designer and artist would profitably idealize when thinking of designing a game in concern to rules (Salen & Zimmerman).

Play not just represents the biological evolution of micro and macro organisms, the simulated agency of a biological evolution, but it is also epiphenomena together with phenomena measurable by physical sensors.

For mechanical engineers play (also called *backlash* or simply *lash*) is "the clearance between mating components, sometimes described as the amount of lost motion due to clearance or slackness when movement is reversed and contact is re-established. For example, in a pair of gears, backlash is the amount of clearance between mated gear teeth" as represented in (Illustration 12).
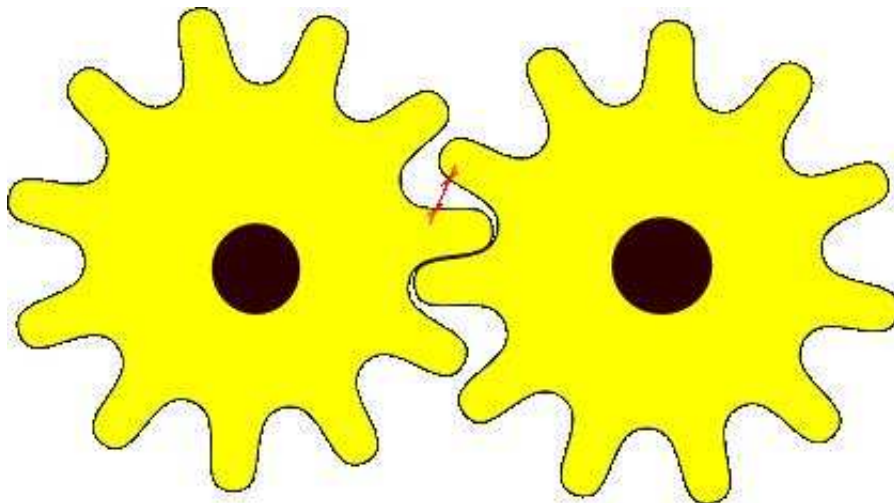
Illustration 12 - Two mated gear. The red line represents the 'play' between them

It is possible to be specific for play in regard of human's play, play between animals, the cross of these play concepts, play in computer games, and introduce how play is related to learning for animals and how this all goes with computing.
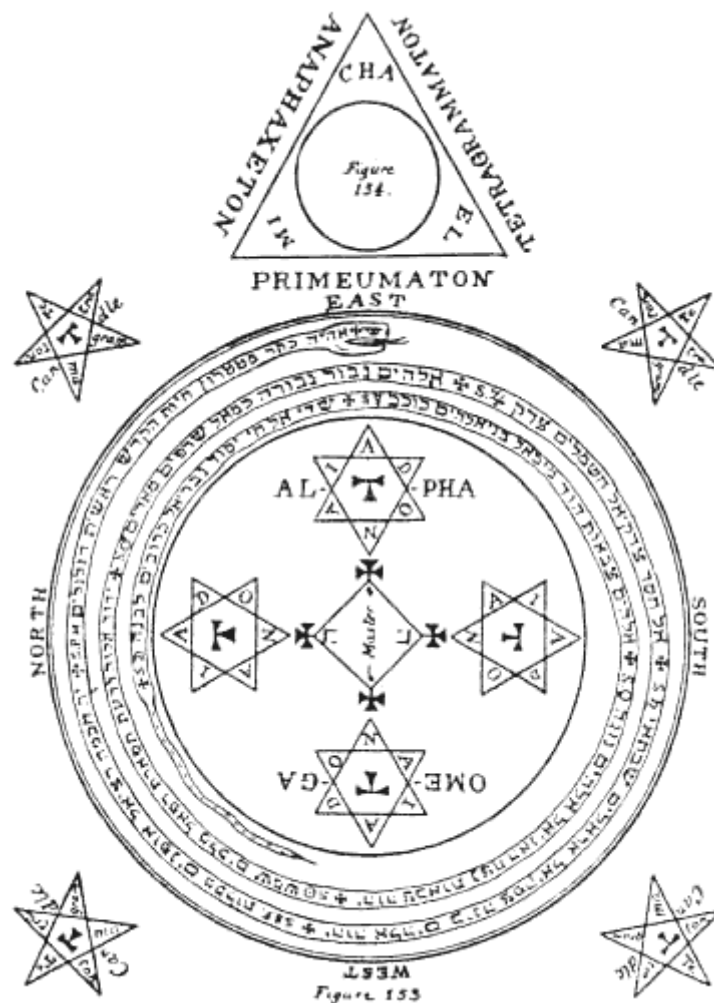
Illustration 13 - a mandala

Play on humans

Most of the work regarding human's play relates on the theory elaborated from (Huizinga). He defined play as a space called "magic circle" (Illustration 13), which is a place where groups of participants engage themselves in actions, by producing changes on an established order, and where autopoiesis drives creativity. The boundaries of this circle, which defines a gameplay, are not always easy to be delimited from real life and work, and the ubiquity of technologies on humans' lives complicates further this matter. In order to focus on the subject on recent hypothesis, two of the most popular way of interpreting the magic circle will be presented.

Thompson-ites: this group of people suggests that only an elite of persons is able to distinguish among magic circle (which is virtuality) and real life, and that everything which can occur on a virtual contest (a virtual contest can be, as instance, an electronic simulation) will be replicated on real life (i.e.: thinking of the case of violent games that protracted on real life are susceptible to be a social threat).

Something-Awful-ites: everything which covers the digital is part of the magic circle, all the rest is out of it. Indeed, they will induce the elements of the digital world in their real world. At first look, their subconscious hides sadism.

From that analysis, whatever relies on the magic circle can appear as frivolous and potentially dangerous, especially if the persons involved are not able of self-control. Instead, the positive qualities of play must be mentioned, such as the importance of play for education. (Sutton-Smith, 1997), and researchers of the National Institute for Play (NIFP, a non-profit institution based in Canada), have worked on play theory, where the first has developed a list of seven traditions that represents the rethorics of play, the latters have produced a list of patterns which identify play on human experience. (Sutton-Smith) seven rethorics of play are:

- *Progress*: play covers the reality of the developing being, which entails an activity to become socially, emotionally and cognitively more adapt to some challenges, together with adapting to some constraints of the natural world.

- *Fate*: this way of concerning play relies on a yin-yang concept of life. Gamblers, dreamers and religious are the players of this area. Players' attempts to achieve positive play, the dark side are represented from animism, magic, chance, divination, chaos, unexpected, psychic masochism.

- *Power*: from agon and competition on youth play, sport, to the warfare of politicians, players' power is showed through the victory of their dominant culture.

- *Identity*: is how social players find self-motivation through deploying their cultural heritage as a mass phenomenon.

- *Imaginary*: from (Burghardt), "play is viewed as transformation. In animals, this is reflected in play being fragmentary, exaggerated, reordered, or repetitive. In humans, this rhetoric is manifested in pretence, fantasy, symbolism, creativity, and imagination. Scholars in art and literature emphasize this rhetoric. Its origins lie in romanticism. Actors are typical players."

- *Self*: players' looks for positive, rewarding experiences, situating on leisure activities, relaxation and solitary activities, extreme games as the places where that can be reached.

- *Frivolity*: here is where the world of grotesque and nonsense takes place. Realities are considered upside-down; the typical player is the trickster, the jester, the comedian and the fool.

and the NIFP patterns:

Attunement play: the interaction which exists between mother and child, which is expressed from the joy of the smiling baby and the rhythmic vocalization of the mother's voice.

Body play and movement: as body movement represents the first approach to our life, as well discovering the potential of our movements and how we can react to physical constraints as gravity, represents ways of exploring how creatively we can use our body to get knowledge about the world. Adaptations, flexibility, resilience, innovation, have their base on human's body motion as they are showed after on planning and human thought.

Object play: as body motion represents the way of exploring knowledge of the world in relation to our organism, as well interacting with objects represents the way of developing our brain circuits for achieving manipulative and mechanical skills. Nonetheless object interaction helps on improving problem solving skills.

Social play: conversations and wordplay within social gigs, teenagers' gameplay in relation to animal play, and the relation of the adult gameplay to the elements that foster attunement play.

Imaginative and pretended play: players aim on creating meaningful interpretation of their own minds and empathize with the others, develop the capacity of imagining and create an environment of reciprocal thrust with their mates.

Storytelling-narrative play: through making sense of the world, in a timeless play experience of narrative and storytelling, intelligibility goes to our conscious, providing learning. Stories represents a universal communication tool, narratives creates a culture on the person, which culture serves as to shape the personality.

Trasformative-integrative and creative play: it is explained from the equation Play and Science=Transformation, meaning that through transcendence, novelty and flow, both the scientist or the industrial designer can find playfulness as drive for shaping their products.

Knowing the unique human capacity of being capable to create, how critical is the role of play within new technologies, how play concerns digital worlds, what is the player concern for the digital designer in relation to the magic circle? Virtual spaces are places where the actions and worlds exist such as to enact dream and reality, that when containing meaningful purposes and structures, in order to deal with the chaos of the magic circle becomes games. When those features are missing, and the interaction is tangible, the objective play is defined as a toy. It is known that a game can be either container or content, depending on its role on narrative of the play space. A game can have a purpose of enjoyment, suscitating fun and an educational goal. As a play activity, games have rules, challenge and interaction. Can be concerned to develop skills, enable art spaces, simulate realities as working environments, sports and competitions, create agency on an historical representation,

simulate environments for leisure activities, can assist as to be platforms for the users to explore their own psyche and physiology, and for educators coordinate this flow. The more pervasive they are, the more they hold the qualities of the audience which is in contact with them. How designers concerns games and virtual worlds? From (Lindley, Nacke & Sennersten), a designer is conscious of the role of games as cognitive learning tools, and how they should reproduce emotional experiences, where the user is involved in accomplishing tasks which, ideally, should include the totality of his/her umwelt.

Illustration 14 - Virtuality continuum (Milgram et al.)

Issues of the designer are on conveying experiences to the user which not only would suit his desires, but would be ubiquitous to a perfect interaction in those worlds. Thinking of mixed realities (Illustration 14), as worlds that mixes multimodal elements and reality, the physiology of the user is involved, and the elements of the psyche are for the designer as to convey a persuading experience of illusion of the senses and dreamscapes; technology for virtual reality tries to cover the perception of reality with alternative realities which should create a tabula rasa from real, and enable a total new world in which to develop an interaction. With augmented worlds, designers try to achieve the enabling of a cohesive role of artificial elements and reality such as to recreate synergy between the parts. The taxonomy just discussed, has been extended to a matrix, such as to include the new scenario of mediated mixed realities; which is to say, designers, according to artistic intentions or user expectations, would make worlds where reality or virtual would be inconsistent with the original ones, such as to provoke psychological effects and dreamscapes. The matrix is showed on (Illustration 15).
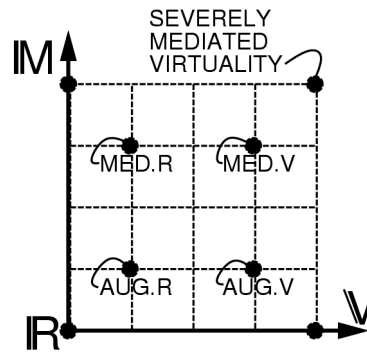
Illustration 15: The matrix of mediated virtual and real

(Woolgar) has outlined what new media and technology constitutes to human's life nowadays:

- Technology has a role for people in their non-technological life

- New media and technology is a social aspect which constantly needs control

- Media and technology is a supplement for activities of reality

- New media and technology is instrumental to enforce contextuality

Knowing how the spaces of the magic circle and reality blurs, how that influences the design process of toys, games and digital tools?

(Gielen), as from his experience as a teacher of toy design courses, identifies three concepts which the toy designer should consider, which are *aimlessness*, *empathy* and *play value*.

Aimlessness

Discerns on the unstructured nature of play. There, were in terms of designing a toy product there is structure (consisting of accomplishing goals of aesthetic preferences, making products fun and cover the user's sense of style), designing a toy inclusively around the play process is not only a problem solving procedure. (Gielen) explains that child play with toys is a process which is entailed from a wider surround of participants than it is for designing around a unique solution on a scenario with a box of a human and an object. It is well known that the life of a child includes interaction with other people, as well as solitary time or without full attention from trustable people. Parents and teachers demands from the toy are, that the toy should satisfy requirements of having learning goals, be safe, must be inclusive (every child must be capable of playing with that toy), must fulfil the imaginative space of the child by allowing the possibility of experimenting with, the toy has to develop problem solving

skills as well, must facilitate socialization, has to cope proficiently with the time the child is not attentioned. When toys are concerned for shared play, friends and schoolmates pretends fun through playing with that toy, meaning that they pretend a usable and simple toy. By considering these basic requirements, the designer understands that the focus of the play activity for the child consists on the process, where outcomes cover a secondary role.

Empathy

As from (Gielen), together with realizing that context of play is a variable that influences design choices for a child's toy, the designer aims for reaching a complete understanding of the bias of the child, how that is related to child development stages, the influence of physical growth in the play process, youth marketing research, learning styles, role models, etc (Illustration 16).
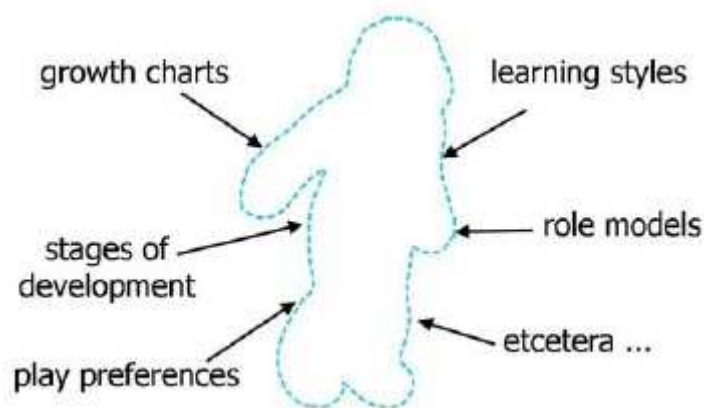
Illustration 16 - Child's play empathy model - parameters for the designer (Gielen)

The design student should conduce his empathic analysis on children's toy play based on interviews and observations, which should give an understanding of how the child makes abstractions, how deep goes the child subconscious and explore the tacit knowledge, examine the skills on context-mapping. Knowing how, by age, the child develops psycho-physical skills, shows to be important for the designer, in order to target properly the design of the toy product. (Piaget) proposed a model of child stage development based on perception, where children's thinking evolves gradually with age. Scientists have found that the age ranges of his proposal are not always matching reality, indeed their progress order has showed to be right. (Piaget) model is presented here:

Skills name + Approximate age range	Description
Sensory-motor (birth to 2 years)	Here the child goes towards recognizing the difference between the self and objects, develops intentionality and agency, understands the concept of permanency for objects.
Pre-operational (2 – 7 years)	The learning of the language occurs by image, sounds, words associations The child develops the ego The child learns classification by a single feature (colour or shape)
Concrete-operational (7 - 11 years)	The child thinks logically (elaborates in the head) about objects and events, and classifies objects based on more features, even if will adopt a unique feature for ordering
Formal operational (11 years and up)	The child thinks logically about abstract propositions, tests hypothesis systematically Becomes concerned about hypothesis, ideas, future

Understanding play preferences of a use for a given toy, in order to optimize play experience for the child, is a primary aspect for toy design. An analysis on the topic has been conducted from (Markopoulous) (Bekker et al.). From that analysis, a child takes a specific role of partners for toy design because, from (Druin), they are "incredibly honest and at times harsh in their assessment of technology". The way children affects usability assessment for toy interfaces design is reported from (Markopoulous) (Bekker et al.) answering previous works accomplished from (Hanna et al.):

- *Capacity and inclination to verbalize:* in order to evaluate consistency for data acquiring out of toy play interaction, the child has to formalize the thinking aloud process and report problems, which expresses capacity of extroversion and verbalize, which strongly depends on how the interaction with adults occurs

- *Capacity to concentrate:* the research of (Hanna et al) has showed that in average the time spent enjoying the accomplishment of a task or activity from children of the age 9-12 is 30 minutes, however considerable exceptions have been reported from the work of (Markopoulous) (Bekker et al.)

- *Children's motivation:* children's reasons for accomplishing tasks come from the urge of pleasing the adults; the role of the facilitator during a usability assessment should evaluate the best method to let the child pursue that goal (Hanna et al.)

- *Ability to adjust to strange environments and surroundings:* recreate cosiness and a familiar environment is a goal for evaluating smoothly the usability of an object with which the child is interacting

- *Trustworthiness of self-report:* the role of the facilitator, during the test phase, concerns a proper understanding of the difficulties met from the child, in order to assess properly the bias out of testing child play. It is known, and as it is enforced from (Druin), that a child acts honestly. Difficulties on acquiring reliable data out of testing are in part depending from the age of the individual, however children can misunderstand their role in the testing of a product, and can be conditioned to external factors as the approval of adults or peers

- *Ability for abstract and logical thinking:* the ability to concentrate on concepts which abstractly represents meaningful use for objects can be assessed through Likert scales and concurrent verbalization, however the assistant is to capture biases occurring to the retrieved data

- *Monitor progress towards a goal:* it is important recognizing the difficulties of the child on achieving results for given tasks, facilitating the reachment of the goal, and reporting how the difficulties occurs

- *Gender difference*s: children play evaluation, in the age 9-11, differs by gender, considering that female players at that age are more verbose, criticize more and differently about the requirements of the toy

- *Knowledge of language and concepts:* the evaluator has to consider a proper language and rhetoric for presenting the tasks, the big picture of the test, details on concepts to be evaluated, according to the age of the children

- *Knowledge and skills:* assessing the previous acquaintance with technological devices is equivalently important to know as to make appropriate tests, which should not uniquely depend from the age

Investigating the appropriateness for the preferred styles of learning for children, reveals to be important in order to assess empathy for toy design investigation. The complexity of finding a universal discrete number of learning styles portrays the necessity for creating testing spaces which should allow complete freedom for the children, as well as allow capture of unbiased data for the test.

