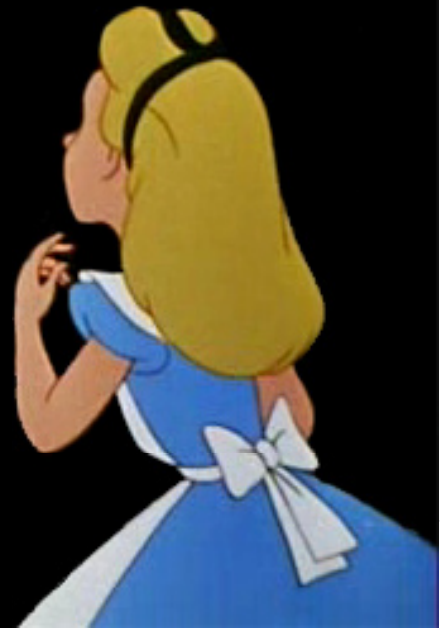
# *Advice from a Caterpillar*

## *Towards Unconscious Metamorphosis*



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## *Abstract*

This project explores an application for a novel direction in human-computer interaction named 'cultural computing', which aims to provide a new medium for cultural translation (Kooijmans and Rauterberg, 2006). More then traditional media such as paintings, books or movies, cultural computing has the potential to offer immersive experiences by using computer-based technologies. The main objective of this project is to create an interactive experience that encourages people to question their self-concept and stimulate unconscious metamorphosis. In Western culture, the self-concept is generally based on conscious perception of the self. The story 'Alice's Adventures in Wonderland', which survived for over centuries, seemed to be a promising narrative to address this issue. An installation will be designed in which the user goes through an interactive experience in the role of Alice and meets a Caterpillar, who questions the participant's whereabouts of his/her self-concept. My individual bachelor project covers the interaction design, implementation and assessment of this installation. I've predicted that the staged experience will have an unconscious effect towards individual metamorphosis. To determine this effect, I employed the 'implicit association test' (IAT) method, which measures changes in a person's implicit self-concept.

# 1 Introduction

## 1.1 Understanding Culture

The word culture (from the Latin "colo, -ere", meaning "to cultivate", "to inhabit" or "to honor") has been defined and used in many ways throughout different contexts. Kroeber and Kluckhohn (1952) compiled a list of more than 200 different definitions of culture in their book "Culture: A Critical Review of Concepts and Definitions". The most popular definition of culture in the field of anthropology is "a complex web of shifting patterns that link people in different locales and that link social formations of different scales" [1]. These patterns can consist of attitudes, norms, values, beliefs, actions, communications, institutions, etc.

To understand the way culture works, it is helpful to make a Cartesian-like split between collective reality on a cultural level and psychological reality on an individual level. I will use a constructivist theory to explain the interrelation of both realities. Dan Sperber (1996) argued that the symbols that construct culture are initiated on the level of the individual and spread in a way that can be explained epidemiologically. This means that contagious ideas that come from the individual are spread like an epidemic until they become a pattern that constructs and maintains the collective reality. The other way around, the individual reality of a person in a social context is shaped and maintained by this collective reality through socialization (Kitayama et al., 1997). This is describes for example how religion is established; some influential people adopted a certain world-view and spread this amongst the people.

## 1.2 Cultural Computing

Recently, developments in the field of Human Computer Interaction (HCI) have opened up a new direction for the application of computer technology. After the introduction of personal computing, cooperative computing and social computing, a new paradigm for HCI named cultural computing has emerged (Rauterberg, 2006). Cultural computing is based on what is called Kansei Mediated Interaction (Nakatsu, Rauterberg & Salem, 2006). Kansei Mediation is a form of multimedia communication that carries non-verbal, emotional and Kansei information (e.g., unconscious communication).

In the first application of cultural computing, Tosa et al. defined cultural computing as cultural translation that uses scientific methods to represent essential aspects of culture (Tosa et al., 2005). These scientific methods, such as artificial intelligence and mixed realities can give a person the sense of entering and participating in a different world. More than paintings or books, which are rather passive media for cultural translation, this has the potential of facilitating rich and immersive experiences. One can imagine that experiencing aspects of a culture through participation has a richer effect then watching a series of paintings.

A possible goal for cultural computing is to stimulate someone's self-awareness with respect to her/his own culture. To achieve this, it is important that a cultural computer facilitates an experience that makes someone's unconscious cultural bounds explicit. This project tries to stimulate one's awareness of these bounds by changing a cultural aspect in a person's environment to create a small culture shock. For such a culture shock to occur, it is essential that the participant of the installation will be immersed in and convinced of the new reality which (s)he enters. Computer technology can mediate such an immersive experience by making use of mixed realities and interactivity (Francois, 2002).

1 Culture, Wikipedia – the Free Encyclopedia, http://en.wikipedia.org/wiki/Culture.

# 2 Related Work

## 2.1 In the 'East'

From a historical perspective, Buddhism is one of the main formers of Eastern culture. Its teachings, which probably originate from the sixth century BC in northern India (areas of Gandhara and Mathura) were transmitted progressively through Central Asia and China until it reached Korea in the fourth century AD and Japan in the sixth century AD. Zen Buddhism is one of the younger traditions and was widely spread in the thirteenth century AD. This religion cultivated discipline and austerity as the path to enlightenment, which is seen in Buddhism as the state of perfect awakening to the eternal and ultimate truth that is the reality of all things. This supreme state of life is characterized by boundless wisdom and infinite compassion[1].

One of the typical images of Zen Buddhism are the carefully designed kare-sansui gardens. As vehicles for contemplation, such gardens convey the vastness of nature through the power of suggestion. The project 'ZENetic Computer' for the first time addresses these images using computer technology. In an installation participants are taken into the world of Zen and build a three-dimensional interactive Japanese sansui ink painting. While creating their imaginary landscape, the system recognises the user's hidden personality through the suggestive powers of the different elements. Using this information, the system stages a conversation in which the user can experience the birth of self-awareness brought about through the unification of one's everyday self and one's unconscious self (Tosa et al., 2005).