Play value

Toys play in children is worthwhile, and (Gielen) has investigated and represented that as design requirements in five elements:

- *behaviour types*: the designer knows in advance that children can be uninterested to a certain toy, which alternatively must be desirable to be played and enjoyable. According to that play behaviours for the toy must be represented such that should fulfil different types of player behaviours, as represented in the diagram below:
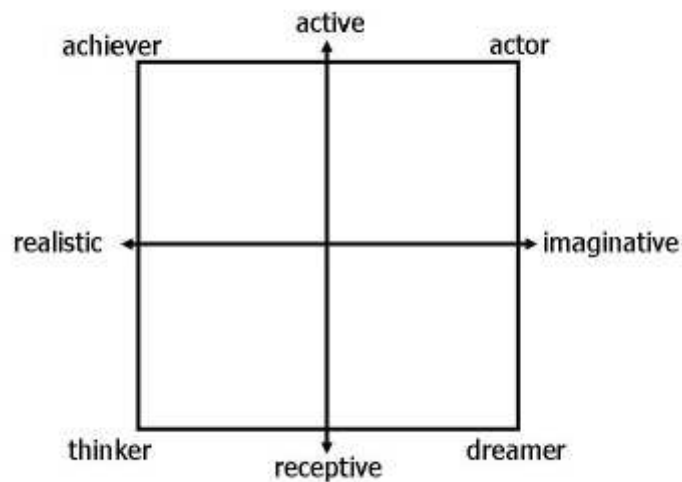
Illustration 17 - Play behaviours (Gielen)

- *types of play:* the designer has the role of understanding the balance which is possible to assess between diversity of playability for the toy to design and the different types of play to which the toy can be designed for. The types of play are listed from (Vermeer, Vedder) as: playful movements, sensopathic play, playful handling of objects, construction play, fantasy and role play, success and team play

- *play phases*: the designer should create continuity among the different play phases, which have to do with creating a proper confidence with a new toy, prepare for the intended design, create diversity of play and complete immersion
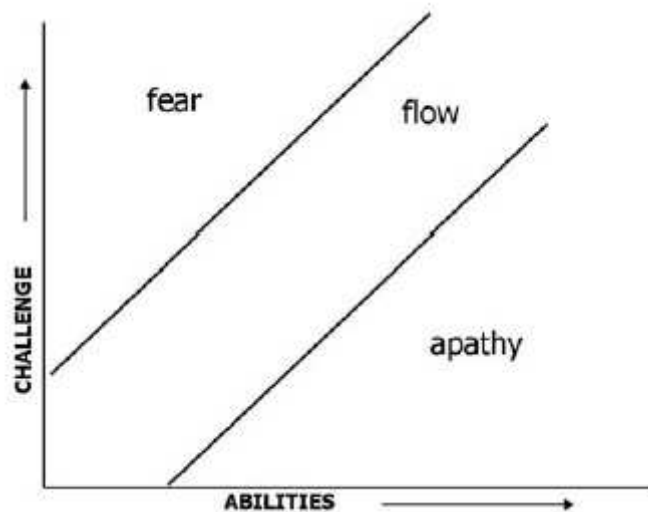
- *levels of complexity:* the toy is to be concerned according to different levels of playability, which should agree to the attitudes of the child, and should always create flow (Csikszentmihalyi):

- *context:* the toy is to be concerned on a multitude of environments and social-contexts. Knowing how that can be done according to how the child will play with that toy, is the desire for a multi-contextual toy design

Games

Toy play does not pretend from the player any kind of engagement, there were the presence of rules and goals represents games. Games are then the results of knowledge of robust design patterns and other elements in which players find themselves entertained with the vision of achieving goals while following certain rules, which as a serious attempt to represent a real phenomenon, are simulations. Rules represents the dictated way of playing with and within the world which is of a given toy, goals can be seen as rules which states what achievements are. Puzzles are a subset of games with one specific goal (which is rebuilding the original picture); multiplayer games are a metaphor of social collaborative environments inside a virtual world. Games, are then defined from a reality (which is the magic circle already defined), where rules represents the constraint to which the players operates. From (Adams), rules represent the agreed instructions and definitions to which players obey by joining a game. Knowing rules allow the players to recognize the context into which they are operating; allow them to anticipate possible outcomes for their actions, and to manage strategies and tactics in order to proceed to the best results. Game rules are denoted from semiotics, gameplay, sequence of play, goals, termination

conditions, and metarules. (Adams) suggests that rules have not to be ambiguous, even if their arrangement is possible in different manners. Semiotics investigates on meta elements of a game, sequence of play represents how the activities of a game progresses along the play, goals are rules for out-giving results of a game, termination conditions represents conditions which terminates the game, metarules are rules which can change existing rules, gameplay is the part of challenge and actions that the game offers to the players. Gameplay needs special attention for the analysis, as it is the feature which represents interactivity for the game medium. The challenge element consists on how the mental and physical abilities are conveyed on the magic circle, which the designer should define tuned according to different degrees of acquaintance which has the player with the game, knowing that they represents elements of confrontation on a multiplayer game. Actions depends on rules and to the skills of the players, transmedia games are affected to less branching of actions than from the original one, which is typical problem for designers of computer version of extreme sports games. Gameplay is assured from fairness, which is consistent when the initial conditions for the players are always equal. It regards the presence of more players. Fair game is symmetric and asymmetric, which is same rules and same victory conditions applies for the players on symmetric play, on asymmetric games players can differ for strategy sets, initial resources and their identifying characteristics.

Having argued before about toy design, it is important now to explain further regarding game design. (Adams) describes game design as a process consisting of three parts, imagining the game, defining the way it works, defining the elements which constitute the game, create a solid communication among the development team. Following *well known practices*, and *design rules*, can result on overcoming on difficult obstacles in which a designer can step on. For (Adams), game design is not only art, but it is a craft which has to hold functional qualities: games have to be *elegant* and *easy to play*, and not only something to admire. Games have to be *player centric*, meaning that the game has to be fun and the designer has to empathize with the player, which means that the game must be built to meet player desires and preferences for entertainment. In this view, games differ from other media (like books or films) where mass-oriented goals can decrease value to the final product. Following that need, (Adams) lists typical misconceptions in which a game designer can typically fall on, which are: *assuming that the typical player is the same as the designer,* as to design games which preclude access to a wide audience, *designing the game thinking of the player as being the opponent,* which will make the game annoyingly difficult there were it should attract more the player.

Game design main concern is on gameplay. This is explained by knowing that on gameplay it is searched how to reach optimal user interactions, coherent narratives, fun, and worlds which should appear natural. As a checklist from (Adams), the designer knows that is important, in order to evoke fun on the player, to make games which does not have *elementary errors* (bad programming, bad music and sound, bad

art, bad user interfaces and bad game design) as it will compromise user's fun, the game must be properly *tuned* and *polished* (the user has to find the game just perfect), the game can be concerned on different *levels*, it must be thought as to *innovate*. In order to keep fun, the designer can automate parts of the simulation that are not fun; the game has to be aesthetically pleasant. Challenges are of two types: *speed,* as in terms of timers for the goals, and *cognitive* ones, as to represent sets of beliefs on the game. (Adams) organizes challenges on computer games as *implicit* and *explicit*, depending on how the user is informed about them. The designer is concerned about balancing between them, meaning that an excess of implicit instructions would make a game just as reading a book, whether some elements of implicit instruction would make the game more engaging. (Adams) lists three factors which represents challenge on computer games: they are intrinsic *skill required, stress, and absolute difficulty*. Intrinsic *skill required* are essentially the level of skill which is necessary to surmount a challenge given an illimitable amount of time, examples are solving puzzles, trivia games, an archer aiming at a target. Here the amount of time would not change the nature of the activity, which is reaching a specific closed goal. Including time as a game variable creates the *stress* factor to the challenge. Tetris is a typical example of this kind of games, where the user is confronted from accomplishing the task while the time running increases the evolution of the game. On the other hand, games as golf have not that quality, being the time a secondary variable. The composite of the two challenge factors afore mentioned is represented from absolute difficulty. Cardiac surgery is an example of this class, being a challenge which is extreme of intrinsic skill and stress.

Actions are the verbs of the game, meaning they have to represent what the player intentions are in the play space. They are not organized in a hierarchy as it is for challenges (in order to win the game, atomic requirements are to be satisfied, sublevel/s must be completed), as they are organized as the output of control devices given to the player. Challenges and actions are not usually on a one-to-one map, essentially because to provide many actions is required a complex interface which cannot be highly usable, second a large number of actions requires a lot of game animations which is a costly process. Actions are defined according to the role of the player in the game, some actions will map challenges already defined in advance, and others will have distinct functions. The first actions to be defined have to be according to the atomic challenges, meaning the design document has to state how the player can overcome that challenge, as sets of actions. The designer has to concern actions in regard to higher level hierarchy challenges, knowing if new actions must be introduced. Some actions are included for functions which does not serve gameplay. Those are:

- *Unstructured play:* as for instance acrobatic moves in sport games, which does not address any challenge of the gameplay

- *Actions for creation and self-expression*: modding of games, where that concerns create and customize objects

- *Actions for socialization*: this is a phenomena observable in online games, where players talk to each other in order to form groups, compare scores, to take part in other community activities

- *Actions to participate in the story*: altering the plot of the game narrative, interactive dialogues, interacting with NPCs, have nothing to do with gameplay challenges

- *Actions to control the game software*: actions which regards the control of the camera, entering the HUD and changing properties of the game, are not related to gameplay challenges

A final concern for gameplay is to allow storing a given context later for undertaking that again. Knowing how in the human world play is expressed, it is of an interest to know how that is different on the animal world.

Play on animals

In ethology, play represents the way animals learn, and a taxonomy of play has been defined from (Bekoff & Byers) (Fagen) as *locomotor* play, *object* play and *social* play. Another taxonomy has been proposed from (Power), which represents play activities as *locomotor*, *solitary object*, *social/object pretend*, *and play fighting* and *parent child*). They represent the overall categories in which animal's play has been debated in regard to children play. (Burghardt) describes them as follows:

- *locomotor* play: it represents the accomplishing of body motion which is unwilling, while for humans' a control on the body movements is exerted

- *object play:* it is represented from defensive or aggressive actions with objects, actions which involves pushing, grabbing, handling with the mouth, paw, puff, lift and carry objects without the direct purpose of retrieving food. Elements of interest for captivated animals and interaction with objects regards the way that can produce learning on them. Some animals, as chimpanzees (pan troglodytes), have the natural capacity of stacking objects one over the other or filling one with another, as children does with toys. Further experiments on chimpanzees involved on a manipulation of sticks and other objects, with disengaged serial order of pins, hooks, eyes and hasps, have made them better at retrieving food than their colleagues which were not involved previously in those tasks. (Power) distinguishes solitary object play among three categories, which are *exploration*, *play*, and *tool use*. Problems which are found for object play on animals are:

- determining that the responses are not performed for "real" from animals that cannot distinguish the play object from the biologically meaningful stimulus (not distinguishing a robot-puppet from the real animal)

- when young animals are observed responding to objects for the first time, the attempts may be tentative, incomplete, "directed" to "non-functional" stimuli, or otherwise just presage to the onset of the normal movements through maturation

- responses to objects by captive animals in deprived or sterile (boring) environments must be distinguished from abnormal stereotyped interactions

- *social* play: it is mostly represented from play occurring among conspecific or others taking the role of the conspecific, and in animals is represented from body postures confrontations which preludes chasing or fighting (wrestling, pawing, nipping) (Illustration 19).

Illustration 19 - Play bow in dogs (Bekoff)

However body postures and meta-communication are not the only forms of interaction as chemical signals, sounds, and face interactions have a role on social play. Interactions take place on role reversal, turn taking, self-handicapping. Fighting play has received much attention for animal social play, even more than among humans. Fighting for animals can also represent hidden courtship. Other behaviours for animals are teasing and harassing, which often terminates on serious fighting among the

animals involved. Bowing is not the only way in the animal world with which animals communicates regarding fight: lemurs (lemur catta) begin or inhibit fight by waving their tail. However tail waving among lemurs signifies serious fight.

Animals does not always care to do mutual play, so to say activities which they accept from both sides, and as in the case of teasing and harassing, those behaviours often ends with fight. From the other manifestations of social play among animals, which does not include body postures, chemical play signals are used to define territories and communicate sexual messages among canids; for rodents, and blattaria for defensive actions. Vocal messages are in use among monkeys to keep the play going on. Exceptions exist for some species, as black bear cubs, where no vocal messages are used for social play neither for play fighting. Face expressions represents another subject which relates animals on social play. Among primates, as from (Pellis & Pellis)(Burghardt), it is possible to observe during social interaction changes which regards eyes, eyebrows, lips, teeth, ears, mouth, and gaze crossing movements; the mouth shifts form among oval and closed; eyes among open, closed and normal conditions; the eyebrows raise or lower; ears flatten and relax; lips are relaxed, pulled back or curled; teeth become exposed, partially exposed, or invisible; gazes become relaxed, contact-directed or eye contact-avoiding.

Alike on humans, social play on animals has a role for social morality and fairness (Bekoff, 2001), which is showed from rites of animals gaze's having predictable movements, that should keep play mood and avoid aggression, inside a safe environment. Interactions among non conspecific can present curious cases. To mention is the case of deceptive response from a pet in interaction with the caregiver (Mitchell & Thompson, 1991), which occurs with the following sequence between a man and a dog: the man throws away a ball, the dog retrieves the ball, drops it in front of the person, once the person will end by stooping the ball, the dog will grab the ball and run away, before the human is able to pick up the ball. As showed from this example, deception is then of an agent producing or withholding an act or a signal so that it is misinterpreted by another to the advantage of the agent. It always involves misinterpretation, it takes at least two animals to make misrepresentation lead to deception. The case is interesting as cognitive abilities are necessary in order to accomplish that. It is possible to find three categories of deceptive behaviours among animals:

- *hardwired/genetic*: which consists on mimicry (of tonalities, postures) which usually are used as the only available chance for defence

- *involving behaviouristic learning/learned*: when an animal transfers a behaviour from another context, where in the real context the response of the target animal has nothing to do with that context but it is simply a rewarding which would normally occur in the other context (example: a young monkey feeling threatened emits sounds which would provoke the mother to feed him, while

the context has had nothing to do with feeding, while it helped to calm down the monkey who got a reward)

- *intentional*: (the human one) the deceptive behaviour is planned, an example consists of two siblings sharing the same sleeping room, with the deceiver telling to the other the excuse of the start of the favourite tv-program in order to have the room all free

For (Burghardt), play for animals require a "relaxed field". Animals need to feel sated, warm and content. The factors which affect animal play are of *physiology (energy)*, *ontogeny of the development*, *ecology*, *psychology* and *sociality,* according to the researches of (Spencer). The diagram is represented in (Illustration 20).
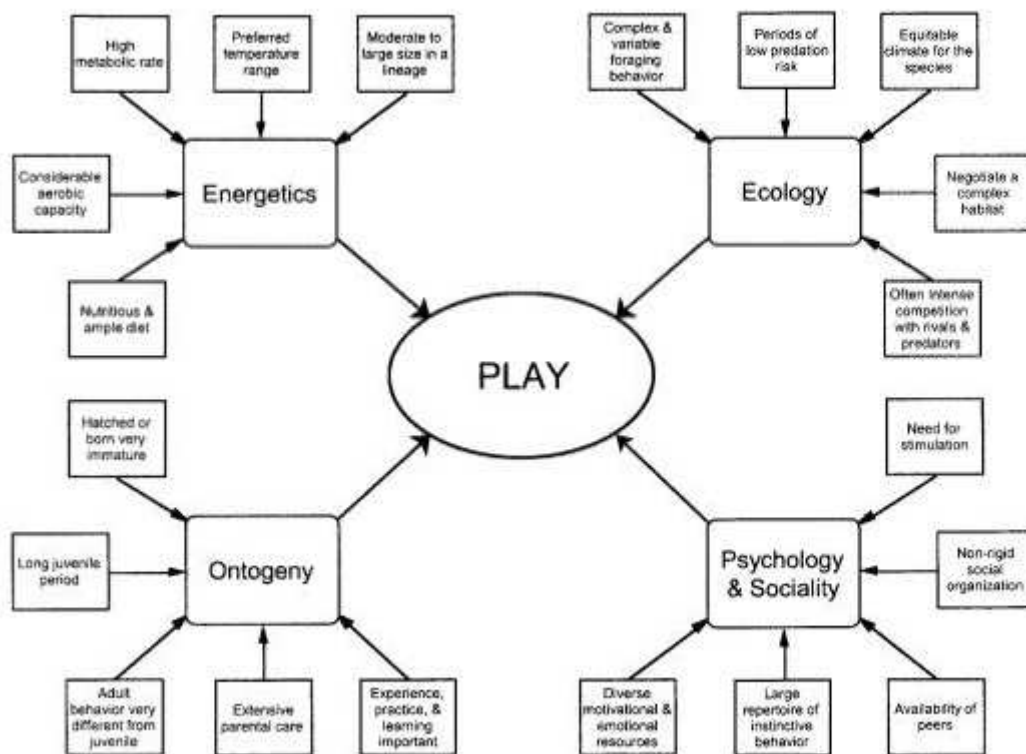
Illustration 20 - Play on animals (Burghardt)

Energy or metabolism represents the fuel of the motor element of the animal world, and then the physiological analysis of the animal play world will be based on that. Energy is referred in 4 behavioural terms (Burghardt):

Meaning of energy	Manifestation of surplus
Vigorous (energetic) behaviour	Elevated activity level (hyperactivity, fidgety, persistent, rambunctious)
Metabolic potential (from food)	Excess available metabolic reserves (i.e., fat)
Derived from specific behaviour system(s), (e.g., motivation, drive, or instinct)	Extreme accumulated specific motivation, drive state, or action-specific energy (e.g., predatory, sexual)
Level of general behavioural arousal or responsiveness	High level of alertness

The brain uses around 20 percent of the energy which is on the body, even when the total quantity of blood is less than 2 percent of the entire mass. (Burghardt) investigations have reported that animals which are less willing to play have low metabolic rates, low endothermy (versus high diffused activity on brains, which is characteristic of arboral and patchal animals). It is possible in general to represent a tabular vision of metabolism in relation to behavioural performances, this part of the conclusive investigations on the subject reported from (Burghardt) as in (Illustration 21):

Metabolic terms related to behavioral performance in animals
_____

1. *Basal metabolic rate* (BMR). Minimal metabolic rate when fasting under optimal environmental conditions. All metabolic rates may be measured indirectly (by oxygen consumption) or directly (by heat production).

2. *Standard metabolic rate* (SMR). Minimum metabolic rate at a given temperature in an ectotherm (no heat production).

3. *Resting metabolic rate* (RMR). The level of oxygen consumption or heat production when an animal is not engaged in any overt activity.

4. *Field metabolic rate* (FMR). Daily total energy costs of animals in the field engaged in all normal activities. Often measured by estimating CO_2 production using the doubly labeled "heavy" water method.

5. *Aerobic metabolism*. Release of metabolic energy by use of external (gaseous) oxygen, generally obtained through breathing, lungs, and associated systems.

6. *Aerobic scope*. The range of oxygen consumption rate between minimum and maximum aerobic oxygen utilization.

7. *Anaerobic metabolism*. Release of metabolic energy by the breakdown of stored glycogen to lactic acid. This occurs when insufficient molecular oxygen is available through ordinary respiration.

8. *Anaerobic scope*. Rate of lactic acid formation during the onset of vigorous activity (usually the first 30 seconds).

9. *Anaerobic capacity*. The amount of lactic acid formed during longer activity bouts, usually those preceding exhaustion.

10. *Maximum sustainable activity*. The amount of exertion (often measured in duration or rate of locomotion) an animal can carry out continuously without building up an oxygen deficit.

11. *Energy costs of activity*. Amount of energy (joules or calories) needed to perform a given behavior. Should be measured as a *rate* of energy output, as in metabolic rate (i.e., watts = joules/second) (P. Martin, 1984). The net cost of activity is the difference between the total energy expenditure rate during activity minus the RMR.

12. *Total metabolic scope*. The difference between BMR and maximum combined contributions of aerobic and anaerobic metabolism.

_____

Illustration 21 - Energy to behaviour performance on animals (Burghardt)

Obvious relations of energy expenditure are in regard to body size and fat percentage. It is also important where the movement occurs. Water animals consumes less energy, since swimming is energetically cheaper than terrestrial motion, therefore to know that sea animals, as seal and dolphins, are the most playful of the mammals, does not surprise. Ethologists argue that the accumulation of energy is as amount and intensity of behaviours. The relation among animal play and brain can appear dissonant, however on animals play has a relation to neural centers related to motion, which is explained from (Spencer). He justifies enactment of play as the lowering of a stimulus threshold explained from a deprivation (ex.: feeling hunger) or lack of opportunity. Related to age is the role of play on young animals, which are usually more motivated after being fed (Burghardt & Burghardt). Children behave in the same way, except that is preferred to play with their mother after being fed.

Ecology within animals play is dyadic of the animal world on animals which find themselves on changing circumstances (for example, providing food – the physiology,

as brain size, metabolism rate, and intelligence, determines how successful will be the animal on providing for the best diet), and evolutionary adaptations of the species, which is establishing how the habitat influences the play behaviours on animals. It has been found that in general, play of all types is reduced in both the wild and captivity in times of food shortage, climatic adversity, social upheaval, and chronic stress (Burghardt, 1984; Caro, 1988; Sommer & Mendoza-Granados, 1995).

The way play is connected to the *social*, has to do, as explained in (Illustration 14), to social organization, need for stimulus, need of peers, finding motivational and emotional resources, investigate on a large repertoire of instinctive behaviours. Age is a factor which in some species, as black bears, corresponds to inversion of behaviours. Young black bears use to be highly social, becoming adults they prefer highly solitary lives. (Burghardt) notes that the role of extra-organizations outside family is not important in regard to play behaviour on animals, where in the case of primates, the rigidity of the family organization represents an important element of influence on the willingness, duration and nature of play and play fighting. The way animal play is also related to their gender. With the exception of spotted hyenas, males are dominant in play among sexes. Fighting between males happens more often and roughly than on females, it happens always between individuals of the same gender, age and features. In the case of monkey squirrels, fight is directional (win/lose) for males, less directional for females. The case of juvenile form of hyena shows that the female is more playful than the male reciprocal. Gender differences exist also for object and locomotor play. (P. Bateson, 1981) outlines how in young kittens object play, which increases steeply from week 8 to 12, is prevalent on male play than in female one. It seems lacking of congruence, knowing that females are supposed to be predator more than males, having to feed their offspring. Hypothesis suggests that pre-natal hormones have a role on that and, as seen in the case of black bears, the juvenile and adult conditions willpower of play are disjointed. As in the human one, in the animal world there are expressed gender preferences for object play, showed from the experiments of (Alexander & Hines, 2002). Animals play behaviour occurs in response of a negative mood, where external searched stimuli, provokes a change of arousal level; play occurs easily among animals which are adapted to chaotic conditions of life-style, where it is necessary to conduct flexible behaviour repertoire styles.

What is then an ontogeny of animals play? (Burghardt) considers an experiential, genetic and developmental perspective of the animal being as a player. He considers as a start the analysis of parental care on animals. From the parent view, the longer the time the young takes to become adult, the more the time to draw out behavioural schemes from young enactments. Play has a primary role when it is a causal role of this developmental process, which is often occurring as correlation between juvenile motor actions (which are usually vigorous), and the age at which the permanent long-term changes occurs to the animal, as in the body and the brain. By domestication, the process of animals' parental care and play has got some changes. Domestic play

has come to speed behavioural and mental development, through selective breeding. Cases like the ones of dogs, which with domestication has become more playful and with smaller brain size, losing some of the behavioural skills of the wild counterpart, keeping features of juvenile wild canids as similar visual signalling behaviours. The decrease on brain size from wild canid to dogs has resulted in smaller neocortex and inhibition of the cognitive areas, instinctive and emotional, something opposite to the domestic evolution of foxes. In the context of domesticated canids, an important distinction exists among herding dogs and guard dogs in relation to play, the latter having social play behaviour towards the guarded animals, something that the herding dog has not. The herding dog approaches the herded animals with predator behaviour, something which is the same for wolves, while guard dogs keep the other animals as social playmates.

In conclusion, play among all species is possible then when psycho-physiological conditions, life history and ecology, and behaviour repertoires reach a threshold level.

The importance of knowing the role of play and learning with animals has further utilitarian meanings than dog guards and herd dogs. *Assistance dogs* (fall under the category of *service animals* – guides for hearing and visually impaired people) are brilliant examples on how animals can be precious helpers for sensorially impaired humans, that fact shows how play and teaching for animals are part of human ecology as an indispensable service. The mentioned animal play world has the inversion of the roles which usually occurs. Meaning that transferred attitudes are given to animals such as to assist for impairment. On the other hand, the usual human role consists on teaching, as it is what the expert dog-trainer does, and in some level the amateur one. The action consists on assisting and helping animals towards becoming independent animal adults. Teaching on animals has been studied as the investigation of the similarities between human teaching and behaviours occurring among conspecific non-human animals which matures an offspring, as well as the lack of providing that among them (Maestripieri) (Caro & Hauser). In synthesis, it occurs as giving independence to the young, where parental guidance is crucial as to provide for forage, which occurs among predators and insectivorous mammals. In some species the attention for the teaching aspect happens exclusively as one-time trial, or it is totally excluded from the agenda of their parents, as it happens among wild chimpanzees. By threatening adults instructs their puppies to avoid predators and sources of danger. More complex forms of teaching among non-human animals conspecific have not been found so far. These observed behaviours are somehow controversial to the theories of filial imprinting from (Lorenz) and (Hess), in which offspring learns immediately the characteristics of their parent or a moving object, only if that parent or that object were available during the first day of their life, and their child behaviour is not driven from primary necessities. Another issue (Garcia, Hankins, Rusniak, 1976) consists on the fact that (Pavlov)'s learning approach for animals, association (instrumental) and (operant) conditioning, can occur even if conditional and unconditional stimulus are presented with greater delays than his

original model (more than 20 minutes), and the same sensory associations have different values for different animals, depending on their natural predispositions.

Teaching for humans, however, has relatively a higher number of instances than what is resumed in the animal world. The next section will then discern further on teaching among humans.

Learning

From our experience as school students, sport and artistic practices, as spectators in circus and animals exhibitions, as viewers of animal documentaries, when we teach tasks to a pet, some form of transmitted learning is taking place, as it is the major responsibility of who is doing the teaching job. However, before to dissert about the teaching phenomena among human and non-human animals, we will start by explaining extensively the concept of learning.
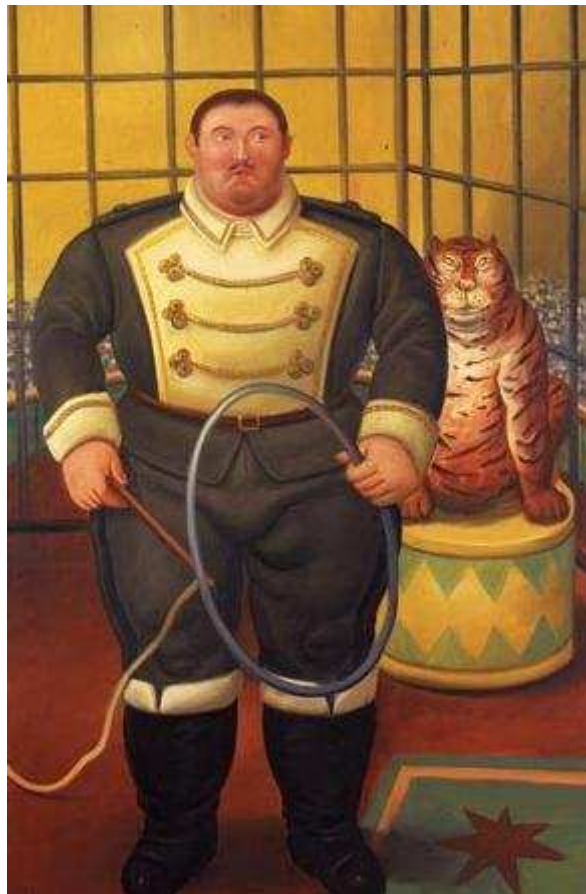
Illustration 22 - "Tamer", oil on canvas (Botero Angulo)

What is learning? It has been conceived under several schools of thought, as a change which occurs to a human, animal or machine, through the transmission of knowledge. Around the subject student, there are motivations, problems which have to be afforded, contexts of appliance of the learning, methods which provokes learning, information which is transmitted to the individual in order to grow up new knowledge. A role is taken from an external actor which acts as facilitator. Different theories and taxonomies have been defined around learning, a cognitive map is showed on (Illustration 23) from (Atherton). This is how learning phenomena is widely meant on higher education:
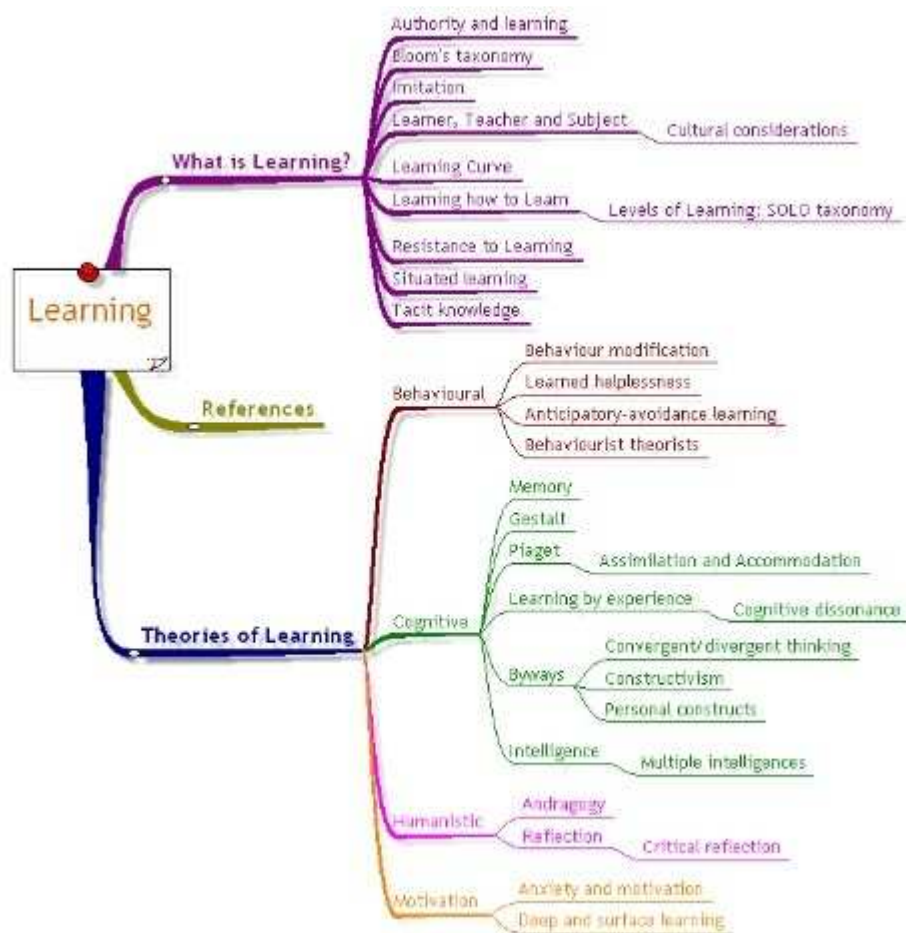
Illustration 23 - Angles of learning (Atherton)

There are many ways in which learning can occur, but a main distinction is from intentional and unintentional of the learner. We will then describe what are the concepts and creative knowledge, the problems, the context, method and how that relates to the student.

- *Knowledge and creativity*: it happens by acquiring new skills, new behaviours, values, recognizing preferences and by understanding concepts

- *Context of learning*: it is specified as the semantic concern of the learning, which is to explain where that specific development is meaningful. Personal development which is also educational development shows an example of learning which is multi-contextual

- *Method*: how to reach a certain result? What practices, in relation to the parameters of the learner, provokes best results? How that can be facilitated? This is with what are confronted both the learner and the learner assistant

- *Problems and motivations*: on a primary instance, to reach an intended outcome is what drives actions for an individual or a group, which is weighted from obtaining the most value out of them, and keeping that as an experience for the future. Discovering how to structure a process which drives towards the goal, instinctively or by well assessed practices, how the process can be further improved by experience, what different utilitarian objectives can be achieved, how that can be simplified, and how the process matters out of the structure, meaning how the individual self beliefs, behaviour sets, and emotions influences the learning experience, which explains the importance of learning by problem analysis.

As humans, knowing how to optimize the learning process is the reason for which assisting and teaching becomes necessary. As said, it is a desire on the learning to involve the learner cognitive capabilities, the affective and the behavioural ones on problems, even if those skills are not all necessary, for the intended activities. The assistant, by doing that, explores the involvement of the learner, the quality and quantity of the elements taught, discovers what is missed from the teaching through interaction with the learner. Humans have cognition of different styles and strategies for learning. Evidence of the same approaches in the non-human animal world is not demonstrated. Experimental teaching and learning, based on preferences and distinct abilities of learners, and the demand of promoting deep learning and constructive learning, is now ever becoming spread academia praxis. Styles of learning have been introduced from (Kolb), which described an experiential cycle of learning, where a learner is using perceptual senses, reflects, abstracts, test some hypothesis, and repeats the same loop. A relation to the brain areas activated is shown on (Illustration 24):
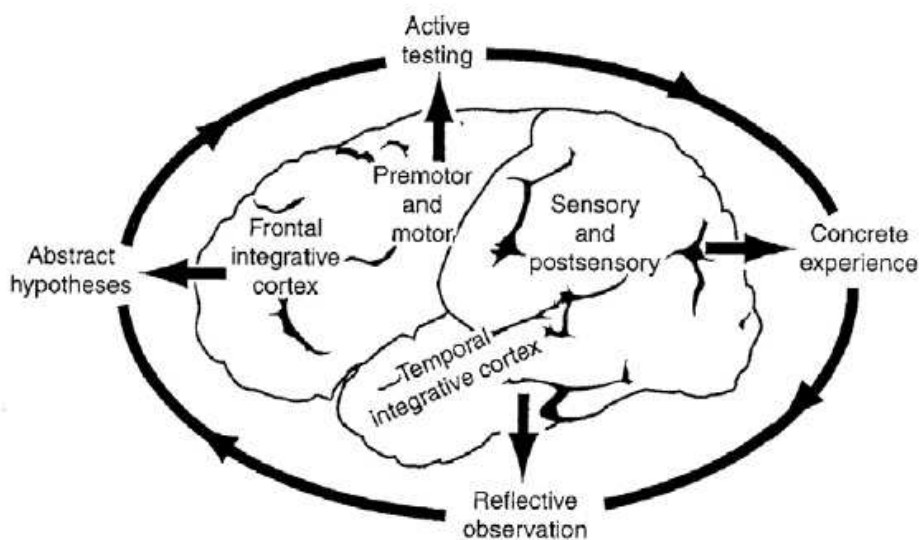
Illustration 24 - Learning styles in relation to brain areas (Kolb)

The model of (Kolb) is learner-centred, explains that the concrete experience produced from sensorial acquisition is followed from reflections, which is the creation of meanings inside the temporal-integrative cortex. With reflective observation creative minds acts their capacity for multiple interpretation of the acquisition by the senses. By abstracting, which happens by understanding underlying reasons with concepts and their relations, it is activated the frontal integrative cortex. This happens by composing the reflections which were elaborated in the temporal-integrative cortex, by updating the information which is part of the databank of the brain and forming new hypothesis. By active experimentation, the premotor and motor area are activated, where the knowledge present in the brain is tested, meaning it is valued and it is confronted with practice, the brain recognizes the presence of cognitive dissonances, by confronting the held knowledge with external stimuli. When experiencing cognitive dissonance, knowledge and external stimuli appears semantically unrelated, something which causes discomfort. This discomfort provokes resistance to learn new concepts, which is a contradiction to what is already known, makes harder to the learner to accept a new formulation of a previously acquainted concept, which depends according to the steepness of the learning curve for the new information, and the flexibility on accepting frequent information changes.

Categories of understanding needs to be defined, in order to clarify what are the general lines which defines learning objectives for a student. (Bloom, 1956) has introduced three domains which encompass the basic goals for a student which is under education, based on behaviour skills. They are grouped under the domain of affective, cognitive and psycho-motor abilities, and are better explained as pyramidal

hierarchies. The affective domain is for giving best guidelines for the enrichment on behavioural attitudes. It is organized in five levels, from bottom to the top:

- *Receiving*: it is the basic level, meaning that there is no learning goal in absence of this level. The student receiving affective learning is only assimilating the presented contents.

- *Responding*: there is a reaction to the stimuli presented, and they are not taken passively

- *Valuing*: the student gives values to objects

- *Organizing*: the student arranges values, information and ideas and tests them in the practice established from his own schema

- *Characterizing:* the student shapes attitudes, by doing further analysis of the contents that has already organized

(Bloom) has originally organized in six levels the learning goals for the cognitive domain, as knowledge, comprehension, application, analysis, synthesis and evaluation. Successively (Anderson & Krathwohl, 2001), have redefined those categories by merging synthesis and evaluation and adding an extra level which regards creativity:

- *Knowledge*: the ability of remembering idioms, instructions, patterns of practice and theories

- *Comprehension*: the ability to elaborate memory material by showing criticism, structure, context-mapping and capacity of rework it

- *Application*: the capacity to integrate new knowledge into the already owned one as well as the ability to innovate on the existing one for problem-solving

- *Analysis*: it is explained as the capacity of dividing the existing knowledge into causal units, which have to be general. The student is capable of finding relations and organization principles, in order to dispose basic elements

- *Evaluation and synthesis*: it is the capacity of rearranging organizational and relationship structures for different communicative strategies, based on a quality assessment of the existing patterns

- **Creation:** is concerned with the capacity of using the tools of flexibility, innovation, brainstorming, tropes, to stimulate curiosity and restructure of knowledge

With the psycho-motor domain the student becomes capable of understanding how to do object play, handle tools, and replicate observed movements. It has not been further explained from (Bloom), (Dave, 1975) has argued it as the gradual

development of skills on mirroring behaviours, on refine the capacity to handle objects towards feeling their handling as an everyday behaviour.

As the same as for understanding, a taxonomy of learning is defined. It is better explained as the capacity of learning how to learn, which is the *capacity of going beyond shallow learning* (Ramsden), and *hierarchical learning* as from (Bateson). Deep learning is a contextual definition, which is according to motivation, and can mask shallow learning within a strategy of a well organized goal oriented process. Without a visible referent and clever reference to previous knowledge, if it is a product of short term memory and concepts are without experiential basis and the structure does not delimit principles and examples and does not make the content coherent, if it is something which is not completely a though of the student, then it is surface learning. Deep learning at last, involves making meaning and reinterpreting knowledge (Säljö, 1979). (Bateson) structures levels of learning in a hierarchy; it is familiar the second level (deuteron-learning), as it has been introduced in the context of human and non-human animal mind comparison; now we will see how that is related to learning, by describing (Bateson) hierarchy from bottom to the top:

- level *zero* of learning: trial-and-error learning

- level *one*: experience tells what can be done and what must be avoided

- level two (*deutero-learning*): it is a faculty which is exclusive of humans; it happens by the learner which formulates strategies to maximize experiential learning as well as understanding how and when to take risks. Several academic practices, such as problem-based learning, tries to justify how the qualitative enhancement occurs among the level below and this one

- level *three*: it is giving to the fate the capacity of creating learning by maximizing risks. It can easily be confused with pure instinct

At last, (Biggs & Collis, 1982) have defined a way to which it is defined learning and understanding guiding to goals, by a structuring approach, which is a refinement of the previous works of (Bateson), (Bloom) and (Säljö) just presented. Their new taxonomy is called SOLO (Structure of Observed Learning Outcomes), as follows:

- *per-structural level*: students collect information without referential meanings and no pattern

- *uni-structural*: the elements now are representable as vertexes and edges; some of the elements can at most appear connected to another element, the big picture is not clever

- *multistructural*: now substructures are in the mind of the learner; elements can be grouped as graphs or trees, indeed each one of them is isolated loosing then the meta-significances, and the big picture is not yet represented

- *relational*: the big picture as well as the details are finally understood

- *extended abstract*: the student is capable to contextualize the focus of the subject to adjacent elements

Learning and context

Learning in relation to context is a paradigm which has been theorized from (Lave & Wenger). Situated learning is a context based learning, which occurs as specific of a culture within a community place of adult learners. Students are involved with learning activities on their everyday life, the knowledge that they produce represents a given context, and learning depends on social interaction and collaboration among students. Pedagogical focus consists on developing analytical skills, through reasoning about problems and project development.

Learning and methods

The cognitive map of learning of (Atherton) shows a relation among context of learning and authority. Through experiments it has been showed that this method creates subjugated learning, as students excessively charged of teacher slavery easily behaves just according to the enjoyment of the teacher, which is counteractive to learning goals. Such environment demotivates learning and reduces the chances for deep learning. By considering that, how a method of learning assistance should be in order for having balance for teaching and assistance purposes? Theory of constructivism on learning suggests that facilitators are meant to provide to that gap. The role of facilitators is of cognitive developers, each student is a unique and distinct learner, which must be continuously enquired for learning desires, assisted when there are difficulties on the understanding of some contents. The facilitator has to understand the creative directions of the student, must be capable of guiding the student towards intended conclusions. Teachers and facilitators initial role is to provide tools for structures and content creation, revisiting them following a cognitive development according to their learners, understand where the gap among the stage of the actual development and the potential are, provides instruction where that is necessary. They are aware that in order to provide an optimal learning environment, learners must be capable of mastering learning, problem-solving, and discuss the problems they are confronting.

Motivations and learning

As introduced before, motivation has a role as an indispensable requirement for deep learning on students. How science explains that? In agreement with a learner-

centered vision, (Clark) compares motivation, within learning, to attitudes, explaining then, that as the learning is concerned mostly as a resulting observable behaviour, the emotional and cognitive are the corollary of the human and the outward which is of appetite for learning. What exactly that means? (Clark) has identified some key qualities which characterize motivation in regard to internal and external sources. Here his schema is further refined, dividing motivation qualities among intrinsic (internal feelings) and extrinsic sources, as in the following table:

Intrinsic	Extrinsic
autonomy	collaboration
self-confidence	social judgement
abilities	challenges
goals	
feedback	

Intrinsic causes of motivation are reflection, realisation, interest, curiosity, physical preservation, or a drive for its own sake. Extrinsic causes groups social judgment, participation, goals and feedback. All the causes, indeed, can be grouped under a hierarchy of goals, according to the individual needs. With this vision, motivation find its parameters as achieving results which are on developing the self, its autonomy, confidence and some basic skills. Goals represents then the structure of how the appetite is conveyed towards learning, meaning it will be directed to initial goals, sub goals, and constructive goals. However on an adult the all qualities can be separated and considered as different elements. The meaning of all the other qualities of motivation is intuitive, however for some details must be provided. Autonomy finds on intentionality for agency the way to reach learning, versus participation which has focus on someone else, or common, appetite for learning. Self-confidence relates to reinforcement, meaning that is an intrinsic quality for which the learner, consciously or unconsciously, progresses for. The corresponding extrinsic motivation as social approval/disapproval.