**Figure 1: 'ZENetic Computer'**

## 2.2 In the 'West'

The Zen teachings and symbols that are used in he 'ZENetic Computer' installation (see Figure 1) are very typical for the Japanese culture and are not likely to be understood by people from a Western culture. The question that arises is how to create a comparable experience in the West that is based on symbols that appeal to people from this culture. Rauterberg (2006) tried to answer this question in the project named ALICE by proposing a cultural computer based on the story of 'Alice's Adventures in Wonderland'. The story was written by the British mathematician and author Reverend Charles Lutwidge Dodgson under the pseudonym Lewis Carroll (1865).

One of the themes that Lewis Carroll intended to address in 'Alice in Wonderland' (short name) is rationality and logic as its product in the process of growing up. A possible explanation that the story has remained popular in the Western culture for almost 150 years could be that the used symbols appeal to our cultural bounds. Nisbett et al. (2001) confirmed that Westerners tend to analytical thought, paying attention primarily to objects and the categories to which they belong and using rules, including formal logic, to understand its behavior. In contrast, East Asians are more likely to think holistically, attending to the entire field and assigning causality to it, making relatively little use of categories and formal logic, and relying on 'dialectical' reasoning.

2 http://www.experiencefestival.com/a/Buddhahood/id/79203

Although Alice's adventures mostly refer to English culture, both English and Western culture in general are based on Monotheist religions (Judaism, Christianity, and Islam), which are concerned with certainty and absolute truth. Besides rationalism, these dogmas can be found back in the narrative of Alice and are manifested in several concepts such as linearity of time and space, the absoluteness of matter, and the self-concept. After Alice decides to escape the rational world and follows the White Rabbit into a hole, she goes through a series of experiences where the certainty and absoluteness of these concepts have disappeared. This makes her experience a culture shock, which is consistent with our earlier mentioned goal of cultural computing. The ALICE project aims at providing a comparable experience to people by letting them assume the role of Alice in an interactive installation.

## *2.3 Contribution to the ALICE project*

Through the course of the experience, the participants of the installation encounter several stages that are based on chapters of the original plot. The following stages were initially selected: "Escaping Reality", "Down the Rabbit Hole", "Shrinking and growing" and "Talk with the Cheshire Cat". To collaborate in the ALICE project, I proposed to include the chapter named "Advice from a Caterpillar". This will be integrated in the whole installation and staged chronologically between the "Shrinking and growing" and "Talk with the Cheshire Cat".

By addressing the Western individual self-concept, Alice's self is challenged in "Advice from a Caterpillar". After she entered the rabbit hole to follow the white rabbit, she experienced a lot of transformations both physically and mentally. This brought her in an initial state of confusion, which is emphasized in her conversation with the Caterpillar: 'Who are YOU?' asked the Caterpillar. This challenging attitude of the Caterpillar makes Alice uncertain about herself, becoming vulnerable for persuasion. Such a situation gives the possibility for a confrontation with and stimulates awareness of the self-concept. The "Advice from a Caterpillar" project aims at designing an installation that facilitates such an experience. Before discussing the design of my installation, we have to look in a broader perspective at what this concept of self comes down to and how it is manifested in different cultures.

# 3 The Self

## 3.1 The Debate around the Self

Throughout history, there have been wide varieties of theories about the self, coming from the fields of philosophy, psychology, and religion. This includes assertions that there is no self; that the idea is a logical, psychological, or grammatical fiction; that the sense of self is properly understood and defined in terms of brain processes; that it is merely a constructed sociological locus, or the centre of personal and public narratives, or that it belongs in an ineffable category on its own (Gallagher and Shear, 1999).

In the West, the discussion about the self started in Greece philosophy, where Socrates promoted freedom and independence of every human being, starting a tradition of self-knowledge in the context of ethical life. The view that was represented by Aristotle describes the self as the embodied existence of a human being, involving a multitude of life functions, which through rational thought can be transcended close to a divine level. This notion was much later elaborated by Kant (1784), who answered the question to 'What is Enlightenment?' by promoting self-realization as the process of releasing 'immaturity', linking will, authority and reason. As a result, the Western ideal of self-knowledge became mainly based on rational understanding of the individual through conscious reflection.

What is in the West generally suggested by soul, self or ego is that there is a permanent, everlasting and absolute entity, which is the unchanging substance behind the changing phenomenal world. Buddhism, which has been one of the major influences in Eastern culture, contrastingly denies the existence of such a self. According to their teachings, the idea of self is an imaginary, false belief which has no corresponding reality, and it produces harmful thoughts of 'me' and 'mine', selfish desire, craving, attachment, hatred, ill-will, conceit, pride, egoism, and other defilements, impurities and problems. 'What is Enlightenment' is answered by Buddhist teachings as the process of realization that there is no self and thus no suffering (Rahula, 1959).

Another teaching that deeply influenced Eastern life and thought are that of the Chinese thinker and social philosopher Confucius, who was born in the 6th century BC. He promoted that self-knowledge is in essence an objectless awareness, or realization, of the human possibility. This can be achieved by means of intellectual intuition, which is described as gaining direct knowledge of reality without logical reasoning or inference (Tu, 1985).

## 3.2 Knowing the Self

"A man likes to belief he is master of his soul. But as long as he is unable to control his moods and emotions, or to be conscious of the myriad secret ways in which unconscious factors insinuate themselves into his arrangements and decisions, he is certainly not his own master." – C.G. Jung, "Man and his Symbols" (1969)

Who are YOU? Most often the answer to this question would be a name or "a human being". Thinking to know oneself is often based on the conscious perception of the self. This conscious perception can be explained by the term qualia, which comprises the 'raw feels' of conscious experience such as the painfulness of pain or the redness of red (Ramachandran and Hirstein, 1999). What is ignored by this conscious perception is the vast amount of activity that happens unconscious and forms another part of our personality. Sigmund Freud was the first to make this separation between the conscious, preconscious and unconscious part of our self. In the conscious part resides what he calls the Ego, which is what we usually refer to when speaking about our self. Secondly, he introduced the Superego, which interfaces our self with the exterior world. The biggest part of the Freudian metaphor of the human psyche as an iceberg (see Figure 2), is what he refers to as the Id. This embodies all our natural, animistic drives such as fears, sexual desires, violent motives and irrational wishes. The role of the Ego is to control these unconscious drives.