(Huitt) justifies motivation to learning as how intentionality and self-control develops the formation of expectations in order to set some goals. (Brand, 1984) considers this component (conation, defined in the analysis section) as a conflicting force which exists among the self autonomy and affective components of drive towards the extra subjective. (Maddi) describes this dichotomy as the *subjective* (the individual) versus the *objective* (external forces). The former consists of searching autonomy in agency; the second is defined from imperativity and social-contexts.

A balance has to exist among the two forces, which is expressed based on three sub dimensions (Miller, 1991), as in the table:

Subjective	Objective
Love seeker	Power seeker
Empathizer	Emotionally detached
Guided from intraception (searches orientation through personal perception)	Propagandistic (guided from extraception)

Constructivism learning theory identifies as learning problems for the learner confidence and constant success on challenges accomplishing in order to progress on cognitive complexity skills.

It is now clever how motivation is qualified in the context of learning. Now it is possible to investigate how problems and learning relates.

Problems and learning

Among schools, academia and management environments, it is practice the use of creative methodologies in support of natural approaches for creating new tools, handling organizations, investigate new developments for existing instruments and educative tools. The requirement for natural approaches for learning which supports creativity, is better explained from problem-based learning (PBL). PBL primary goals consist on contents knowledge, enhancements on communication, problem-solving and self-directed learning skills. Teaching in PBL is a process of assisting students developing themselves towards their desires and their surroundings, possibly through collaborative work, stimulate the use of episodic and semantic memory, develop the student entrepreneurial capacities, and the knowledge of attitudes for learning, learn by doing and by teaching; students simulates problems and environmental conditions of professional contexts. They build narratives in order to promote intelligible uses of the tools they create, formalizing their working process, justifying the results of their analysis. Decision making is then dependent on the possible procedures for the resolution of the problem, the starting and occurring parameters, constraints which are of sociological nature, potentials which are of technology. How PBL relates to the role of technology in academia? The development of computer games is what mostly represents a tool of building this learning approach inside students' minds. The powerful capacity of games along creating focusing factors, strengthening team work, explaining the practice of educative tools is from time to time reinforcing this statement. Mixing entertainments with education has, among its roles, the one of involving the actors participating in the development and play process, and create visions among improving existing tools. Affectiveness is among the major topic of

interest on psychology, neuroscience, and education, and an understanding of how that crosses within a mediated environment is of interest for computer games, as it is highlighted from emergent research interests both in academia and in the industry world.

Computer games, learning, and animals care giving

In order to provide a full understanding of the topic, it will first be introduced what good games are, the role of games for learning, concluding with the analysis of tangible examples of nurturing in the context of computer games, such as to prepare for the final problem.

What are good computer games

There is a huge discussion about the role of computer games in relation to the effects on the player; hereby will be defined some of the aspects which give meaning for a good computer game, in terms of the features it offers. (Gee) lists them as:

- *Interactivity*: the computer game has to enhance the agency of the player, meaning that the player is to feel not constrained from the author design, instead has to feel as natural the enacting in the game world. The pleasure dimension, to mention (Ryan), occurs then as the porting of the textual world of the game, as a balance of (Plato)'s concept of *ludus* (rule-governed behaviour requiring "effort, adroitness, and ingenuity on the part of the players") and *paidia*, an activity characterized by "fun, turbulence, free improvisation, and fantasy") (Motte)
- *Customization*: the game has to offer the possibility to adapt to the learning and play styles of the player (this last for instance by offering different characters to play with)
- *Strong Identities*: the player experiences a corporeal participation in the mixed reality of the game, as a driven extension or spin-off from the proprioception, in an immersed amalgam of world elements, self-avatar, and other characters
- *Well-ordered problems*: computer games should offer high levels of usability
- *Games are pleasantly frustrating*: games should offer balance among challenge and abilities thereby allowing flow experience
- *Games are built around the cycle of expertise*: games should offer occasion for the player brain to accomplish a learning styles process, as for instance enacting the (Kolb) model loop of experience, perception, cognition, testing, and active testing
- *"Deep" and "Fair"*: there as to be a coherence among avoiding shallowness of contents, and the initial conditions for all the players must be equal (Adams)

It is now turn to delve into the learning role of computer games, such as to understand why they have a role in academia outside pure entertainment.

The role of computer games for learning

Why computer games are becoming so popular for learning and serious purposes?

The present topic is by time more popular within mass media, therefore a comprehensive analysis is beneficial.

Playing computer games is widely considered as a joyful activity; however, adults consider it as a dispersion of human energies, having no concrete serious purposes, and a source of health problems (physiological and psychic). However by finding on gaming learning values, it becomes worth the use of such approach on academia. This is best showed on the expansion of gaming products for health care, active journalism and serious contents (global problems) on game narrative, military, business and emergency management simulations.

(Blunt, 2007) gave some proofs of the concept by creating a test benchmark for assessing the role of games on reinforcing learning for business, economics and management (Wilson, Bedwell, Lazzara, Salas, Burke, Estock, Orvis, Conkey). The framework was based on testing, among the three different education domains, groups of students provided with a game simulator before the test, and another group who had not played any. For each domain, a different game was used (Industry Giant II in business, Zapitalism in economics, and Virtual U in management). The results showed higher scores on tests for students (younger than 40 years old) provided with a game rather than the ones devoid.

The health care domain benefits of recurrent innovations on gaming contents and interfaces, on contents which can provide placebo on intelligible use of physical interfaces, and novelties on diagnostics and prevention systems.

The military world knows enough the role of simulation technology for improving tactics and strategies, and for training purposes.

Journalism has known a new way of expressing the meta-aspect of their profession, throughout agency deployed as mass phenomena, through the work "Global conflicts" of (Egenfeldt-Nielsen), which has portrayed filmic realities of a journalist confronted with his job in territories of weapons and military conflict. Throughout this work then, the role of computer games has evolved more from the one of entertainment and learning tool, to the one of innovative tool for immersion and agency on professions within areas of complexity and mass information.

(Gee) has conducted a critical discourse analysis on the theme games and learning, outlining the reason why they are important learning tools:
- games are enjoyable. Science and engineering are, on the other hand, massively considered boring activities. With the consequence that it becomes cognitively heavy to learn subjects of science and engineering in the traditional way. Motivating students towards expressing their own science or engineering skills only through multiple-choice tests, is rather superficial
- teenagers would spend hours and hours playing games, no matter what other alternatives are proposed, and they are much more proficient on reasoning on school subjects after that
- young adults show a similar tendency as for teenagers game players'

Meaning that games are powerful for engaging compared to classical approaches on learning. (Wilson, Bedwell, Lazzara, Salas, Burke, Estock, Orvis, Conkey) summarizes that as:
- players' cognitive functions
- players' skills
- players' affective outcomes

How that can be achieved? *Cognitive functions enhancement* through games is explainable according to the taxonomies of (Bloom) and (Anderson & Krathwohl), combined to the learning styles defined from (Kolb). The levels of learning defined from (Bloom) and (Anderson & Krathwohl) are modified according to the model of (Kolb), having some steps merged. The final model appears as follows:

- The base knowledge of the game learner consists of forming knowledge and understanding, as:
  - *declarative*: knowledge about something
  - *procedural*: know-how
  - *strategic or tacit*: recognition of objects, timing, causalities

- organization of the knowledge
- analysis
- synthesis of the knowledge
- reforming of the knowledge (creativity)
- application of the knowledge

Learning skills occurs once the knowledge is cognified. For games they can occur as technical or motor ones, according to some goals, following a systemic organization.

The way psychomotor skills get acquired, from (Simpson, 1972), helps elucidating the concept. The process occurs as follows:
- perception (use sensory cues to guide motor activity)
- set (readiness to act)
- guided response (imitation)
- mechanism (exhibiting habitual movement patterns)
- complex overt response (exhibiting proficient, habitual movement patterns)
- adaptation (modification of habitual movement patterns to meet a special need)
- origination (creation of new movement patterns to meet specific situations)

Further stages of proficiency are explained from (Kraiger et al., 1993) as *compilation* and *automaticity* of the psychomotor abilities. Once reached the stage of compilation, the learner is engaged with fluid, proceduralized and quicker patterns of movements, with controlled occurrence of errors (players at this stage feel a high level of familiarity with tasks). Automaticity happens as the capacity to adapt a known motor pattern to meet special needs; this is the combination of the adaptation and origination levels of (Simpson, 1972).

(Kraiger et al., 1993) adopts for *affective game learning outcomes* a model which differs from the objectives model of (Bloom), expressing the outcomes of the cognitive model as:
- goals based on direct attitudinal or preference changes: creative individualism, inner growth, self-awareness, and change in values. The planning of these goals occurs as a proportioned balance among diegetic and extra-diegetic level of the intentions of the individual
- goals focused indirectly on motivational changes: motivational dispositions, self-efficacy, and goal setting. These goals weights more in the extra-diegetic level of planning of the individual

Computer games also, reflect a sociality, political ideas, experimental learning, culture and artistic choices, which were not possible in the same way before:
- games are for collaboration and participation with others, which is essential to engaged thinking and learning
- games have a role for youth emancipation, allowing the creation and expansion of cultural groups which are not under conventional adults labelling
- games create agency towards new forms of global culture
- games are a powerful way of understanding "situated meanings"
- gamers show better design skills than non-gamers

On the other hand, they are a potential threat to children minds, as effects of exposure to violent games. Here it is where they escape the goodness quality value. Therefore the following problem comes up: how does violence is transferred in real life as effect of the computer game content?
This is a relevant problem, in the context of nurturing and computer games, because the dangerous effects of computer games are a threat to the credibility of the teaching tool. Therefore, first it will be analyzed the aspect of nurturing and computer games, focusing the problem of violence within this context.

Computer games and nurturing
Nurturing depends on variables of space and contents; thereby a space of play has to be described together with how in such domain learning is provided, that considering the electronic context. Such domain of play is in the ethological domain represented as follows (Illustration 25):

Primary needs world

Wild animals, micro-organisms

Human game world (domesticized)

Animals in captivity, domestic animals, and children play

Human adult play (deeper needs & reasoning)

Human adults

Illustration 25 - The domain of play among living beings

There are important distinctions between each domain, and the picture above is to be interpreted as the inclusion of more actors, goals and rules (which is the wild world

itself would be consistent with a toy vision of play, scaling towards human gameplay by the inclusion of more game features). How is nurturing then dependent on the media factor?

According to the matrix of mixed reality and in relation to game examples given from (Järvinen), it is possible to give taxonomy of computer games for nurturing:

- Believable simulations: games with the goal of representing believably the worlds and the agents involved as in the organic world for the act of nurturing. Meaning that, in order to accomplish this goal, they attempt to reproduce attitudinal and/or physiological conditions of reality, and social contexts. This category includes commercial examples as: The Sims.
- Learning animal bots: anthropomorphic bots or software agents, which have some capacities such as to enact some learning through some functions of nurturing. Depending on the code which implements the learning functions, they can be both on a simple pattern of learning and allow a high level of instructional complexity. Home automation robots, and toys as Tamagotchi, Nintendogs, Dogz, Puppy Luv are in this category.
- Virtual reality nurturing: where a world which is an allegory of the organic world is represented, modalities and role-play among nurtured and the trainer are melted. In this category falls the title Animal Crossing
- Augmented virtuality nurturing: teaching and learning which occurs throughout electronic media, and the interactions occurs through supervised play activities: platforms of e-learning

It is to be noted that nurturing in computer games is affected from physical limitations, which consists on reproducing the exact nature of the simulated interactions, especially in the domain of animals' nurturing. Physical interfaces cannot offer symmetry on embodied interactions beyond specific stages, unless that is not conveyed throughout synaesthesia of ligands. In other words, the reciprocity of feedback that would happen in a context of pet caring, where a tactile player's input of caressing would produce the pet answer of thanking the owner (a reaction which occurs in dogs as emitting appeasing pheromones from the mouth – which serves to calm down the dog, are a sign of respect and appeasement to the owner, which is dependent on human facial emotions) is deceived from consistency to natural interaction.

The above is on a concern of human-animal play; a human game world vision is represented instead from the taxonomy of edutainment and game titles given from (Egenfeldt-Nielsen, Heide Smith, Pajares Tosca). The categories the authors identify on computer games for learning are:

- *Games for problem solving*: games are fun media for learning science, acquiring problem solving skills
- *Life simulations*: immerse and interact in a computerized vision of life simulations
- *Experimental research based games*: platforms for the serious games learning subject

Edutainment brings values of learning in the human game world. First as it would be a condemnable mistake to assure that education can occur without supervision, and that transferred in the context of computer games means that the educated through

gaming is advantaged from the presence of a teacher who can guide towards the cognitive and emotional importance of game experience, and give cross-media understanding of the experiential world of the learner. Education based games strengths as well the focus on intrinsic motivations of the learner (give meaningful interpretations to the play activity, elicit the role of inner fantasy of the player on solving a puzzle, concentrate on the feeling of mastery and flow from completing a level rather than from the obtained rewards), on conveying cohesive and deep narratives for the problems the learners are focusing and levels which provides affordable information and ergodicity. A distinct approach of learning and nurturing with computer games determines on constructivist knowledge as the way to deploy better learning. The critics of different approaches consists on recognizing that behaviourism and cognitivism can pose limits on the ergo of learning, while constructing knowledge creates a proprioception of the contents which the educator needs to transmit, and it gives power to create engagement towards the educational experience by letting students create their own worlds and play with them.

In this area of game and mental simulation, role of the guidance is also to know how mystery and fantasy are concerned into the learner throughout the gaming phase. The teacher is taken from understanding the strategies of common-sense reasoning that the learner is choosing along the gaming process, by reasoning throughout the interpretation of the same inputs the learner processes, or alternatively interprets the different reasoning abilities (or mental states) that the learner is affording. The reason for accomplishing mental empathy on locating the learner emotions within the consciousness, therefore participating to that (Ryan). This shared fiction is following the constructive vision of learning, which is of improvement for communication probes, but is also for creating conditions for understanding how contexts which would normally be condemned in real life are instead embodied and interacted. The assessor is then responsible for knowing what kind of physical and mental reactions can provoke a violent context, which is typical on a numerous amount of commercial game titles.

Computer games and violence

(Gee) conveys to the statement that violent computer games have no high relevance on causing misleading behaviours, outside the mediated world, to the players. His conclusion derives from considering cathartic for the non-virtual world the act of playing violent games as well as context specific for the player's mind; the empirical proof that is provided regards knowledge of the consequences of each year's play competition at QuakeCon, which would have been bloodish and catastrophic for the streets of Los Angeles. However, it is known that young boys, especially the ones raised in a culture of violence or abuse, may consume media (television, cinema and videogames) as indirect arousing of anger and confusion. This is prescribed inside the general effects of gaming for the young player, which can make her aroused for a short period of time after play as effect of pretension. (Sherry, 2006) investigations showed that passive assimilation of violent contents is more prosperous of creating violence in the player than from interactive media (as are computer games). Of a completely different opinion are (Anderson & Dill, 2000), that investigated on the problem starting from events in the news of the time – the 20 April 1999, in the Columbine High School in Littleton, Colorado, when two young guys, Eric Harris and Dylan Klebold, launched an assault to the school, murdering 13 and wounding 23 people before turning the guns on themselves; the 2 guys were habitual to play

violent computer games, enjoyed playing first person shooter titles (as Doom), with which worked for a school project by producing a modified version.

From knowing the way entertainment media have on affecting the mass population, and that much of behaviours that children and adults consider appropriate are influenced from the exposure to television and movies, violent computer games should be seen as well as affective media, which should be investigated on how they can produce similar or worse effects for aggression, that in short term (as within 20 minutes of game play) and long periods of time (a period of years). Short term is evaluable through tests on laboratory sessions; long term media violence effects on aggression as result from the development, over learning and reinforcement of aggression-related knowledge structures.

The approach used from (Anderson & Dill, 2000) to investigate on aggression and media relation is called GAAM (General Affective Aggression Model). This method integrates existing theory and data concerning learning, development, instigation, and expression of human aggression, which is largely based on knowledge structures (scripts, schemas, etc.) from social learning processes. The way to test an individual should consider the own internal states (as cognition, affect and arousal), which are directly related, as the activation of one triggers the activation of the other. The hypothesis for violence on computer games states that an active cognitive involvement and learning occurs while playing and interacting with computer games (and other interactive media), therefore the violent content is mentally reproducible outside the context of media play. Cognified aggressive scripts can be then emitted quickly and easily and without a conscious level of automation neither external provoking reasons (Anderson, Benjamin, Bartholow, 1998).

The conclusions to which arrived (Anderson & Dill, 2000), finds on three general reasons why violent computer games have a higher impact on creating violence on the consumer rather than non-interactive media:

- Player-embodiment: players who gets told to identify with the aggressor character of the media, reports higher values for aggressive behaviour as measured in a post-analysis, in comparison to the way it increases for other participants not told to identify with the aggressor (Leyens & Picus, 1973).
- Active-participation: there is no evident proof that catharsis can occur as from the effect of involving aggressive behaviour in the interaction with a media (Bushman, Baumeister, Stack, 1975) (Geen, Quanty, 1977) (Geen, Stonner, Shope, 1975). Instead, the agency creates cognition of the scripted aggressive actions of the games, therefore creating or reinforcing the learning of them, which can be far more complete than what would occur in a passive role as on watching violent movies.
- Addiction: violent computer games provide a complete learning environment for aggression, with simultaneous exposure to modeling, reinforcement, and rehearsal of behaviours. This combination of learning strategies has been shown to be more powerful than any of these methods used singly (Barton, 1981) (Chambers, Ascione, 1987) (Loftus, Loftus, 1983).

Therefore, from the initial general problem of investigating electronic mediation and communication within human and animals, the final problem statement assigned relevancy on understanding how certain emotions can affect in a malevolent fashion a synergetic empathy of the two entities, therefore knowing how bad emotions and empathy can affect interactions among human and animal, how that can be diagnosed

giving an inspective role to electronic media and intelligible assessment, as the final goal of this thesis.

Final problem statement

Therefore the final problem statement is formulated as:

> "How is it possible to assess the influence of exposure to violent play, by understanding on natural interactions and tendency towards violence?"

The investigation of (Gee) on violence and computer games consisted of critical discourse, reporting a given objectivity, which is in fact contrasting the circumstances of the 20 April 1999 in the Columbine High School in Littleton. Therefore, this thesis will conduce investigation on subjects, understanding their tendency towards aggressiveness, together with trying to understand how they empathize. Goal is to find out data regarding tendency towards aggressiveness and how, on subjects who shows high tendency towards aggressiveness, computer games with violence can enhance that tendency. Case scenarios have been prepared for the testing, and together with interviews regarding affection and domestic animals, they will give answers to the final problem statement.

Hypothesis to test

Some hypothesis needs to be formulated, in order to establish how to shape the test framework. They are:

- Agency on a mediated environment is representable in quasi-believable conditions
- Structural conditions, external to the player, used synergistically can create believable immersion in the psychological conditions of the content conveyed
- The player awareness of the test-context affects the truism of the assessment platform
- Violence immersion and enactment affects daily tasks, and the emotional and physiological progress can be represented through simulating gaming contents
- Data measurements have relevance for emotional and empathic understanding of the effects of violence consumption, and on predicting possible consequences on daily activities, that also in the context of human-animal interactions

Therefore an approach for understanding empathy and emotions has been taken, and an existing test method was adapted, in order to portray the role of computer games within social and daily tasks and give answer to the test hypothesis.