Jung brought the concept of the unconscious a step further by claiming that it transcends the individual and resides in what is called the collective unconscious. This collective unconscious is constituted of archetypes that influence human behavior and manifests itself as symbols in dreams (Jung, 1969). Being aware of the collective unconscious is commonly reported as a mystical experience of becoming unified with external objects. Forman (1999) described in an essay about mysticism and the self how this could be experienced through meditative

practice.

Realizing that one doesn't really know her/himself and that many secrets are hidden in the unconscious can enrich life and promote psychological development (Jung, 1969). We think a situation that is comparable to what Alice experiences in Wonderland has the potential of challenging people to inquire about their own self-concept. If successful, this could be a starting point to a quest of strengthening relationships, achieving inner balance and finding deeper meaning in life.

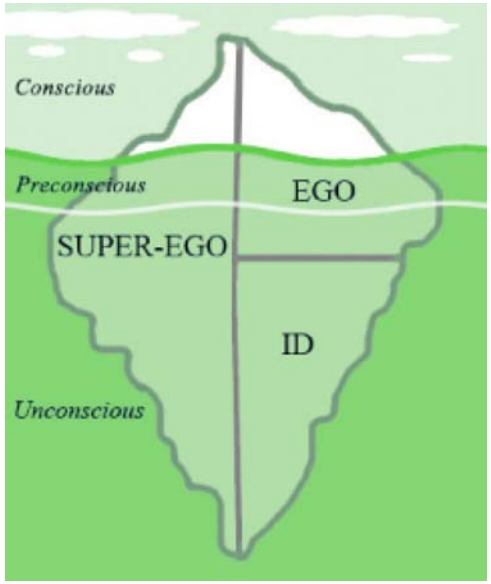


**Figure 2: Sigmund Freud's Iceberg methafore of the mind**

# 4 The Narrative

Using an interactive installation, my main goals are (1) to make the participant question her/his own self-concept and (2) to use unconscious symbols for stimulating individual metamorphosis. Although this might sound very ambitious at first, it is what happens in the chapter 'Advice from a Caterpillar'. My strategy for this project is thus to design the installation in such a way that the participant's experience is as consistent as possible with Alice's experience in the original story. This first of all asks for a deeper analysis of what happens during Alice's encounter with the Caterpillar.

## 4.1 Meeting the Caterpillar

Alice is tired of all the seriousness of the world and wanders off in her fantasies. Then suddenly, she sees the White Rabbit who seems to be in a hurry. She decides to follow him and arrives at a rabbit hole. When entering, Alice falls in the deep hole and arrives in a room with a small door. After growing and shrinking a couple of times, she manages to go out through the keyhole. Next, there are a couple of chapters in the original story that are skipped in the ALICE project until she arrives at the Caterpillar (see Figure 3).

The character symbolized as a caterpillar is well chosen. One of the most important characteristics of caterpillars and butterflies is their unique life cycle. One of nature's most mysterious metamorphoses[1] occurs when a caterpillar changes from a slow-moving, fat and ugly creature to a colorfully winged, beautiful butterfly. This metamorphosis happens to a lot of insects, but not as dramatically as it does to a butterfly (Heiligman, 1996). In this respect the 'Caterpillar' character can unconsciously pursue the message to a human user not to be afraid of a fundamental metamorphosis in his or her self-concept. This symbolic meaning can counterbalance the challenges intended by the conscious dialog.

From the dialog between Alice and the Caterpillar, we can extract some relevant statements with respect to goal (1) and (2):

**Figure 3: Original illustration of the Caterpillar**

*'Who are YOU?' said the Caterpillar.*

*This was not an encouraging opening for a conversation. Alice replied, rather shyly, 'I–I hardly know, sir, just at present– at least I know who I WAS when I got up this morning, but I think I must have been changed several times since then.'*

*'What do you mean by that?' said the Caterpillar sternly. 'Explain yourself!'*

*'I can't explain MYSELF, I'm afraid, sir' said Alice, 'because I'm not myself, you see.'*

*'I don't see,' said the Caterpillar.*

3 The Greek word 'metamorphosis' means 'change in form'

*'I'm afraid I can't put it more clearly,' Alice replied very politely, 'for I can't understand it myself to begin with; and being so many different sizes in a day is very confusing.'*

*'It isn't,' said the Caterpillar.*

*'Well, perhaps you haven't found it so yet,' said Alice; 'but when you have to turn into a chrysalis–you will some day, you know–and then after that into a butterfly, I should think you'll feel it a little queer, won't you?'*

*'Not a bit,' said the Caterpillar.*

*'Well, perhaps your feelings may be different,' said Alice; 'all I know is, it would feel very queer to ME.'*

*'You!' said the Caterpillar contemptuously. 'Who are YOU?'*

When meeting the Caterpillar, (1) Alice is in a state of confusion. She has changed size several times after entering the rabbit hole and has met strange characters. The Caterpillar (2) makes use of her mood by persuading Alice that changing is not a problem at all. The Caterpillar himself represents the transience of the self because he will change into a chrysalis and later into a butterfly. Moreover, he implicitly questions Alice's self-knowledge by asking her to tell a poem from her childhood (3) The underlying theory about the self that makes this passage interesting was proposed by Dennett (1992), who argued that the self is the center of narrative gravity and thus a collection of memories from our past:

*'Repeat, "YOU ARE OLD, FATHER WILLIAM,"' said the Caterpillar.*

*Alice folded her hands, and began:*

…

*'That is not said right,' said the Caterpillar.*

Another important aspect of their encounter is that (5) Alice is small and has the same size as the Caterpillar. Her wish is to regain her normal size again:

*'Well, I should like to be a LITTLE larger, sir, if you wouldn't mind,' said Alice: 'three inches is such a wretched height to be.'*

*'It is a very good height indeed!' said the Caterpillar angrily, rearing itself upright as it spoke (it was exactly three inches high).*

Finally, the scene contains (5) several references to the unconscious. First of all, the Caterpillar smokes a water pipe, which is used in several cultures as a means of transcending conscious awareness. Moreover, the Caterpillar appears to have telepathic capabilities, which seems from the following passage:

*One side will make you grow taller, and the other side will make you grow shorter.'*

*'One side of WHAT? The other side of WHAT?' thought Alice to herself.*

*'Of the mushroom,' said the Caterpillar*

## *4.2 Design Criteria*

Based on statements (1) to (5), I have listed the basic design criteria for the envisioned installation. These criteria form a guide in achieving the above-mentioned project goals.