Emotions and empathy assessment

First, how is it possible to empirically assess emotions on lab tests sessions? A way to conduce self-report of emotions has been explained from (Wundt, 1996) (Bradley & Lang, 1994), who suggests three basic dimensions of affective meaning conveyed from stimuli, labelled as *lust* (pleasure), *spannung* (tension), and *beruhigung* (inhibition). Human judgements are for (Wundt) organized by the guidance of

pleasure, arousal and dominance. The way of assessing emotions suggested from (Mehrabian & Russell, 1974), is in the base of the work of (Wundt), and consists of values into a Semantic Differential Scale, which is a 3-dimensional structure of objects, events, and situations, with 18 bipolar adjective pairs that are each rated along a 9-point scale. Each test subject scores then along the dimensions of pleasure, arousal, and dominance (Illustration 26):

Factor Loadings of Each of the 18 Bipolar Adjective Pairs in the Semantic Differential for Picture Ratings

	Factor 1 "Pleasure"	Factor 2 "Arousal"	Factor 3 "Dominance"
Unhappy–Happy	0.914	0.063	0.148
Annoyed–Pleased	0.883	0.068	0.158
Unsatisfied–Satisfied	0.868	0.144	0.114
Melancholic–Contented	0.725	0.095	0.056
Despairing–Hopeful	0.858	0.063	0.078
Bored–Relaxed	0.580	0.372	0.234
Relaxed–Stimulated	−0.211	0.774	0.052
Calm–Excited	−0.181	0.793	0.056
Sluggish–Frenzied	0.268	0.771	0.005
Dull–Jittery	−0.211	0.793	0.121
Sleepy–Wide awake	−0.046	0.810	0.047
Unaroused–Aroused	0.051	0.827	0.127
Controlled–Controlling	0.262	0.192	−0.673
Influenced–Influential	0.292	0.089	−0.618
Cared for–In control	−0.090	0.198	−0.626
Awed–Important	0.199	−0.040	−0.301
Submissive–Dominant	0.195	0.306	−0.695
Guided–Autonomous	0.161	−0.100	−0.479
Amount of variance accounted for:	24.6	23.12	12.18

Illustration 26 - The Semantic Differential Scale (Mehrabian & Russell)

This method is informative but complex both in terms of inclusiveness of testers, and for the evaluator as well. The evaluator is confronted with large sets of data, testers' needs to be linguistically sophisticated and English-speaking. Therefore (Hodes, Cook, Lang, 1985) provided an iconic version of the emotional assessment framework, called Self-assessment Manikin (SAM), used to measure the same parameters through a graphical approach (Illustration 27):
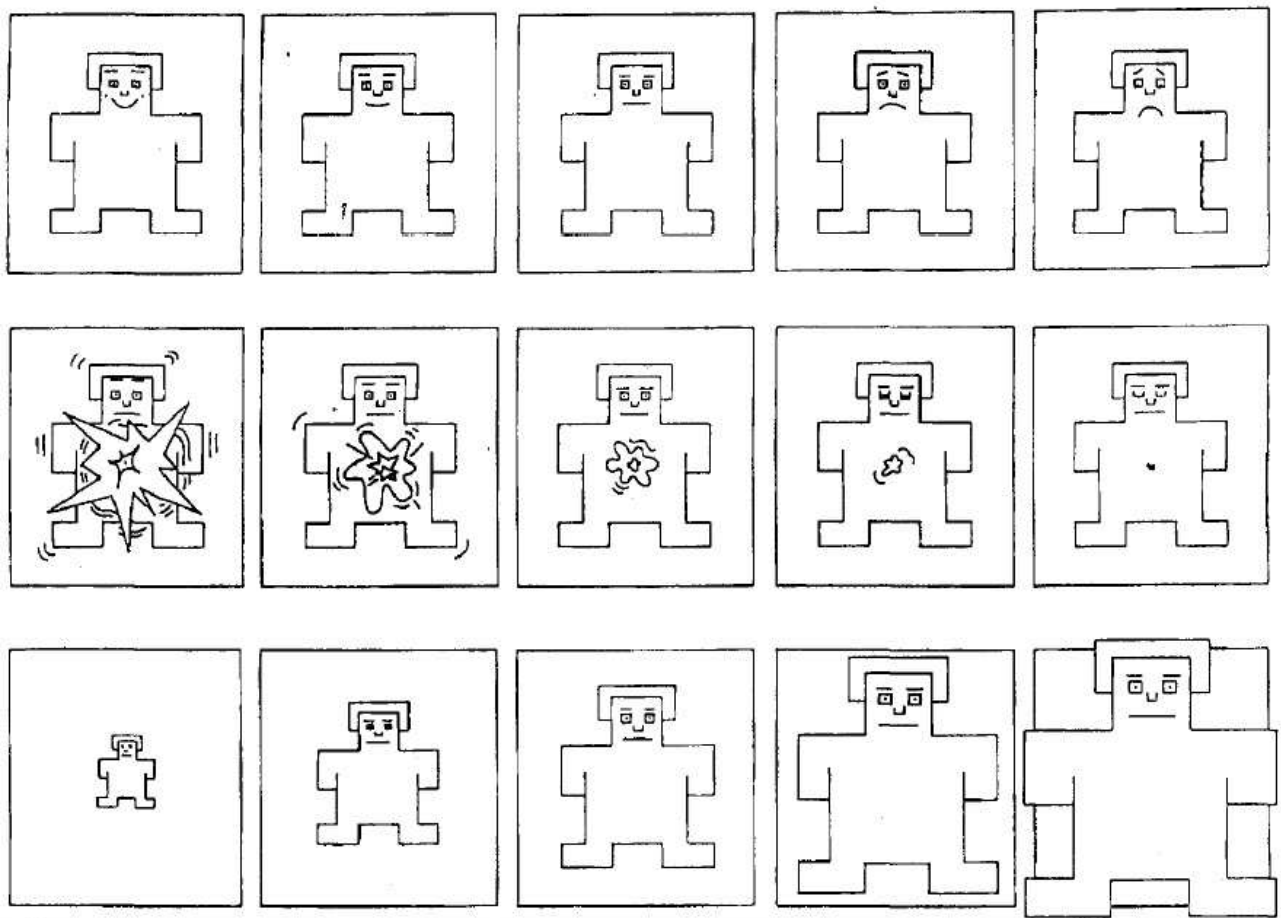
Illustration 27 - Self-assessment Manikin (Hodes, Cook, Lang)

- *Valence* is on the topmost level. It describes from a smiling figure to a frowning, unhappy one
- *Arousal* ranges from an excited figure to a relaxed and sleepy figure
- *Dominance* represents changes in control according to the ratio of the figure to the square (the bigger the figure, the more in control)

The way the tester reports answers is on placing an 'x' over any of the five figures in each scale, or between any two figures, which results in a 9-point rating scale for each dimension. (Bradley & Lang, 1994), in order to make a comprehensive testing, combined the SAM framework to the semantic differential rating system, where the 9-point rating scale ranged from -4 to +4, with 0 the center of the scale. Positively weighted are the adjectives on the left side of the (Illustration 26) corresponding to the right side of the SAM, and vice versa. The mapping between SDS (textual) and SAM (graphical) (18 textual values to 5 pictorial, for each level) is on (Illustration 28):

Pleasure
    Unhappy–Happy
    Annoyed–Pleased
    Unsatisfied–Satisfied
    Melancholic–Contented
    Despairing–Hopeful
    Bored–Relaxed
Arousal
    Relaxed–Stimulated
    Calm–Excited
    Sluggish–Frenzied
    Dull–Jittery
    Sleepy–Wideawake
    Unaroused–Aroused
Dominance
    Controlled–Controlling
    Influenced–Influential
    Cared for–In control
    Awed–Important
    Submissive–Dominant
    Guided–Autonomous

Illustration 28 - correlation of the domains of the Self Assessment Manikin to the adjectives of Semantic Differential Scale

Results of the mapping through tests conducted from (Bradley & Lang) finds discrepancies, as lacks of correlation have occurred among self-reports of SDS tests and SAM (in the tests conducted from the authors, a subject reported 'not in control' using the SDS and through SAM rated himself 'in control'; the subjects conduced both paper and pencil and computer based tests). Moreover some emotions resulted out of the prescribed dimension (as bored and relaxed for Pleasure). But in general, the SAM method as described is more universal than the SDS, it is helpful to produce assessments which are subjective (relating closely to self-assessment rather than perception, as subjects refers to the iconic self-mirroring rather than giving judgements about perceived stimuli) and it is versatile as it can be combined with a more objective assessment framework as the SDS.

However a way to measure the emotion of aggressiveness is not outlined from the considered framework, which is instead of a more general use. A way to design a proper analysis of the aggressiveness (both as perception from an external and as self-report, and in terms of physiological responses and observed behaviour) needs to be found, and since it is not possible to give self-reports when the facts happens, an offline method is needed. Therefore a test methodology is here described. Measures can be done through the Aggression Questionnaire (AQ) (Buss & Perry, 1992) (O'Connor, Archer, Wu, 2001), that measures, in four scales of relation to text, physical and verbal aggression, anger, and hostility, in Likert-answers. Their data reports that men are more prone to physical and verbal aggression rather than women. A rather more men-oriented aggression test is the Aggressive Provocative Questionnaire, vignette and textual based instrumental for assessing briefing on

exposure violence tests. This methodology works as self-report of feelings and disposition to aggressiveness due to provoking situations. People's responses are hypothetical, however they can be based on their past. Each assessment presents a number of enquiries, with presented scenarios which should be of provocation to the tester. A question is presented regarding the feeling for that situation, in which the tester answers on a 5 Likert-scale for each of three different scales (angry, frustrated, irritated) with scaling going from 0 (not at all) to 5 (extremely). Then it is presented the behavioural question, which regards how the reaction to such situation would be hypothetically (or in the case of relation to the past, has been) produced, with 5 different answers reported, according to categories of action responses of:

- Avoid the situation
- Do nothing
- Anger
- Assertive behaviour
- Aggressive behaviour

A typical enquiry looks like (Illustration 29):

3. Imagine yourself in the following situation:

You are in a great hurry and right in front of you a car stops. A man gets out but he carries on talking to the driver, blatantly ignoring your calls for him to move. You cannot get past the car. *How would you feel in this situation?*

	Not at all	A little bit	Moderately	Quite a bit	Extremely
Angry	0	1	2	3	4
Frustrated	0	1	2	3	4
Irritated	0	1	2	3	4

What do you think you would do in this situation?
○ Get out of your car, walk over to the man and threaten him.
○ Reverse the car and take another route.
○ Sit in the car and fume with anger, but do nothing.
○ Calmly wait until he moved.
○ Go over to him, tell him that he is being unreasonable and ask him to move.

Illustration 29 - an extraction from the aggression questionnaire, as elaborated from (O'Connor, Archer, Wu)

The overall assessment is intelligible as to give a measure of emotional empathy, with the understanding of psychological conditions of test subjects in a concentrated number of case scenarios which should elicit high emotional impact; thereby test sessions needs to be divided and meaningfully concentrate the questions and assessment modalities of the responses to be measured. A framework for assessing emotional empathy was proposed from (Mehrabian & Epstein, 1972), which encompasses the procedures of investigating aggressive behaviour in relation to procedures for assessing altruism. The same has been adapted to give numerical differences among human-to-human and human-to-animal interactions (Paul, 2000). The hypothesis empirically accepted from the tests of (Mehrabian & Epstein, 1972),

relates to acknowledging that high level of emotional empathy in individuals is less likely to make them engage in aggressive behaviour, that same persons are more likely to engage in helping behaviour when noticing distress in another, dependent on heightened level of responsiveness to other's emotional experience.

Physiology and emotions

Within that framework, and in order to obtain a complete vision of the affection occurring to the tester, physiological responses are measured with a *Biopac* system, a data acquisition hardware which is able to give physiological measures of an individual to which some electrodes are connected, in terms of electroencephalography (EEG), electrocardiogram (ECG), electrooculogram (EOG), electromyogram for hands or arm responses (EMG).

This system operates by acquiring electrical signals from the electrodes and transducers of the system related to signals from the heart, muscle, nerve, brain, eye, respiratory system, and tissue preparations. The hardware captures data which is in electrical signals extremely small, therefore these are amplified, noise and interfering signals are filtered, and that dataset is converted into numbers sent through Universal Serial Bus (USB) to the computer. The software system that interprets the data is Biopac Student Lab, that displays the numbers as waveforms on a monitor, and it is available for personal computers running Windows, and for Macintosh operating systems. The Biopac system used for the tests is the version MP40, as in (Illustration 30):

Illustration 30 - the Biopac MP40 system

Once the data has been collected, analysis tools measures amplitude and frequency, plus a wide range of other values from the electrical signals. The analysis process allows making general comparisons with the data.

Thereby it is needed to formulate the presented frameworks according to the assessment of the role of games for empathy and emotions.

Pilot test framework

There was an initial indecision regarding how to delimit the way of assessing the hypothesis, according to the limitations to which tests in laboratory are constrained due to the complexity of the intended realities to be evaluated; the choice went for combining two approaches. Both of them made of two test sessions, testing for aggressiveness and altruism with nurturing; however they differed in some way as explained:

- The first approach consists of conducing *isolation* test, in order to measure emotional involvement on a scenario where users should play in an ordinary scenario (being taking care of a pet), make self-report of the emotions felt during that activity, and after immerse themselves and interact on environments which could have a potential for evoking aggressive behaviour. Goal of the test is to represent how a proper immersive environment, and an interactive media combined, can become source of aggressiveness for their consumers, that dependently on their self-declared personality. The way of making the test includes therefore self-report and data capture.

- The second idea is based on adapting the *emotional empathy assessment* framework of (Mehrabian & Epstein, 1972) to include computer games related to the violent area for investigating computer games as effective on reproducing realities of emotional empathy and understanding of potential aggressiveness in a context of social play.

The findings of (Anderson & Dille, 2000) are applied for both approaches.
The two of them are presented here. That is needed as to give an understanding to the reader about the two choices. The test in isolation conditions is needed as to focus understanding on human-machine direct interaction, using physiological, audio visual and self-report captured data to include a wide understanding of the dynamics of the happenings during the tests; social conditions steers the understanding of the reproduced conditions in a laboratory towards outwards realities of the measurements to be accomplished; they focus on how cooperation and altruism are reached, in contrast to how conflicts occurs, comparing that to self-report which should give a profile of tendencies towards empathy versus conflict and aggressiveness. The second pilot test does not include physiological data capture, as the device for measurements of electrical signals is only for one test subject per time. Self reports and audiovisual data capture, from the original framework and with the integration of the questions which regards the area to be evaluated, are indeed proper for achieving a consistent measure of the user responses.

Isolation test

First test: establishing physiological responses to common activities in normal conditions of the test subject

In this test a user is conduced into the laboratory, he/she has to feel comfortable, and then he/she has to play a computer game for nurturing. The interactions with the evaluator needs, from now on, to be limited to the synchronization for capturing the data.

- He/she has *not to* be aware of what is going to do
- must be in conditions of high susceptibility to the content, such as to instantiate a natural response to the context in which is immersing
- has not done the test before

Test infrastructure:

User environment:
- a room illuminated according to the lighting conditions of the computer game tested
- conditions proximal to silence
- a big screen that would encompass the field of view of the player
- a mouse
- the computer game Dogz (Ubisoft, 2006) (which is a simulation of dog nurturing – one of the most common human activities)
- Biopac system, with electrodes connected to the test subject

Evaluator tools:
- a dedicated computer that captures the physiological responses of the test subjects given through the Biopac device
- a video and audio capture of the player actions

Test procedure

The player has to play the game for half an hour, without being discomforted from external people during this lab session. The assessor of the test interacts initially with the user in order to synchronize the acquisition of the physiological responses and the acquisition of the video and audio computer game – player's interactions, giving after to the user an environment which should portray complete isolation, immersion and interactivity focus to the computer game. At the end of the game the user is presented a questionnaire of think aloud self assessment of the emotions in the game, based on the combined SDS/SAM questionnaire, which should, after being filled up, handed in to the evaluator. Captured data will be interpreted, and used for comparison with the results of the next tests to the same person subject.

Second test: establishing physiological responses to common activities of the test subject after exposure to violent content

This test requires that the user has previously conducted the first test, where he now plays again the same computer game of nurturing a pet, in a different testing environment and after having played a violent computer game. Physiological responses are taken, and the test subject should be in the most natural conditions as to represent believability in the simulation.

Pre-requirements from the subject:

- He/she has *not to* be aware of what is going to do
- must be in conditions of high susceptibility to the content, such as to instantiate a natural response to the context in which is immersing

- has not done this test before

Test infrastructure:

User environment:
- a completely dark and gloomy room
- lightning
- storm ambient sounds
- a big screen that would encompass the field of view of the player
- a controller system (mouse and keyboard)
- two computer games:
    - Bullfighting (a blood sport simulation)
    - Dogz (Ubisoft, 2006) (which is a simulation of dog nurturing – one of the most common human activities)
- Biopac system, with electrodes connected to the test subject

Evaluator tools:
- a dedicated computer that captures the physiological responses of the test subjects given through the Biopac device
- a video and audio capture of the player actions

Test procedure

The player is initially immersed into this scary environment, where proper lighting and ambient sound should evoke a basic level of fear. After the user has entered the room, the experimenter gives an APQ questionnaire in order to create knowledge of the user profile, and then the experimenter interacts with the user in order to synchronize the acquisition of the physiological responses and the acquisition of the video and audio player's interaction with the computer game. Here it is needed isolation in order to recreate the conditions of immersion and interactivity for the intended user gameplay. The bullfight game has to stimulate aggression (as it is for blood sport games – the player has the role of a torero in a bullfight). The length of gameplay is not foreseeable; it is expected for a maximum of 30 minutes, which is then interrupted. The capture of the physiological and audiovisual data is here concluded for this test session; the end of the computer game is also supposed to keep the emotional status of aggressiveness connected to the events just happened on the screen. Hereafter, the other game Dogz is started, the same process of data capture is activated (as in the first test stage, with audio/video and physiological data). The two games are expected to last for a maximum of ten minutes each one. The debriefing consists of a game experience questionnaire related to the computer game just played, which after having been filled up is handed in to the evaluator. The captured data is extremely important such as to compare the results with the first test conducted to the same person subject.

Expectations of the test methodology

The two test sessions' data captured, should give answers to respond on the efficiency of the framework on representing the intended realities, specifying how computer games can transmit violence, on the base of mapping the data capture to emotional

categories and making a comparison with the prediction. Aim is to quantify the proximity to the predicted results, by conducting qualitative and quantitative tests.

Social test framework: Mehrabian and Epstein emotional empathy test and computer games

However it is needed to assess emotional empathy, therefore a methodology for social context needs to be used for other tests, which is in the adapted framework from (Mehrabian and Epstein, 1972). Following it is presented the block structure which describes the way, abstractly, this test methodology is composed:

```
                    ┌──────────────┐
                    │   Starting   │
                    │  hypothesis  │
                    └──────────────┘
                           │
                           ▼
        ┌───────────────────────────────────────┐
        │           Iterative block             │
        │   ┌───────────────────────────────┐   │
        │   │     Test item hypothesis      │   │
        │   └───────────────────────────────┘   │
        │   ┌───────────────────────────────┐   │
        │   │ Variables                     │   │
        │   │      • dependent              │   │
        │   │      • independent            │   │
        │   └───────────────────────────────┘   │
        │   ┌───────────────────────────────┐   │
        │   │ Requirements                  │   │
        │   │      • Informal               │   │
        │   │      • formal (audience,      │   │
        │   │        infrastructure, etc.)  │   │
        │   └───────────────────────────────┘   │
        │   ┌───────────────────────────────┐   │
        │   │ Method                        │   │
        │   │      • Subjects analysis      │   │
        │   │      • Test procedure         │   │
        │   └───────────────────────────────┘   │
        │   ┌───────────────────────────────┐   │
        │   │      Iteration results        │   │
        │   └───────────────────────────────┘   │
        └───────────────────────────────────────┘
                           │
                           ▼
        ┌───────────────────────────────────────┐
        │ Final collected data and offline       │
        │ assessment                             │
        └───────────────────────────────────────┘
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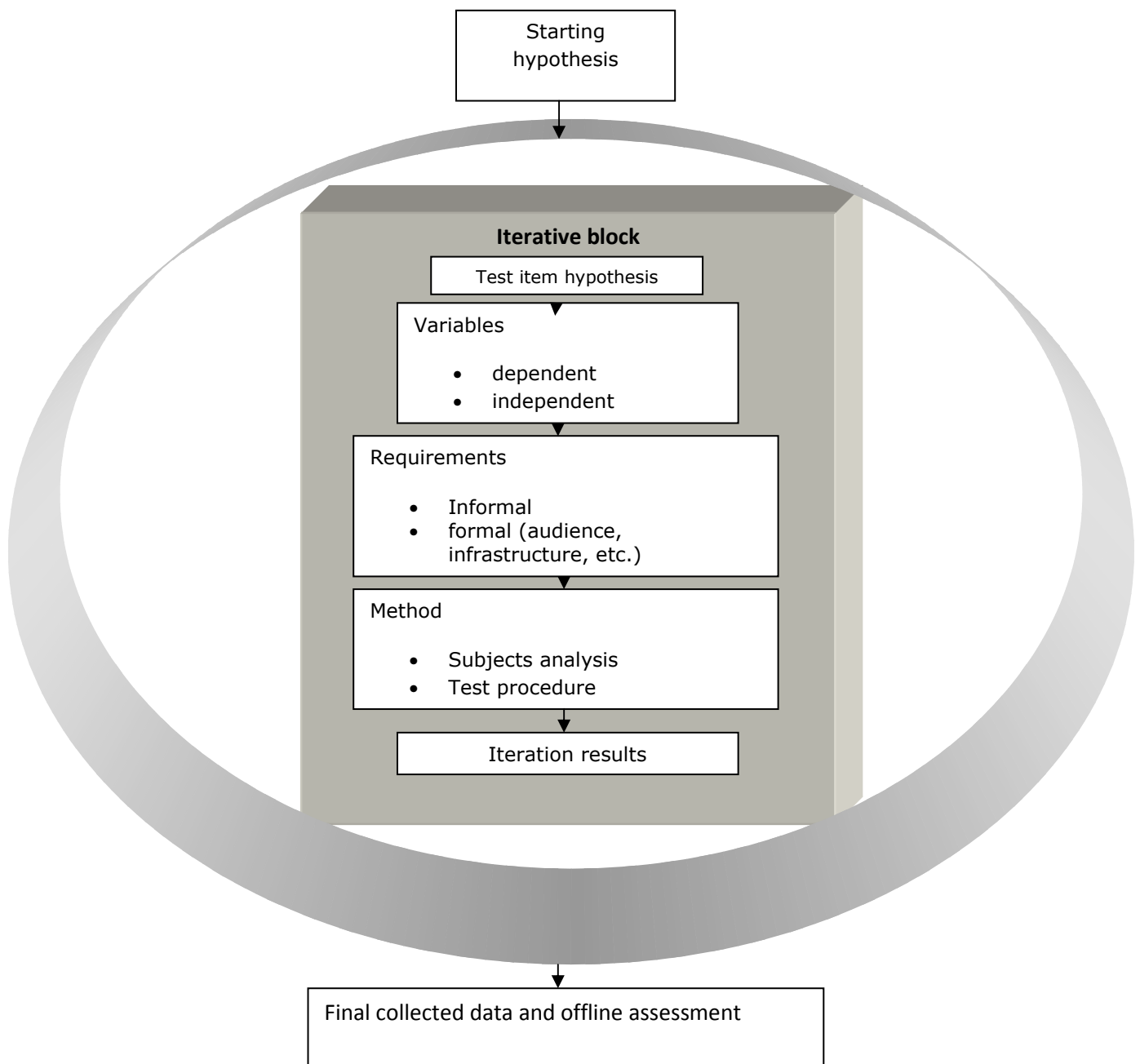
The adaptation to the original test framework consists on assessing the congruent role of computer games as stimuli of empathy and emotions to the outside media staged events. The adapted test framework is here presented.

1st test: tests in couple: an instructor and pupil as roles of the users

The total time for the test should not be for more than half an hour. The first stage of the test framework consists of a couple of testers doing role play and playing the computer game. One tester takes the role of a severe old-fashion instructor, who is in charge of judging the other tester (who has then the role of a subjugated student). The way the instructor gives notes is through immediate shocking feedback (electro-shocks through electrodes connected to the student body). They will also play a violent computer game, where both of them will have to identify with their given character inside the computer game, one of them will play and interact within the computer game, and the other will have only the role of passive observer. Tests are conducted in order to give measures of empathy and aggressive tendency for both subjects. The script of the scenario of test, together with the hypothesis to be tested, is as follows:

Hypothesis

- The decrement in aggression in a more immediate feedback condition is especially greater for more empathic persons

- Differential responsiveness are found to painful emotional feedback from victims

- Violence, both in agency and perceived, has measurable consequences from the mediated electronic context to the physical reality

Independent variables

- Empathic tendency

- Gender

Test method

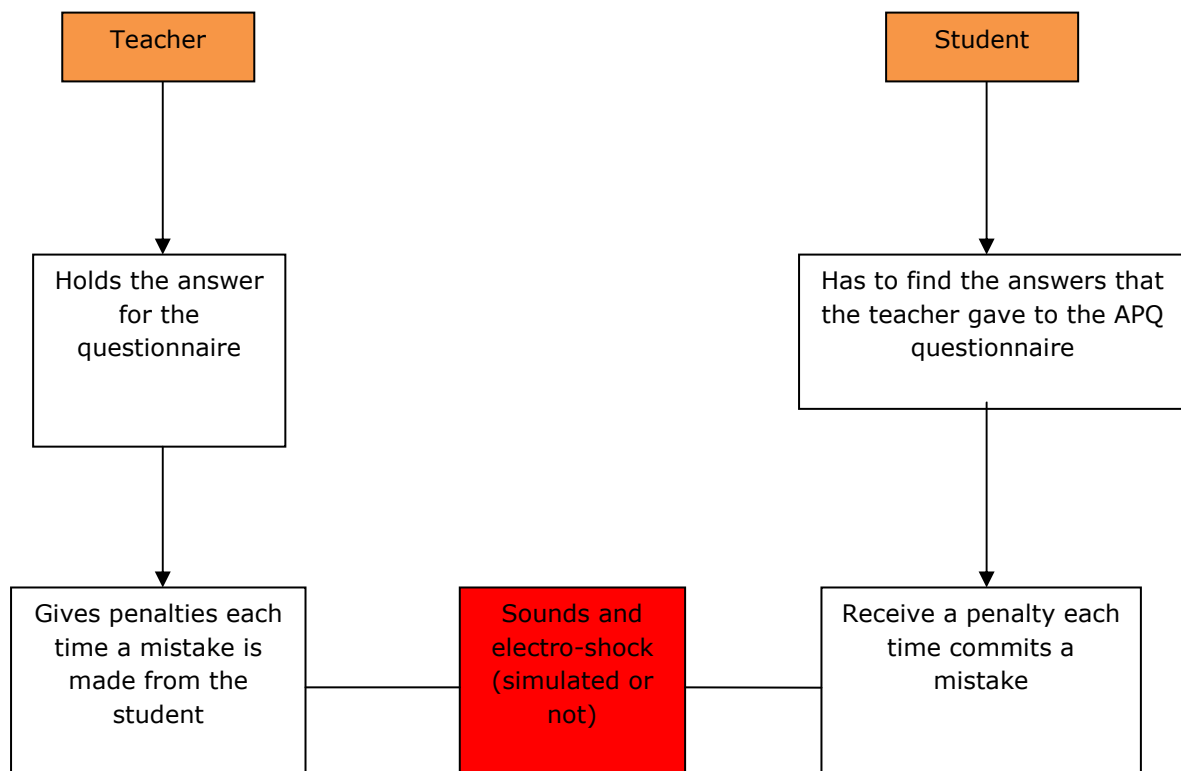- The testers receives a general empathy questionnaire (to measure empathy and non-aggression), with questions as the one below:

    - It makes me sad to see a lonely stranger in a group

- The testers are involved into the gameplay of the computer game of bullfight, max for 10 minutes. There are in use two different screens, one is for the player which interacts with the game, the other for the tester which is spectator

of the scripted actions of the Non-Playable-Character (NPC) enacted in the computer from the bull model.

- At the end of the computer game, both test participants will fill up an Aggressive Provocative Questionnaire; after having filled up the questionnaires, the student delivers it to the evaluator. The instructor keeps the own questionnaire as he/she now is in charge of measuring aggressiveness empathy from the student, and that will be the next play on stage.

- Teacher and student speeches are the way the two communicates; the instructor keeps a record of the empathy answer the student gives to the previous questionnaire filled up (which is to say, the student attempts to guess what answer the instructor gave in the previous test), grading which is in accordance to the shock given to the student for the wrong answer (0-low shock, 4-highest shock).

  The student has a maximum of two times the total number of questions in the questionnaire.