1. As the entrance condition of the installation, the participant should be *confused* by some preliminary events.

2. The participant should be *immersed* in a challenging dialog with a character and *persuaded* to question her/his self-concept.

3. The character should represent by its design the *transience (impermanence) of the self*.

4. The participant should have the *feeling of smallness* when entering and being inside of the installation.

5. The installation should contain *symbolical references* to the unconscious.

# 5 Interaction Design

To integrate my installation with the rest of the ALICE project and to manage internal consistency, we have agreed on a system that is based on entrance and exit conditions. The exit condition of each stage should match with the entrance condition of the next one. The following aimed conditions relate to stage of 'Advice from a Caterpillar':

- Entrance condition: participant is confused, has the feeling of being small and wants to be normal again.
- Exit condition: participant questions his/her self-concept

This chapter elaborates on how the installation will be designed in order to meet these conditions. Some design issues that are of general concern for the ALICE project are immersion and persuasion. Both are discussed in the next sections.

## 5.1 How to Achieve Immersion

For the installation to be effective, it is essential to make it immersive so that people feel part of the environment they experience and control. If not, people will keep mental distance from the aimed narrative instead of participating within it. Especially with regard to the interaction with the character, immersion will be important (see design criterion 2). Achieving this is strongly related to the feeling of presence. Feeling of presence is higher for instance, when being together in the same room with a person then seeing and talking to each other through a screen. My aim is to let the character cause a feeling that is as close as possible to physical human presence. I assume this will increase the immersion of the dialog.

Another technique to achieve immersion is connectedness. A ski-simulator is an interesting example of how direct connection between user-action (moving the skis) and system-reaction (visualizing the ski-run) creates an immersive experience. In case of the envisioned installation, connectedness could be implemented through the interaction between the participant and the character. Techniques such as gaze, gestures and contingent movement are well-known ways of doing this.

**Figure 3: An immersive ski-simulator**

## 5.2 How to Achieve Persuasion

With respect to design criterion (2), the character in the installation will persuade the user to question her/his self-concept. There are several available techniques for persuasion from the field of HCI that can be off use. According to Fogg (2003) people are most open for persuasion in situations such as: when they find their current world-view no longer makes sense, when they are in a good mood, when they can take action immediately, or when they want something. I want to use the first and the last of these situations as the starting conditions for the installation (see design criterion 1). This is also the case when Alice meets the Caterpillar. After arriving in a dream world and going through her physical and mental transformations, here world-view doesn't make sense anymore. Moreover,

she wants to go back to her normal situation and therefore asks for his advice. In the context of the ALICE project, the stages of the installation that precede the 'Advice from a Caterpillar' will take care of these starting condition as much as possible.

Fogg made a distinction between different applications of computer technology where persuasion plays a role. The categories he identified are 'tools', 'media' and 'social actors'. The one that is of highest interest to this project is 'social actors', because the character in the installation will be of this category. He described a series of techniques that should be taken into account when designing a social actor that aspires to be persuasive: attractiveness, giving psychological cues (emotions, preferences, motivations and personality), similarity with user (in opinions, attitudes, lifestyle, background and membership), language, praise, social dynamics (rituals) and assuming a role of authority (teacher, doctor, friend, etc.). I will use a selection of these in the design of the character.

## *5.3 The Stage*

Conform the story, Alice is small when meeting the Caterpillar and in fact as tall as him (three inches). The stage of the installation should give the participant a sense of smallness as well (see design criterion 4). I will do this by scaling the objects on the stage with a factor of approximately 25 times their normal size. This means that the participant will walk through huge grass and mushrooms. The Caterpillar will add to the sense of smallness by being on a higher level then the participant (e.g. sitting on a mushroom) and by bowing over her/him.

## *5.4 The Character*

Initially, I came up with several concepts for the installation of which each incorporates a different kind of character:

1. The 'reversed engineering' concept: replica of the original story (Figure 4).
2. 'Encountering yourself' concept: the character is a talking picture of the participant in a comparable environment as the original story (Figure 5).
3. 'Me TV' concept: a talking face on a television in a living room with a relax fauteuil and ambient lighting. It suddenly appears when the participant sits down (Figure 6).

When discussing these concepts in the context of the ALICE project, the general decision was to stick to the original plot as much as possible. This is based on the assumption that the symbology in the story contains enough depth to survive for such a long period of time. To set a boundary for my project, I want to stick to this decision as well instead of trying to reinvent the story and thus work out concept (1).

An important discussion for the Caterpillar in the installation is whether it should be a virtual projection or a physical embodiment. The physical embodiment has the advantage that it will probably increase immersion for it is likely to cause a higher feeling of presence. Another advantage of physical embodiment is that the Caterpillar has more freedom of movement and can enter the personal space of a participant, making it more persuasive. A disadvantage is that shortcomings in its design could cause a 'puppet effect', making the Caterpillar unconvincing. This is less problematic with a virtual version, since it is much easier to make a natural looking and moving character in 3D software then with mechanical constructions. A possible solution to prevent the 'puppet effect' is to design an abstraction of the Caterpillar. Given the arguments of this discussion, the only way of really knowing which solution works best would be to compare them in. The available time for this project unfortunately doesn't allow this, so I've chosen the option that seems most promising to me, which is the physical embodiment.

*Concept 1*


*Concept 2*


*Concept 3*

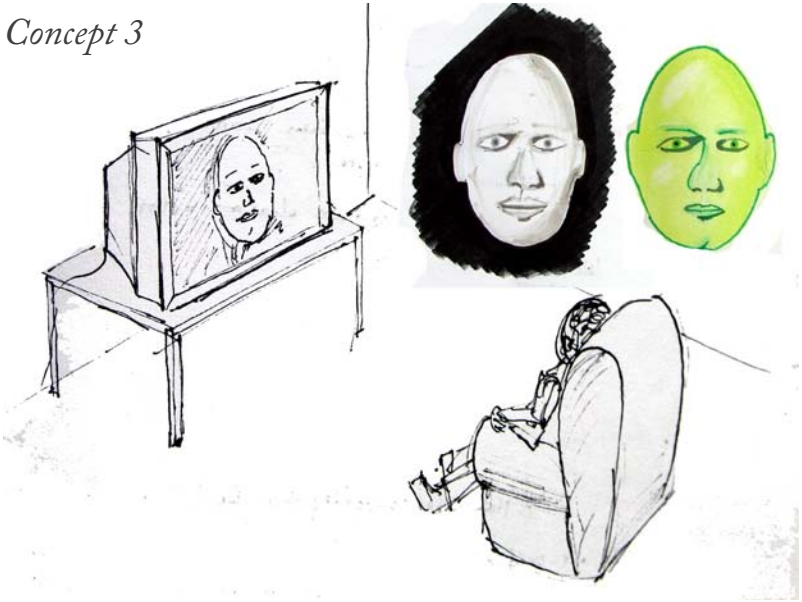

**Figure 4,5,6: Respectively concept 1, 2 and 3**

## *5.5 Interaction Scenario*

On entering the stage, the participant will see the Caterpillar, who has its back turned towards her/him. He is humming softly and smoking a water pipe. When the participant comes closer and enters the personal space of the Caterpillar, he suddenly wakes up, turns and bends towards the participant. This should be a spontaneous movement to yield a surprise reaction. "Who are YOU?" the Caterpillar asks next. This should initiate a dialog in which the Caterpillar is agent (steers the dialog). During the dialog, the Caterpillar maintains eye contact with the participant and supports its utterances with subtle body expressions. Please refer to appendix II for a detailed interaction scenario.

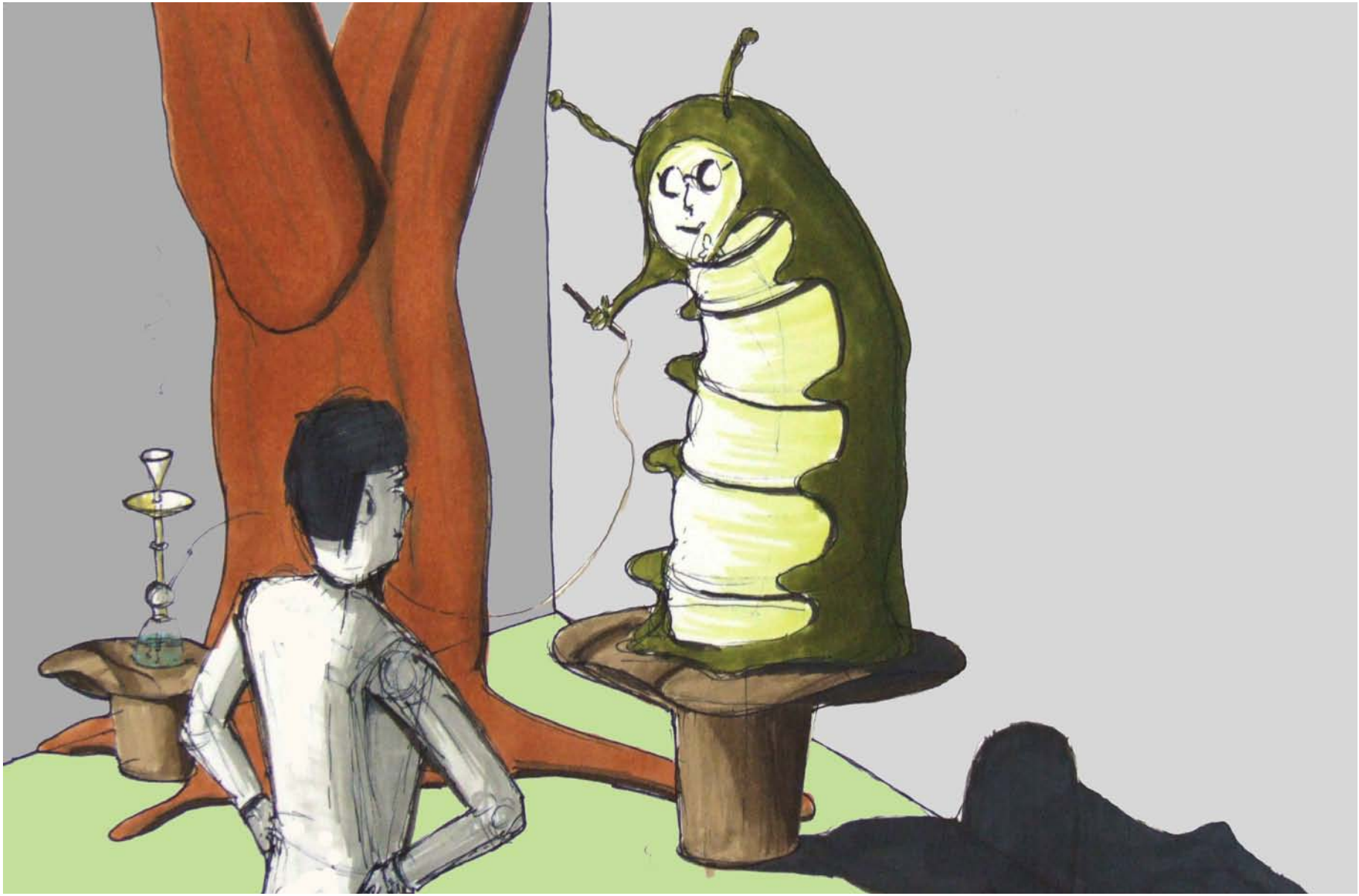

**Figure 7: Final Caterpillar design**

# 6 Caterpillar Prototype

The part of the installation that was worked as a prototype in accordance with my design criteria is the Caterpillar. The role of this prototype is to provide a means of experimentally researching the possibility of achieving goal (1) and (2) through an interactive experience. In the next chapter I discuss the assessment of this experience as well as the experimental setup that was used. This chapter provides design- as well as technical details of the Caterpillar prototype and clarifies the related decisions.