```
┌──────────────┐                              ┌──────────────┐
│   Teacher    │                              │   Student    │
└──────┬───────┘                              └──────┬───────┘
       │                                             │
┌──────▼───────┐                              ┌──────▼───────────┐
│ Holds the    │                              │ Has to find the  │
│ answer for   │                              │ answers that the │
│ the          │                              │ teacher gave to  │
│ questionnaire│                              │ the APQ          │
│              │                              │ questionnaire    │
└──────┬───────┘                              └──────┬───────────┘
       │                                             │
┌──────▼───────┐     ┌──────────────┐         ┌──────▼───────────┐
│ Gives        │     │ Sounds and   │         │ Receive a        │
│ penalties    ├─────┤ electro-shock├─────────┤ penalty each     │
│ each time a  │     │ (simulated or│         │ time commits a   │
│ mistake is   │     │ not)         │         │ mistake          │
│ made from    │     │              │         │                  │
│ the student  │     │              │         │                  │
└──────────────┘     └──────────────┘         └──────────────────┘
```

- Post testing: the entire data captured is there to give results of emotional mapping and for producing qualitative and quantitative statistics.

2nd test: testers acts as peers, assessment of altruism and animal nurturing

While with the first test stage of the empathic test framework, it was possible to give an assessment of aggressiveness empathy on two test subjects, this second stage is devoted to find how altruism occurs throughout two persons, and how that can be related to nurturing a pet in a digital context, therefore understanding the psychophysiology of the helping behaviour among mixed realities. The test starts by conducting an attitudinal test towards pet nurturing, and then it continues with a set of questionnaires to assess personality attributes, which is then followed from the play of the computer game Dogz (Ubisoft, 2006) from one player subject while the other is waiting. There is given a questionnaire of in-game play on behalf of the gameplay, and another at the end of the play session such as to evaluate the play experience. The two will after exchange one of the questionnaires as to get to know each other, and the actions of test for altruism starts. The testers

The script of the scenario of test, together with the hypothesis to be tested, is as follows:

Hypothesis to test
- Is the combined contribution of situational and personality variables for the helping behaviour

Dependent variable
- time

Test method
- *Attitudinal test*: a questionnaire regarding pet's nurturing, derived from (Williams, Muldoon, Lawrence, 2010), where it is measured:

  - Pet attitude scale (Munsell, Canfield, Templer, Tangan, Arikawa, 2004) which measures attitudes towards pets, as in the following example:
    - I would like a pet, or to continue to have a pet, in my home.

  - Attachment to pet's scale (Staats, Miller, Carnot, Rada, Turnes, 1996), which measures the commitment to a pet by giving an evaluation, with questions as :
    - If a pet destroyed a DKK50.00 piece of furniture or personal item, I would get rid of it.

  - Lexington attachment to pets scale (Johnson, Garrity, Stallones, 1992), with items for "general attachment", like:

    - I often talk to other people about my pet.

- Affective empathy, with items for assessing general affective empathy (not specifically towards animals) (Enz, Zoll, 2010). Questions are alike:

    - It makes me sad to see a child who can't find anyone to play with

- Questions which regards animal welfare, like giving a judgement regarding:

    - I consider blood sports something humanly acceptable

- *A set of questionnaires (randomly afforded) for giving personality attributes of*:

    - Emotional empathic tendency

    - Nurturance

    - Succorance (which is the act of seeking out affectionate care & social support)

    - Affiliative tendency and sensitivity to rejection

    - Approval seeking tendency

        This is made through the group of questionnaires:
    - SDS/SAM combined test method (empathic tendency in terms of basic feeling dimensions) (Bradley & Lang, 1994)

    - Questions for determining nurturing and succorance tendencies (Jackson, 1967); the same author assess high scorer profile for nurturance as the person who gives sympathy and comfort; assists others whenever possible; is interested in caring for children, the disabled, or the infirm; offers a 'helping hand' to those in need; readily performs favours for others. Other examples of questions which assess that personality are:

        - When I see a baby, I often ask to hold him/her

        Also from the same author, succorance high scorer profile "frequently seeks the sympathy, protection, love, advice, and reassurance of other people; may feel insecure or helpless without such support; confides difficulties readily to a receptive person."

    - Questions for determining affiliative tendency and sensitivity to rejection from (Mehrabian, 1970) with items such as ('+' as for positive emotion, '-' for negative):

        - For affiliative tendency:

Preference for friends and attachments versus greater independence from others
(+) If I had to choose, I would rather have strong attachments with my friends than have them regard me as witty and clever
(-) I prefer the independence which comes from lack of attachments to the good and warm feelings associated with close ties

- Sensitivity to rejection:
  Preferences for behaviours or situations which minimized negative feedback from others
  (+) I prefer not to go to a place if I know that some of the people who will be there don't like me
  (+) I tend to be more at ease around people who think like I do
  (-) When two of my friends are arguing, I don't mind taking sides to support the one I agree with
  (-) I enjoy discussing controversial topics like politics and religion

- Questions for determining the approval seeking tendency (Crowne & Marlowe, 1960) of the personality, measured in Boolean scale, as for instance:
  - Before voting I thoroughly investigate the qualifications of all the candidates.

- At this point, the script coordination concentrates on evaluating for the gameplay experience of the computer game Dogz. The test questionnaire for empathic tendency has been swapped between the testers before starting the game, such as for them to understand better each other. One of the testers plays and interacts with the game, while the other is thought to collaborate with the playing tester, and they are told to do that for 15 minutes. The testers are also told, at 5 minutes from the start of the gameplay, to fill up a questionnaire of in-game self-evaluation of gameplay experience (Forgas, Smith, 2003) (IJsselsteijn, de Kort, Poels). The questionnaire is then given back to the evaluator. The spectator has been told to stop helping and communicating with the player tester after this point, out of the attention of the player tester. Therefore here the player will feel surprised from not receiving any help and suggestion. The spectator is told also, out of the attention of the player, to do nothing and sit nearby the player until he/she decides to end the game. At the end of the gameplay session both testers fills up a questionnaire of debriefing in relation to the gameplay experience, which is then given to the evaluator.

  - Post testing: the entire data captured is mapped to give results of emotions and personality, for quality and quantitative statistics.

Testers, after this last session, give an evaluation of the overall test and the games on it. The results of each test are combined, producing a large data set, where statistics of the all population are conducted. A report of them is produced, giving answers to the main hypothesis.

Results

Expected

The two test frameworks are compared for the different emotions expressed. The differences observed between each test should give an expressive quality of how participants are affected from aggressive environments on their behaviours, and also how their aggressive personality attributes can be discovered through a well thought set of scenarios. Measures of emotionality with violence, and the relation of aggressiveness to empathic emotions and altruist play will produce beneficial results for the research. Moreover, in the content of the research, it will be discovered their innate tendency towards pet caring.

Data analysis

Analyses of the results of the tests are conducted, in order to evaluate the results in relation to the hypothesis presented. Parameters in use are the mean value, representing the average score of the test subjects, the standard deviation to know how every sample differs from the mean value, and the t-value meaning how the majority of the responses differed from the expected mean value. For each test part, the hypothesis for the population is of a normal distribution, which is confronted with each sample of test.

Data analysis regarding the isolated conditions

The first framework of tests conducted, needed to be conducted involving the test subject in conditions of isolation. The assessment could not be executed properly; as it is a natural tendency for subjects to involve themselves on interacting with the surrounding, therefore avoiding inducted contact for uniquely human-to-machine interaction and pretended isolation (knowing that somewhere in the laboratory there is at least the evaluator). Therefore this natural tendency, affected the intended goals of this part of the overall test. Indeed, here the analysis presents results and statistics of their self-reports and multimodal data capture.
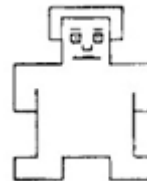
The first game experience questionnaire, was presented as a way to evaluate testers to a game which would not produce conditions of stress, and providing to the testers environmental conditions which would also avoid to induce such conditions. The questionnaire presented is a combination of game experience valued on a visual base, together with a game experience questionnaire from (Forgas, Smith, 2003) (IJsselsteijn, de Kort, Poels). The first questionnaire is ranked with values 0-8 of Likert scale, while the textual questionnaire from 0-4. Analysis of the data obtained, shows the following results:

With a mean value of 4 for the first part of the questionnaire
Hypothesis consisting of:

H(0) (Null hypothesis): There is no difference between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and environmentally inducted aggressive gameplay

H(1): there is difference between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and environmentally inducted aggressive gameplay

The analysis will make use of t-tests, as to evaluate the difference between two responses measured on the same statistical unit in distinct sessions. That will give a confirmation for one of the two hypotheses. Assumed is a significance level of 0.05, with any t-value greater or equal to 2.101 has 0.05 or less probability of occurring under the assumptions of the null hypothesis. Therefore for larger values, the H(1) holds.

	Pleasure	Arousal	Dominance
mean			
Standard deviation	1,253566341	0,7867958	2,035400978
N	7	7	7

The test sample, from the self-report and as it is visible in the graph, shows a higher tendency towards happiness due to the game play rather than the mean value, reduced tendency towards phenomena of arousal from the game, tendency towards being influenced from the game rather than controlling it. Subjects show more concordance for their answers regarding arousal.

The analysis of the second part of the first test questionnaire, which is textual based, is here reported:

The mean value this time is equal to 2

question	mean	sd	N
It gave me a bad mood	slightly	0,951189731	7
I found it tiresome	slightly	1,511857892	7
I thought it was hard	slightly	1,272418021	7
It was aesthetically pleasing	moderately	1,253566341	7
I forgot everything around me	slightly	1,253566341	7
I felt successful	moderately	0,975900073	7
I felt imaginative	moderately	0,951189731	7
I was fast at reaching the game's targets	moderately	1,133893419	7
I felt pressured	not at all	0,755928946	7

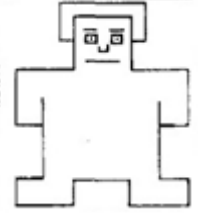|			
I felt irritable	slightly	1,214985793	7
I lost track of time	moderately	1,380131119	7
I felt challenged	moderately	1,069044968	7
I found it impressive	slightly	1,345185418	7
I was deeply concentrated in the game	moderately	0,951189731	7
I felt frustrated	slightly	1,4142136	7
I felt like a rich experience	moderately	0,899735411	7
I lost connection with the outside world	slightly	0,951189731	7
I felt time pressure	slightly	1,496026483	7
I had to put a lot of effort into it	slightly	0,951189731	7
I felt completely absorbed	slightly	0,951189731	7
I felt revived	slightly	0,786795792	7
I felt bad	slightly	0,9759	7
I found it hard to get back to reality	not at all	0	7
I felt guilty	slightly	1,253566	7
I felt like a victory	moderately	1	7
I found it a waste of time	slightly	0,78679579	7
I felt energized	slightly	0,755929	7
I felt disoriented	slightly	1,112697281	7
I felt exhausted	not at all	0,377964473	7
I felt that I could have done more useful things	moderately	1,272418021	7
I felt weary	slightly	1,25356634	7
I felt ashamed	not at all	1,133893419	7
I felt proud	slightly	1,112697281	7
I had a sense that I returned from a journey	slightly	0,975900073	7

The second part of the first test in isolation conditions, was intended to create conditions such as to elicit forms of fear and aggressive response on the test subjects, both from environmental conditions and from the computer game to be played, trying to assess how the responses to the same computer game of the first questionnaire would have differed under such an influence. The first questionnaire that the sample received was given before playing the computer games, a way to understand the self-report of tendency towards aggressiveness without the immediate influence of a computer game with violent content. Analysis of the results, with a sample of 4 subjects, with mean value of 2, shows the following:

question	Average answers	Sd angriness	Sd frustration	Sd irritation	Sd behavior response
It is saturday evening and you are queuing to buy a lottery ticket. It 's very busy and the sh op is soon to close. Yo u have already been w aiting for 10 minutes. Just when it's your tur n, someone else pushe s in front of you. How would you feel in this s ituation?	• Quite a bit/extremely angry • Quite a bit frustrated • Quite a bit/extremely irritated • Say "I'm sorry but it was my turn"	0,57735	1,5	0,57735	0,5
You have gone out to have a couple of drinks with your partner. Whilst you are at the bar, a stranger approaches your partner and grabs her/his backside. On your return, your partner tells you that. How would you feel in this situation?	• A little bit/moderately angry • Moderately frustrated • Moderately irritated • Tell him that such behaviour is unacceptable and out of order	1,290994	1,5	1,825742	1,5
You are in a great hurr y and right in front of you a car stops. A man gets out but he carrie s on talking to the driv er, blatantly ignoring y our calls for him to mo ve. You cannot get pas t the car. How would y ou feel in this situation ?	• Quite a bit angry • Quite a bit frustrated • Quite a bit irritated • Threaten the stranger and swear at him	0,5	1,707825	1,892969	1,5
Your boss believes you have made a minor mi stake at work. In the p resence of all your wor k mates, he embarrass es you by calling you a n incompetent imbecil	• Moderately angry • Quite a bit frustrated • Extremely irritated • Fell angry, but do not do anything	1,707825	2	0	1,732051

e. How would you feel in this situation?					
You are in the cinema watching a movie. Behind you two lads are talking, laughing loudly and kicking the back of your seat all the time. How would you feel in this situation?	• Moderately / quite a bit angry • Moderately / quite a bit frustrated • Quite a bit / extremely irritated • Feel angry, and do nothing	0,57735	1,290994	0,57735	1,154701
You are driving down the motorway. As you are in the process of changing to a slower lane, a reckless driver speeds out from the inside lane, cutting you off, causing you to slam on your brakes, swerve, and nearly lose control of your car. How would you feel in this situation?	• Quite a bit angry • Moderately frustrated • Quite a bit irritated • Leave and go home	0,957427	2,309401	1,154701	1,030776
You are out with a group of friends and there is one guy who is continually "taking the piss" out of you and generally insulting your family. How would you feel in this situation?	• Quite a bit angry • Moderately frustrated • Extremely irritated • Leave and go home, Feel angry but do nothing	0,5	1,825742	0,5	1,732051
You find out from a friend that your partner has been unfaithful to you on one occasion, after a works Christmas party. How would you feel in this situation?	• Moderately / quite a bit angry • Quite a bit frustrated • Quite a bit irritated • Get angry creating a big scene when you next see her/him	1,290994	0,816497	0,957427	1,5
You are walking down the street on your way to an interview for a new job. As you turn the corner, a window cleaner nearby, accidentally spills soapy, hot water on your newly dry cleaned suit. How would you feel in this situation?	• Moderately angry • A little bit / moderately frustrated • Quite a bit irritated • Attract his attention and point out what he had done	1,5	1,914854	1,414214	0,25

You're sat on a train quietly reading the newspaper. A couple of football supporters are sitting a few seats in front shouting, swearing and generally being obnoxious. Suddenly, one of them throws an empty beer can in the air and it accidentally hits you. How would you feel in this situation?	• Moderately angry • Moderately frustrated • Moderately / quite a bit irritated • Try to ignore them, find somewhere else to sit	1,825742	2,309401	1,914854	1,290994
It is Saturday afternoon and you are looking for a parking space in the centre of town. You drive into a car park and just as you are about to reverse into one of the few remaining spaces another car speeds into your space. How would you feel in this situation?	• Moderately angry • A little bit frustrated • Moderately irritated • Do nothing	1,414214	1,5	1,707825	1,258306
You find out that the controls of the game just played were not the same as you thought, nobody told you instructions to play the game in advance, therefore you got killed easily and quickly. How did you felt?	• A little bit angry • Not at all frustrated • A little bit irritated • Say "That's not fair!"	0,957427	0,5	0,957427	0
You are schoolchild, groups of bad students waits out of school to threat or beat you. How would you feel in this situation?	• Moderately / Quite a bit angry • Moderately frustrated • Quite a bit irritated • Try to run away	1,914854	2,309401	2	0
You are obliged to get part to a blood fight, and a group of bad people makes sure that by having kidnapped someone of your beloved. How would you feel in this situation?	• Quite a bit / extremely angry • Quite a bit frustrated • Extremely irritated • Protest with these persons and try to confront them	0,57735	0,957427	0,5	1,414214

After showing the results of the APQ questionnaire, together with related analysis, now is turn to show how the answers to the first game experience questionnaire differs according to the same questionnaire presented as last game experience questionnaire for the first framework of testing (in isolation conditions). It is important to note that only part of the subjects took part to the all first framework test, this part taking as well test on the APQ. Therefore the comparative analysis will include that part of the original sample. The results of the questionnaire out of playing the sequence of the two computer games (the first person shooting mod plus Dogz of Ubisoft) is here presented:

	Pleasure	Arousal	Dominance
mean			
std	2,516611478	1,258306	2,7537853
mean difference	-0,5	-1,75	1,75
std difference	1,36191094	0,258306	0,8389311
t-value	-6,60836163	-44,5209	-5,363969
N	4	4	4

It is assumed a significance level of .05, and any t-value greater or equal to 2.101 has a .05 or less probability of occurring under the assumptions of the null hypothesis. For larger values, the H(1) holds. Therefore, for this case, the null hypothesis holds giving validity to the hypothesis that in conditions of non-social play, there is no difference between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and environmentally inducted aggressive game play.

Data analysis for the social conditions

The empathy test was to be conducted with two test subjects per time, on a questionnaire on multiple-choice. The test was conducted only on a sample. The results here reported argue about the differences for their answers:

Question	Average answer
It makes me sad to see a lonely stranger in a group	yes
People make too much of the feelings and sensitivity of animals	no
I often find public displays of affection annoying	undecided

I am annoyed by unhappy people who are just sorry for themselves	no
I become nervous if others around me seem to be nervous	yes
I find it silly for people to cry out of happiness	yes
I tend to get emotionally involved with a friend's problems	undecided
Sometimes the words of a love song can move me deeply	undecided
I tend to lose control when I am bringing bad news to people	no
The people around me have a great influence on my moods	yes
Most foreigners I have met seemed cool and unemotional	undecided
I would rather be a social worker than work in a job training center	undecided
I don't get upset just because a friend is acting upset	no
I like to watch people open presents	undecided
Lonely people are probably unfriendly	no
Seeing people cry upsets me	undecided
Some songs make me happy	yes
I really get involved with the feelings of the characters in a novel	yes
I get very angry when I see someone being ill-treated	yes
I am able to remain calm even though those around me worry	yes
When a friend starts to talk about his problems, I try to steer the conversation to something else	no
Another's laughter is not catching for me	no
Sometimes at the movies I am amused by the amount of crying and sniffling around me	undecided
I am able to make decisions without being influenced by people's feelings	undecided
I cannot continue to feel OK if people around me are depressed	undecided
It is hard for me to see how some things upset people so much	undecided
I am very upset when I see an animal in pain	yes
Becoming involved in books or movies is a little silly	undecided
It upsets me to see helpless old people	undecided
I become more irritated than sympathetic when I see someone's tears	no
I become very involved when I watch a movie	yes
I often find that I can remain cool in spite of the excitement around me	yes
Little children sometimes cry for no apparent reason	yes

The social test was intended on obtaining from the test participants a new self-report regarding aggressiveness, this time after having played a computer game that could have elicited aggression. One of the subject decided to confirm the answers previously reported to the same questionnaire, while the other decided freely not to give any answer. It was also intended to proceed with a further assessment of empathy in regard to inducted aggressiveness, but the testers decided to end at this point their testing phase for the first part of the social pilot test.

The second part of the test regarded assessing how in normal conditions social play for nurturing would have been conduced, after all of the previous conditions in which testers where constrained. Only a sample was tested, analysis of the first

questionnaire for the two subjects (attitudinal test towards love for pets and nurturing) is here reported:

question	Average answer
1. I would like a pet, or to continue to have a pet, in my home	Disagree / Neutral
2. I have occasionally communicated with my pet and understood what it was trying to express (or would if I had one)	Disagree / Neutral
3. I frequently talk to my pet (or would if I had one)	Disagree

1. If a pet destroyed a DKK50.00 piece of furniture or personal item, I would get rid of it	Strongly Disagree
2. If a pet destroyed a DKK40000.00 piece of furniture or personal item, I would get rid of it	Strongly Disagree / Disagree
3. If a young pet required extensive veterinary care, I would get rid of it	Neutral
4. If an old pet required extensive veterinary care, I would get rid of it	Agree
4. b) If a three month old puppy or kitten was having problems with housebreaking, I would get rid of it	Disagree
5. If a six month old puppy or kitten was having problems with housebreaking, I would get rid of it	Disagree
6. If an adult dog or cat was having problems with house breaking, I would get rid of it.	Neutral
7. If a three month old puppy or kitten was having problems with destructiveness, I would get rid of it	Disagree
8. If a six month old puppy or kitten was having problems with destructiveness, I would get rid of it.	neutral
9. If an adult dog or cat was having problems with destructiveness, I would get rid of it.	Disagree

Lexington Attachment to Pets Scale

question	Average answer
a) My pet means more to me than any of my friends	Disagree Strongly / Don't Know or Refuse
b) Quite often I confide in my pet	Disagree Somewhat
c) I believe that pets should have the same rights and privileges as family members	Agree Somewhat
d) I believe my pet is my best friend	Agree / Disagree Somewhat
e) Quite often, my feelings toward people are affected by the way	Agree Somewhat

	they react to my pet
f) I love my pet because he/she is more loyal to me than most of the people in my life	Disagree Somewhat
g) I enjoy showing other people pictures of my pet	Disagree somewhat
h) I think my pet is just a pet	Agree / Disagree Somewhat
i) I love my pet because it never judges me	Agree / Disagree Somewhat
j) My pet knows when I'm feeling bad	Agree / Disagree Somewhat
k) I often talk to other people about my pet	Disagree Somewhat / Strongly
l) My pet understands me	Disagree Somewhat
m) I believe that loving my pet helps me stay healthy	Agree / Disagree Somewhat
n) Pets deserve as much respect as humans do	Agree Strongly / Somewhat
o) My pet and I have a very close relationship	Agree / Disagree Somewhat
p) I would do almost anything to take care of my pet	Agree Somewhat
q) I play with my pet quite often	Agree Somewhat
r) I consider my pet to be a great companion	Agree / Disagree Somewhat
s) My pet makes me feel happy	Agree Somewhat
t) I feel that my pet is a part of my family	Agree Somewhat
u) I am not very attached to my pet	Disagree Somewhat / Strongly
v) Owning a pet adds to my happiness	Agree / Disagree Somewhat
w) I consider my pet to be a friend	Agree / Disagree Somewhat

statement	Average answer
1. It makes me sad to see a child who can't find anyone to play with	Moderately / Fairly
2. Seeing a child who is crying makes me feel like crying	Moderately
3. Sometimes I cry when I watch TV	Moderately
4. It get upset when I see a child being hurt	Moderately
5. Some songs make me so sad I feel like crying	Slightly / Moderately
6. When I see someone suffering, I feel bad too	Moderately / Fairly
7. When I walk by a needy person I feel like giving them something	Moderately
8. It upsets me when another child is being shouted at	Slightly / Moderately
9. When my parents get upset I feel bad	Moderately

10. I get upset when I see an animal being hurt	Moderately / Fairly

statement	Average answer
1. It was of my interest to play bullfight in a computer game	Slightly
2. I consider blood sports something humanly acceptable	Not at all
3. I consider bullfight as an artistic form and entertainment, therefore I accept it, indeed it is a violent sport	Not at all / Slightly

Assessment of affiliative tendency and sensitivity to rejection

statement	Average answer
1. preference for friends and attachments versus greater independence from others	Neutral
2. one's preference for group versus individual activities	Neutral
3. positive-negative feelings associated with the presence of many people	Neutral
4. preference for expressing affection toward people	Neutral
5. active seeking of friends'	Disagree
1. preferences for behaviours or situations which minimized negative feedback from others	Neutral
2. preferences for being spontaneous and expressing desires and feelings	Disagree
3. positive-negative feelings associated with the presence of many people	Agree
4. inability to refuse favors	Agree
5. concern about being liked	Neutral
6. negative feelings associated with the presence of many people	Agree

None of the testers was interested regarding associating sentences of values for their preferences for behaviours or situations which minimized negative feedback from others.

Assessment of approval seeking and personality attitudes and traits

question	average answer
1. Before voting I thoroughly investigate the qualifications of all the candidates	True
2. I never hesitate to go out of my way to help someone in trouble	Neutral
3. It is sometimes hard for me to go on with my work if I am not encouraged	Neutral

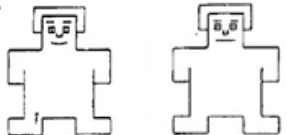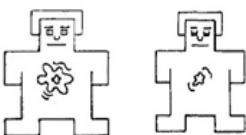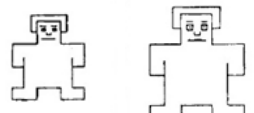| 4. I have never intensely disliked anyone	Neutral
5. On occasion I have had doubts about my ability to succeed in life	True
6. I sometimes feel resentful when I don't get my way	True
7. I am always careful about my manner of dress	Neutral
8. My table manners at home are as good as when I eat out in a restaurant	Neutral
9. If I could get into a movie without paying and be sure I was not seen I would probably do it	Neutral
10. On a few occasions, I have given up doing something because I thought too little of my ability	Neutral
11. I like to gossip at times	Neutral
12. There have been times when I felt like rebelling against people in authority even though I knew they were right	Neutral
13. No matter who I'm talking to, I'm always a good listener	Neutral
14. I can remember "playing sick" to get out of something	Neutral
15. There have been occasions when I took advantage of someone	Neutral
16. I'm always willing to admit it when I make a mistake	True
17. I always try to practice what I preach	Neutral
18. I don't find it particularly difficult to get along with loud mouthed, obnoxious people	No
19. I sometimes try to get even rather than forgive and forget	Neutral
20. When I don't know something I don't at all mind admitting it	Neutral
21. I am always courteous, even to people who are disagreeable	No
22. At times I have really insisted on having things my own way	Neutral
23. There have been occasions when I felt like smashing things	Neutral
24. I would never think of letting someone else be punished for my wrong-doings	True
25. I never resent being asked to return a favour	Neutral
26. I have never been irked when people expressed ideas very different from my own	No
27. I never make a long trip without checking the safety of my car	Neutral
28. There have been times when I was quite jealous of the good fortune of others	No
29. I have almost never felt the urge to tell someone off	No
30. I am sometimes irritated by people who ask favors of me	Neutral
31. I have never felt that I was punished without cause	Neutral
32. I sometimes think when people have a misfortune they only got what they deserved	No

33. I have never deliberately said something that hurt someone's feelings	No

Nurturance and succorance assessment

question	Average answer
1. I enjoy to give sympathy and comfort	Agree
2. I enjoy to assist others whenever possible	Agree
3. I am interested in caring for children, the disabled, or the infirm	Neutral / Agree
4. I am always ready to encourage someone who feels depressed	Agree
5. When I see a baby, I often ask to hold him/her	Disagree

question	Average answer
1. I frequently search for the sympathy of people	Neutral
2. I frequently search people for feeling protected	Neutral
3. I am a person that needs love from other people	Neutral
4. I often ask for advices from other people	Agree
5. I often ask to be reassured from other people	Neutral
6. I promptly confide my difficulties to a receptive person	Neutral
7. I often feel insecure	Disagree

With self-report for personality traits as:

	Pleasure	Arousal	Dominance
mean			
std	1,41421356	1,414214	1,41421356
N	2	2	2

The empathy and in-game play questionnaire was meant different among the two subjects of every sample, with the one participating to the test (thereby assisting the computer game player) having some extra questions. Due to lack of time and participants, only one sample was possible to be analyzed, and therefore the results here presented regard the answer of this sample. The answers to the extra-questions given were:

Question	Answer
1. How relevant (important) is what is happening in this	Neutral

situation to my needs and goals?	
2. Is this congruent with my goals (good)? Or is it incongruent with them (bad)?	Disagree
3. To what extent am I responsible for what is happening in this situation?	Neutral
4. To what extent is the other or something else responsible for what is happening in this situation?	Agree
5. To what extent can I act on this situation to make (or keep) it more like what I want?	Agree
6. To what extent can I handle and adjust to this situation however it might turn out?	Strongly Agree
7. To what extent do I expect this situation to improve, or get worse, for any reason?	Strongly Disagree

And the common questions of:

question	Average answer
1. I was interested in the game's story	Neutral / Agree
2. I felt successful	Agree
3. I found it impressive	Disagree / Neutral
4. I forgot everything around me	Disagree
5. I felt frustrated	Strongly Disagree / Disagree
6. I felt irritable	Disagree
7. I felt completely absorbed	Disagree
8. I felt challenged	Disagree / Neutral
9. I had to put a lot of effort into it	Disagree
1. I empathized with the other(s)	Agree
2. My actions depended on the other(s) actions	Strongly Agree
3. The other's actions were dependent on my actions	Neutral
4. I felt connected to the other(s)	Disagree / Neutral
5. The other(s) paid close attention to me	Disagree
6. I paid close attention to the other(s)	Neutral
7. I felt jealous about the other(s)	Strongly Disagree
8. I found it enjoyable to be with the other(s)	Disagree / Neutral
9. When I was happy, the other(s) was(were) happy	Neutral / Agree
10. When the other(s) was(were) happy, I was happy	Agree
11. I influenced the mood of the other(s)	Neutral / Agree
12. I was influenced by the other(s) moods	Neutral / Agree
13. I admired the other(s)	Disagree
14. What the other(s) did affected what I did	Disagree / Neutral
15. What I did affected what the other(s) did	Agree / Strongly Agree
16. I felt revengeful	Strongly Disagree
17. I felt schadenfreude (malicious delight)	Strongly Disagree

Game experience questionnaire in social conditions, with difference and t-value respect to the first assessment in isolation conditions
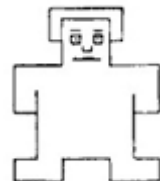
The mean value assumed was of 4.

Hypothesis to be evaluated were:

H(0) (Null hypothesis): There is no difference for emotional responses between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and inducted aggressiveness, before and after having experienced the aggressive stimuli

H(1): there is difference for emotional responses between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and inducted aggressiveness, before and after having experienced the aggressive stimuli

As for the case of the overall first test, in this case numerical validation will be given from the computation of the t-value, where with significance level of 0.05, any t-value up to 2.101 has 0.05 or less probability of occurring under the assumptions of the null hypothesis; therefore for larger values H(1) holds.

	Pleasure	Arousal	Dominance
Mean			
Std	0,707107	0	0
mean difference	-0,5	-1	0
std difference	-0,70711	-1,4142136	-2,8284271
t-value	12,72792	7,0710678	2,82842712
N	2	2	2

This case implies that the H(1) hypothesis holds, meaning that the comparison of the initial conditions of game play without any aggressive stimuli received, and the final

one which is in natural conditions but after receiving stimuli for aggressiveness, shows a t-value higher than 2.101 for each of the emotional dimensions, therefore with a properly constructed scenario for aggressiveness stimuli, consequent responses to stimuli which should not elicit aggressiveness shows different emotional responses for the same game. However it is to be considered the role of the social emotions into this framework.

And textual questionnaire answers of:

question	Previous average answer	Average answer	Std difference
1. It gave me a bad mood	Slightly	Not at all	0
2. I found it tiresome	Slightly	Not at all	-1
3. I thought it was hard	Slightly	Moderately	0
4. It was aesthetically pleasing	Moderately	Moderately	-1
5. I forgot everything around me	Slightly	Not at all / slightly	0,71
6. I felt successful	Moderately	Slightly	1
7. I felt imaginative	Moderately	Moderately	1
8. I was fast at reaching the game's targets	Moderately	Moderately	-1
9. I felt pressured	Not at all	Slightly	1
10. I felt irritable	Slightly	Not at all	0
11. I lost track of time	Moderately	Not at all / slightly	0,707107
12. I felt challenged	Moderately	Moderately	-0,70710678
13. I found it impressive	Slightly	Moderately	0
14. I was deeply concentrated in the game	Moderately	Moderately	0
15. I felt frustrated	Slightly	Not at all	-0,70711
16. It felt like a rich experience	Moderately	Moderately	-0,70711
17. I lost connection with the outside world	Slightly	Moderately	0,707107
18. I felt time pressure	Slightly	Slightly	1,414214
19. I had to put a lot of effort into it	Slightly	Slightly	-1,41421
20. I felt completely absorbed	Slightly	Not at all / slightly	0
21. I felt revived	Slightly	Not at all / slightly	0
22. I felt bad	Slightly	Not at all	0

23. I found it hard to get back to reality	Not at all	Not at all	0
24. I felt guilty	Slightly	Not at all	0
25. I felt like a victory	Moderately	Not at all / slightly	-0,70711
26. I found it a waste of time	Slightly	Slightly	0,707107
27. I felt energized	Slightly	Not at all / slightly	0
28. I felt disoriented	Slightly	Slightly	1,414214
29. I felt exhausted	Not at all	Slightly / Moderately	2,12132
30. I felt that I could have done more useful things	Moderately	Moderately / Fairly	1,414214
31. I felt weary	Slightly	Not at all	0
32. I felt ashamed	Not at all	Not at all	0
33. I felt proud	Slightly	Not at all / Slightly	0
34. I had a sense that I returned from a journey	Slightly	Slightly	-1,41421

Discussion

Due to time limit and availability of testers, it was not possible to have a substantial number of data to test. However, with the data obtained, and comparing the self-reports with the multimodal and physiological captures, it was possible to make a qualitative assessment of factors related to personality, empathic tendency and aggressiveness, emotionality in regard to sociality, and interaction with electronic media in deprived and unconstrained sociality.

While multimodal, physiological and self-reports shows an agreement regarding contentedness on the game play for Dogz, with dull arousal and mean tendency for dominance, the overall emotional arousal is numerically slight.

Starting from the first part of the 4 case scenario of the pilot test, testers manifested initially their feeling comfortable in the environment where they were located for playing the computer game, however with time showed disappreciation for having connected electrodes to their bodies. Moreover they would have preferred a shorter time for the all testing, indeed it was not possible to cut further. The self-report for aggressiveness feelings and behaviour, filled from the testers in isolation conditions, shows a general tendency for moderate angriness and frustration, but in general quite a bit easiness for irritation. Moderate is also the judgement for the elicited response due to the represented scenario. The comparison for differences on emotional responses, in quasi-isolation conditions, among subjects involved in a non-aggressive computer game and a computer game with violent content, shows that the effects of the scenario plus the contents of the computer game have no efficacy on inducing aggressiveness on test subjects.

Another matter regards the second part of the pilot test, where two subjects per time were taking each test. The first test regarded empathy, in 13 of the 33 questions (thereby between 39 and 40% of the questions) answers were discordant. The questions in which answers were discordant are:

- I often find public displays of affection annoying
- I tend to get emotionally involved with a friend's problems
- Sometimes the words of a love song can move me deeply
- Most foreigners I have met seemed cool and unemotional
- I would rather be a social worker than work in a job training center
- I like to watch people open presents
- Seeing people cry upsets me
- Sometimes at the movies I am amused by the amount of crying and sniffling around me
- I am able to make decisions without being influenced by people's feelings
- I cannot continue to feel OK if people around me are depressed
- It is hard for me to see how some things upset people so much
- Becoming involved in books or movies is a little silly
- It upsets me to see helpless old people

This first part of the second pilot framework was not possible to be completed from all the participants, as they did not filled up the APQ questionnaire which was intended such as to measure variations on the measured responses from the first case scenario. Neither it was possible to obtain an evaluation or to conduct the aggressive eliciting scripted scenario and have data regarding self-report on this specific game experience. However, the last part of the test was possible to be conducted for one sample; from the attitudinal test, the Lexington attachment to pets scale showed a general somewhat disagreement with the questions and for the other questions of the part of the questionnaire as well. The questions that regarded the participants opinions regarding bullfight as a simulation and in general as a sport, shows that they had a slight interest on playing a bullfight computer game, that the participants does not consider blood sports something that it is possible to accept as humans, that quite not all it can be considered as an artistic form and entertainment, indeed it is qualifiable as a violent sport.

General neutrality was expressed on regard to affiliative tendency and sensitivity to rejection. The participants also answered the other questions of the personality test. Finally, the last hypothesis to be verified, as understanding whether there is no difference for emotional responses between the hypothesized mean and the expected mean of emotionality for game experience between natural conditions and inducted aggressiveness, before and after having experienced the aggressive stimuli and in the same non-aggressive game, gave validity to change, meaning that different emotional responses were measured to the same sample.

Conclusion

While it has been previously done an extended research towards the subjects of neural networks, fuzzy logic, finite-state-machines, and reinforced learning which has tried to explain how to machinize the internal capabilities of people, this project has

focused on understanding the subject of believalism in a hybrid context, being the duality human-animal. Starting from the specific problem of understanding the context of communication applied among the two entities, ending with analyzing human emotions involved in a mediated context of human-animal interactions, this project has attempted to bridge somehow the gap existing on the researches which often goes across those field of studies, trying to compose a qualitatively valid research on topics which regard that bridge (proposing an analysis of the human-animal bridge of the nervous system, explaining how learning and play is differentiated among persons and animals, proposing at the end an analysis of the electronic media and their role for pet nurturance and empathy), trying at the end to make a survey on how people and their personalities can relate to this subject, meaning their aptitude on empathy, altruism, nurturance, and how in fact that can be measured in a laboratory context trying somehow to achieve an approach which would not constrain test subjects, neither would give short term answers. The assessment were made through self-reports, thinking aloud, and daily conversations. In order to give a way of measuring how factors of stress could have changed the personality tendency towards the above mentioned qualities, the assessment was effectuated by using a customized framework for measuring aggressiveness in opposite to case scenario for conducting throughout role play and combined computer games (one for pet nurturing, another with a violent content - bullfight), how the participants would have responded in such cases, with showcases findable from the previous analysis and research conducted, and in a statistically measurable way. While trying to give an answer to the validity of this experimental project, questions that were analyzed regarded the role of the quality of the modalities for the computer games on affecting different responses to the test subjects, as well as understanding the possibility of making simpler testing procedures more effective as for the comfort of testers and for measuring reliability. However, the complexity of the overall subject did not offered these options, while further work is of auspicious.

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Appendix

The game of bullfight

Bullfight is a spectacle which is basically dedicated on creating show from a professional person (toreador), that has to confront the bull having an instrument to attract the bull (called mulet, a red cloth which is used to attract the bull) and blunt weapons, as it is the case of swords. Its choreography is in reality much more complicated than this description; due to the delimitations of the project, it was decided to simplify the game elements as much as possible. In order to conduct the tests for human to animal relationships and aggressive inductance through electronic media, it was decided to implement this game, as a mod of an existing computer game. That computer game modified was the First Person Shooter example deployed from Unity3D; Unity3D is also a powerful computer game engine, therefore it was used for the development of the mod. The strategy for the development was based on creating a semi-realistic setting in which the bullfight happens in the real world (an arena is such an instance). In order to feel better quality of immersion into the acts of the toreador, the camera for the computer player was meant just for first person actions. A screenshot of how the game appears is in (1):
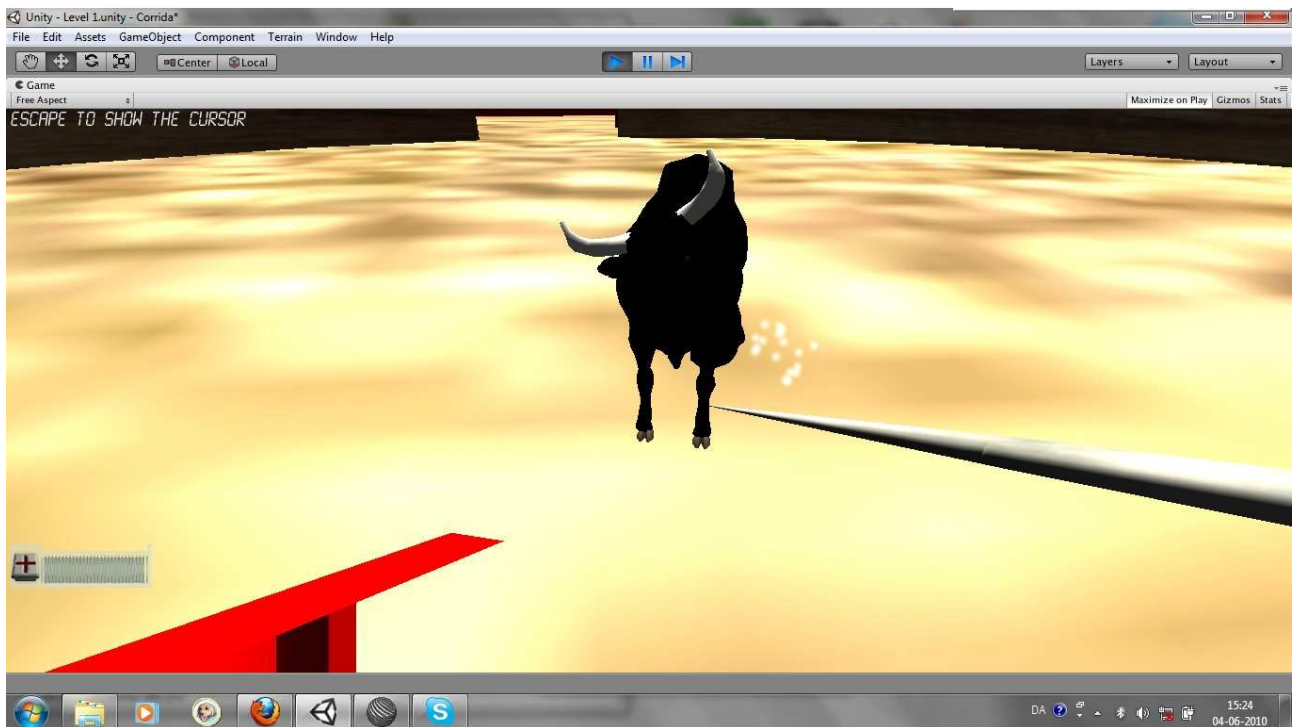
1 - The bullfight game

In order to conduce combined tests (isolation conditions and social ones), it was also included an extra camera, comfortable to be used on a double screen view, in a way to follow the actions of the bull from a passive spectator interested on embodying into the actions of the bull.

The show includes also an audience, and a proper ambient music that should match the represented environment.

The work consisted on modeling components for the environment, one sword and a mulet for the toreador, the audience, the non-playable-character. Some parts of the original game were kept faithful to the original; others were adapted to this game or eliminated, as is the case of the GUI object. Here in advance will be showed the models realized with the project choices, and further details regarding how the scripting of the original game (the first person shooting) was changed.

The arena
The arena is made of a central area, with a floor of sand, a wooden wall, used to create a middle space between the area where the bulls and the toreador departs before starting the bullfight and the fighting area itself. The audience locations use a wooden texture. A screen dump, giving an overview of the scenario is here presented (2):

2 - An overview of the bullfight arena

The arena is also a sound source for the ambient music. It is also associated to sounds triggered with the event of the murder of the bull. The arena has also associated a set of waypoints, which are used for orienting the movement of the bull around the arena, on inspecting for the presence of the toreador and for the preparing acts before attacking. They are visible in the image above with the 'W' character, forming a squared figure. One directional light is used as to represent the sunlight.

The GUI

As a way for the player to understand how much has got damaged due to accidents on the game, one element on screen (a GUI bar) is in use. That is showed in (3):

3 - Play action, with the GUI life bar on the bottom-left side of the screen

The next element being presented consists of the first person character.

The first person character

It is used the same element as from the Standard Assets of Unity3D; from the original game, the user is not handling a gun neither a rocket launcher, but instead is using a sword and a mulet, as in the following screen dumps (4):
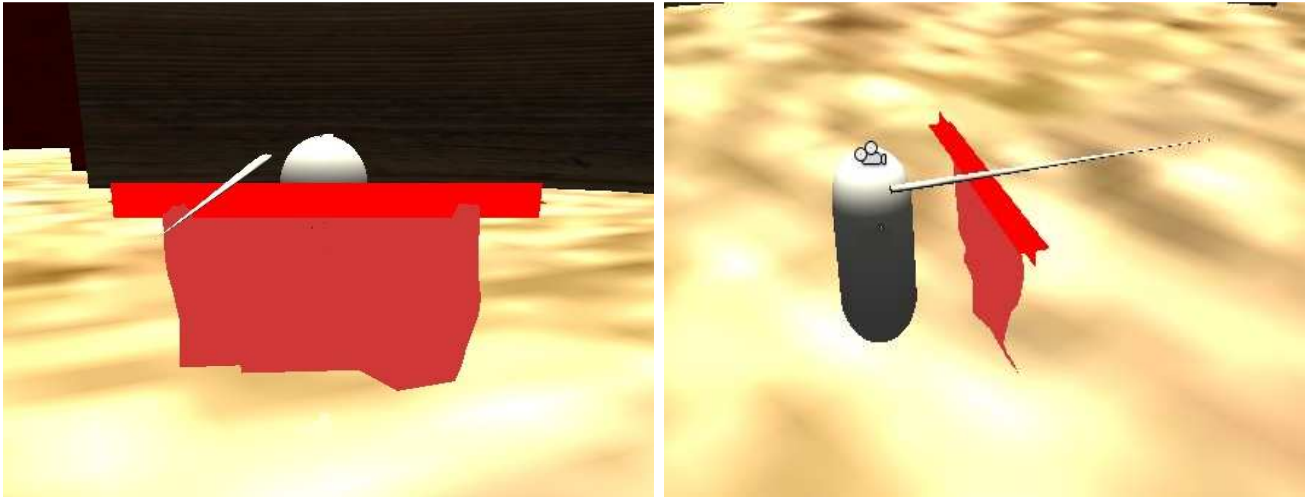
4 - the first person controller, with in evidence the sword and the mulet in use

The mulet has a simple animation on it, which replicates the windy effect on a cloth element.

The audience character

It was chosen to represent an animal as element of the audience, that being a gorilla. A screen dump is showed in the following (5):

5 - An element of the audience

It is represented from a game object having a non-sophisticated animation of exultation made with Autodesk Maya®, and in the game repeats this animation with a Ping-Pong loop.

The bull character

Another element is the non-playable character, which is an agent with a scripted behaviour, sounds and animations. One sample of the existing bots of the original game was used as template for that; the animations were replaced, with the ones for the bull, weapons actions were substituted with the goring action, explosion actions for bullets and rockets replaced with bleeding in the case of hitting the player. The damage script is modified as to give realism to the damage behaviour. Parameters, such as speed, are changed also accordingly in order to concern realism. The game object is here showed (6):

6 – The bull, as a NPC

Hereby it is described how the scripts differ from the original ones. The original script for handling the machine gun was modified such as to be used for handling the collision of the horns with the body of the player. The part that got modified is the function FireOneShot(), with the new function as in the following:

```
function FireOneShot() {
    var direction =
transform.TransformDirection(GameObject.FindWithTag("Player").transform.position);
    var hit : RayCastHit;

    if(Physics.Raycast(transform.position,direction,hit,range)) {
      if(hit.rigidbody) {
      hit.rigidbody.AddForceAtPosition(force*direction, hit.point);
      }
    }

  // the bleeding reaction
  If(hitParticles) {
   If(hit.collider.name == "FirstPerson Player") { // check if it is the player that is hitted
      hitParticles.transform.position = hit.point;
      hitParticles.transform.rotation = Quaternion.FromToRotation(Vector3.up, hit.normal);
      hitParticles.Emit();
   }
  }


hit.collider.SendMessageUpwards("ApplyDamage",damage,SendMessageOptions.DontRequireReceiver);
}
}
```

A similar approach is used for a modified version of the machine gun script applied for the action of swording. Here the difference consisting of accomplishing the swording action as a reduced movement in a very small fraction of time, indeed visibly appreciable, of the frontal position of the sword. The transform related to that game object is then modified and resettled to the original position. That is done through adding a simple if – else statement on the function FireOneShot():

```
var counter=0;
function FireOneShot() {
 if(counter >= 1) {
    transform.localPosition.z -=.5;
    counter = 0;
}
else {
    transform.localPosition.z +=.5;
    counter++;
}
}
```

After the player concludes with the murder of the bull, a contrasting scenario is presented:
• Fireworks for partying the victory
• Horror movies sounds, for eliciting fear now and trying to represent regret from the murder about his/her action

After a short time, the player is presented an audio video slides show regarding the history of bullfight.

For the gameplay occurring with 2 different subjects, one as a passive spectator embodying on the bull, that is the screen dump that they will face (7):
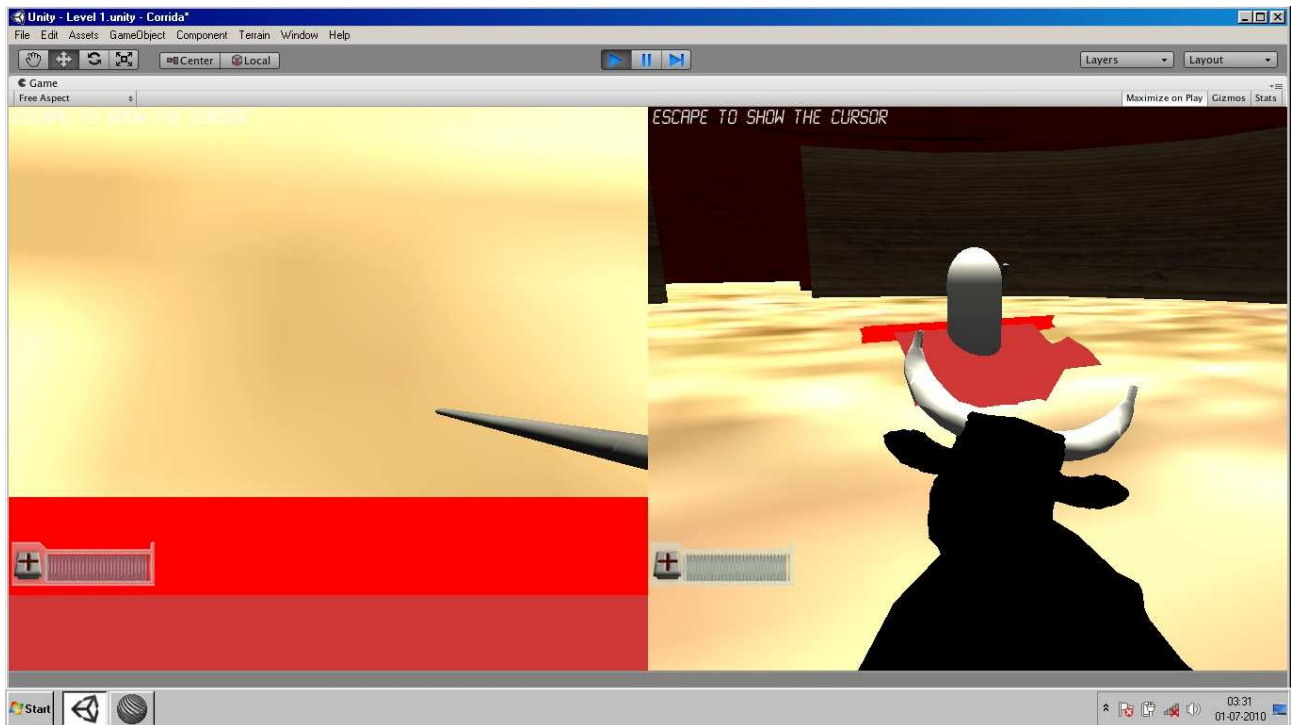
7 - The gameplay with double screen

The questionnaire that was not used for testing

With the exception of one questionnaire type, all the other ones were filled up from the testers at least once. The questionnaire mentioned is here presented, and it is related to expressing general background with games from self-report:

TESTER'S NAME & LASTNAME: GENDER: M/F
AGE:

Questionnaire of general knowledge as gamer

Write an 'x' or write down your answer where required

1. How often do you play computer games?

	Never	1-2 hours/week	5-10 hours/week	15-20 hours/week	More
Level	0	1	2	3	4

2. Name your favorite type of game

3. And the title name (the name of your favorite game title)

4. How much do you think is violent this game?

	Not at all	Slightly	Moderately	A lot	Extremely
Level	0	1	2	3	4