## 6.1 Form and Movement

In order to make the Caterpillar prototype work as an unconscious symbol of metamorphosis, it is important that the form of the prototype matches with the archetypical form of a caterpillar. After visiting Amsterdam's hortus, I decided to base my design on the Privet hawkmoth (Sphinx ligustri)[1] caterpillar both for its beauty as well as its high prevalence in Europe (see figure 7 and 8). Although no validation survey was conducted, my impression is that it makes a good candidate for an archetypical caterpillar.

In moving from a natural form of a caterpillar towards an embodied artificial representation (further called "robot"), there were several considerations taken into account. First of all, it demands for social abilities in order to become a persuasive character (refer to paragraph 5.2). Since people have a basic tendency to project human beings onto animistic objects (Reeves and Nass, 1996), there is no need for really adding a human face onto the robot to make it social. In my case, I only equipped it with one eye and a mouth, to make it gaze and talk.

Another aspect in achieving social abilities is lifelike behavior (Yamaoka et al., 2005). This was implemented by means of a periodical wave motion of the robot's body that resembles the locomotive contractions and extractions of a real Caterpillar. Furthermore, the robot gazes at its dialog partner by aiming both its body, eye and head. This gaze was implemented semi-contingent, which means that it combines random movements with reactive movements. Yamaoka et al.

**Figure 8: Sphinx ligustri caterpillar**

(2006) experimentally evaluated a contingency factor of 60% (40% random, 60% reactive) to be perceived as most lifelike for communication robots.

To enable these required movements, I have equipped the robot with a number of servomotors that offer in total nine degrees of freedom. Four degrees of freedom are dedicated to the periodic motion of its body, two for horizontal and vertical rotation of its head, two for horizontal and vertical rotation of its eye, and one for the overall rotation of the body. To determine the position and distance of the participant, the robot has an array of 9 motion detection sensors around its base and a rotating distance sensor. A limitation of this configuration is that it is difficult to measure the vertical size of a participant for gazing. In future improvements of the robot, I recommend using computer vision for this.

4 http://nl.wikipedia.org/wiki/Ligusterpijlstaart

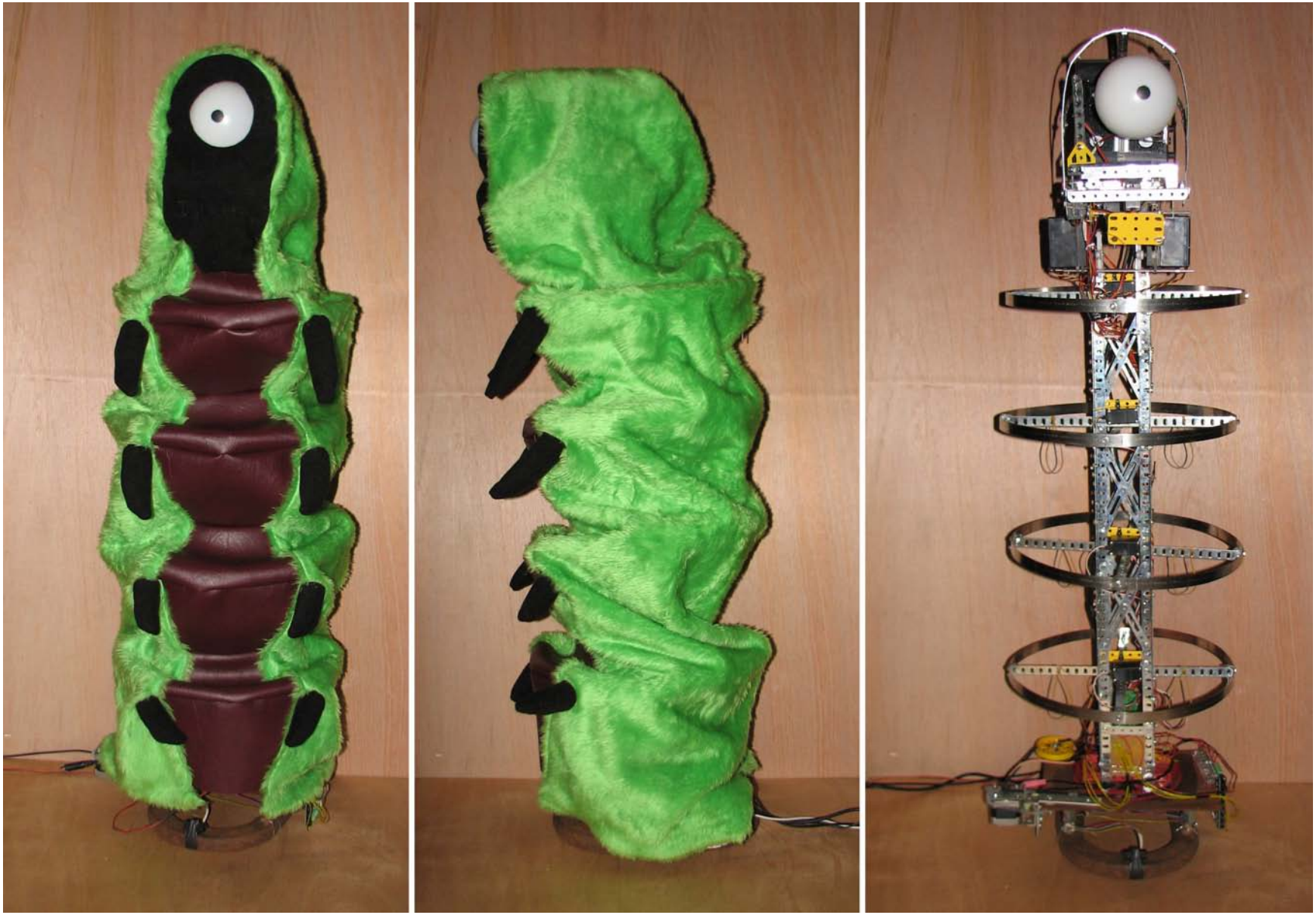

**Figure 9: Final Caterpillar prototype**

## 6.2 *Dialog Management*

Since the dialog between the Caterpillar and the participant is one of the most crucial components of the interaction, I will address this in detail. In order to engage the participant in a spoken dialog with the Caterpillar, there is a need for a system that facilitates speech input to understand the participant, speech output to talk to the participant and script control to steer the dialog in the right direction. The problem here is that every person will react differently to what the Caterpillar says, hence the dialog cannot be fully pre-programmed and should be constructed dynamically. I will outline the implemented technologies that deal with this.

In choosing between a synthetic or recorded voice, Nass and Brave (2005) prescribed that it should be well taken into account that if a robot has a recorded (read: naturally human) voice, people feel easily tricked when the robot doesn't look human. This argument made me choose for a synthetic voice for the Caterpillar robot. A drawback of this decision is that it became difficult to give emotional expression or emphasis to utterances. In line with the earlier mentioned guidelines for persuasion, I have selected a voice that resembles a wise person. To pursue consistency with the original story, it is a male and bit languid, sleepy, voice.

For speech input, the available technology is speech recognition. The current status of natural language recognition through speech is still of low quality and needs training time to let the system get used to a voice. To overcome this problem I have used a limited set of vocabulary to detect. When focusing only on a small set of key words, the accuracy of speech recognition can increase significantly. An advantage is that the Caterpillar steers the dialog and act as an agent. It can then predict the possible answers a participant will give (refer to Appendix II).

To control the dialog, we need a script-based dialog management system. ELIZA is the first yet still famous computer program that enables certain kinds of natural language conversation between man and computer (Weizenbaum, 1966). Input sentences are analyzed on the basis of decomposition rules, which are triggered by key words appearing in the input text. Responses are generated by reassembly rules associated with selected decomposition rules. The rules are stored in a script and can be edited to tailor the software for a specific application. The combination of such an adapted ELIZA version with speech recognition and synthesis is a powerful way to control a dynamic dialog. For the prototype, I have implemented a system based on this principle.

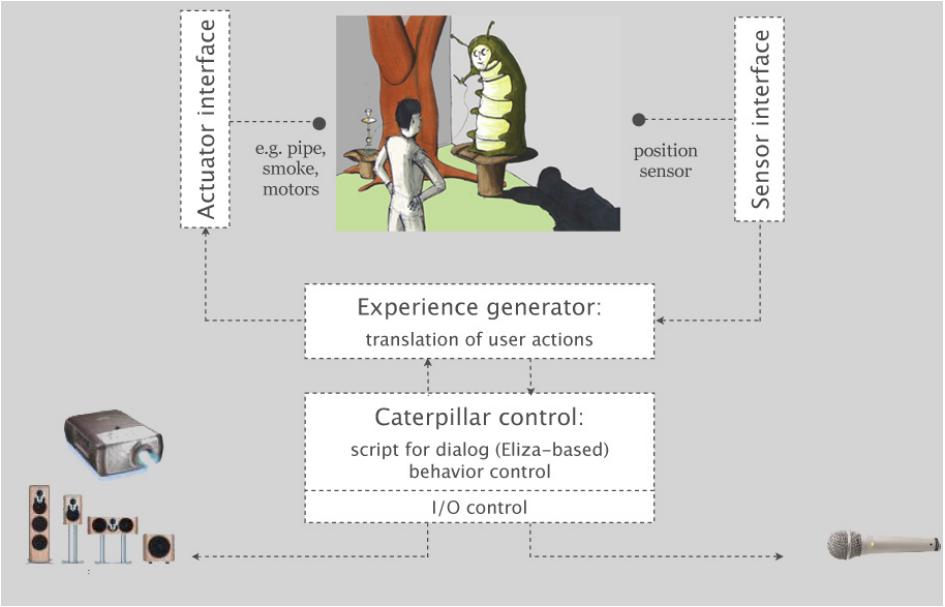


**Figure 10: Software Framework**

## 6.3 *Software Framework*

Figure 10 gives a global overview of the software framework of the prototype. The dashed-line boxes contain the following software components for the system:

- The main component is the experience generator. This takes care of the overall management of the installation and schedules the execution and transitions of the different states of the interaction script (see Appendix II).
- The next component is in charge of the Caterpillar control, which manages the behaviors of the robot. It also incorporates a dialog manager that steers the

conversation with the participant according to the predefined script, and deals with the speech input and output of the robot.

- The role of the sensor interface is to gather information about the participant in the installation. This is done by translating the retrieved data from the distance and motion sensors into higher-level information, such as the position of the participant in the area around the robot.

- The actuator interface controls the hardware part of the installation, which basically consists of the robot's motors. The actuators are activated through the experience generator and Caterpillar control components.

# 7 Experience Assessment

## 7.1 Target Audience

The original story of Alice was intended to teach logic and manners to children. This would suggest that children are the most likely target audience for the installation. However, over the years, 'Alice in Wonderland' became popular amongst a much bigger amount of people from different age groups and cultural background and has been translated in over 50 languages. It is thus very difficult to determine which group of people is the most interesting target audience for the installation.

With respect to the stage "Advice from a Caterpillar" it is easier to choose for a suitable audience. Since the Caterpillar will challenge people to question their self-concept, it is necessary for participants to be in a phase of their life where they have already developed a concept of their self. According to research in developmental psychology, individuals begin to develop more abstract characterizations of themselves during their adolescence, and self-concepts become more differentiated and better organized (Steinberg, 2001). In the early adulthood phase, which follows up the adolescence, I can thus assume that people will have a self-concept. Since adolescence is generally considered to begin somewhere between ages 12 and 14, and end at 19 or 20[1], people in their early-twenties are the most interesting age group for my experiments.

Further considerations were that the subjects speak English on at least a conversational level in order to verbally communicate with the Caterpillar. For reliability of the results, all subjects should be from a comparable background such as 'university student'. I have made no difference between male or female in selecting the subjects. When analyzing the results however, this could be an interesting categorization criterion.

## 7.2 The Implicit Association Test


**Figure 11: example stimulus of IAT**

To measure the effect of the installation with respect to goal (1), we need to test whether participants experience any changes in self-concept when coming out of the installation. This has been a big challenge, for we suspected the installation will mainly have an unconscious effect on people. Moreover, the self is a very personal issue and therefore difficult to enquire. Even in the context of therapy, psychologists have problems finding out how a client really thinks about her/himself. Greenwald et al. (1998) made a distinction between conscious (explicit) and unconscious (implicit) cognition and the way they influence human response mechanisms. For example, when a person is addicted to smoking, he may respond "no" to the question of whether he is addicted by consciously overruling his unconscious addiction.

The Implicit Association Test (IAT) was developed to focus only on the implicit (unconscious) part of our cognition and was demonstrated to be effective across different cultures (Greenwald et al. 1998). The test measures differential association of 2 target concepts with an attribute. The 2 concepts appear in a 2-choice task (e.g., meat vs. vegetables related words), and the attribute in a 2nd task (e.g., positive vs. negative words for an evaluation attribute). Subjects are asked to categorize a set of stimuli (words or pictures) with the correct concept or attribute. This is done by pressing a response key on the keyboard (see figure 11) When instructions oblige highly associated categories (e.g., vegetables + positive) to share a response key, the response time is faster than when less associated categories (e.g., meat + positive) share a key. This response time difference implic-

5 http://en.wikipedia.org/wiki/Adolescence

itly measures differential association of the 2 concepts with the attribute.

Greenwald and Farnham (2000) developed an IAT to measure self-concept. This is a useful starting point for the participant analysis of this project. By choosing concepts that relate to the self vs. others and attributes such as positive vs. negative, it would be possible to measure someone's unconscious self-concept. An overall significant change of the subjects' self-concept when comparing before and after entering the installation would be the indicator for success of the experience.

## *7.3 Experimental Setup*

I have conducted an experiment, which aim was to investigate if one can measure any significant difference between a subject's self-concept before and after going through the installation and having interaction with the Caterpillar. To do so, I invited 20 university students (3 arts, 5 medicine, 12 design) in accordance with the above-mentioned criteria for the target audience. For the test I used a modifiable flash-based implementation of the IAT designed by Timothy Takemoto and Jamie Pratt[2]. Using this platform, I prepared two different self-concept tests based on Greenwald and Farnham's (2000) research. The two tests contain different stimuli for the attributes positive and negative. The first one uses words prescribed by Greenwald and Farnham. The second one contains words that I selected relating to confidence, such as {sure, confident, secure} vs. {unsure, unconfident, insecure}.

The basic structure of the experiment was as follows:

1. Subject fills in both self-concept IATs.

2. Participant enters the installation room and interacts with the Caterpillar based on the interaction script.

3. Subject fills in both self-concept IATs.

## *7.4 Experiment Results*

The results of the experiment are currently being processed using a within-subject analysis, and will be presented during the presentation of this project on November the 2nd, 2006.

## *7.5 Discussions*

The test-retest reliability of the self-concept IAT measure was tested r = .52, (N = 44, p = ,0003) by Greenwald and Farnham when repeating the test with the same group of people after 8 days (on average). This could both indicate that the test is sensitive for short-term changes in ones self-concept, or that the test is not consistent with itself. The former would be a positive attribute of the test, whereas the latter would mean that my test results are not useful.

An important limitation that one should take into account when assessing the individual experience of "Advice form a Caterpillar" is that in the story, there are a number of experiences such as "falling down the rabbit hole" and "shrinking and growing" that precede this encounter. This could have a limiting effect on the unconscious impact of the experience. I am therefore looking forward to reassess the experience with the full installation in a later stadium of the ALICE project.

6 Test of Unconscious Identification (TUI): http://jamiep.org/course/view.php?id=7

# 8 Conclusion

In this report I've discussed an application for the new field in HCI named cultural computing, based on a chapter of 'Alice in Wonderland'. It addresses the individual self-concept of Westerners through an interactive experience of Alice's encounter with the Caterpillar. I have discussed design decisions, which form the proposal for an installation offering an experience that is as consistent as possible with the original story. The Caterpillar was worked out as a robot that challenges the participant's self-concept through an interactive dialog. An experiment was conducted to assess the unconscious effect of the encounter with the Caterpillar. We are currently waiting for the results of this experiment to have an idea of its success.

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*Interaction script Caterpillar (Event-Action model)*

| State | Input | Event | Action | Output |
|---|---|---|---|---|
| 1. Start | | | Body turned away from user<br>Swing body segments periodically*<br>Go to state 2 | Move Body servos |
| 2. Encounter | Distance sensor < 1m | User approaches caterpillar | Move body towards user<br>Say "Who are you?"<br>Go to state 3 | Stepper Motor rotate 180º<br>Speech Synthesizer |
| 3. Dialog part 1 | Motion sensors change | User move in front of caterpillar | Gaze at user** | Move Neck and Eye servos |
| | Speech Recognizer | User reply contains "Who are you?" | Say "Why do you ask?" | Speech Synthesizer |
| | Speech Recognizer | User reply contains "You" | Say "We're talking about you, not me. You, who are YOU?" | Speech Synthesizer |
| | Speech Recognizer | User reply contains "I'm", "I am" or "Name" (1st time) | Say "I didn't ask for your name. Who are YOU?" | Speech Synthesizer |
| | Speech Recognizer | User reply contains "I'm", "I am" or "Name" | Say "I didn't ask for that. Who are YOU?" | Speech Synthesizer |
| | Speech Recognizer | User reply contains "Hello", "Hi", "Good afternoon", "Good evening" or "Good morning" | Say "Hello. Who are YOU?" | Speech Synthesizer |
| | Speech Recognizer | Any other reply | Say "What does that mean for you? Explain YOURSELF!" | Speech Synthesizer |
| | Counter | After 4 dialog turns | Say "Do you know yourself?"<br>Go to state 4 | Speech Synthesizer |
| 4. Dialog part 2 | Motion sensors change | User move in front of caterpillar | Gaze at user** | Move Neck and Eye servos |
| | Speech Recognizer | User reply contains "You" | Say "We're talking about you, not me. Do you know yourself?" | Speech Synthesizer |
| | Speech Recognizer | User reply contains "Yes", "Of course", "Sure" or "Definitely" | Say "Hmmm, I see, then tell me a poem or song from your childhood"<br>Go to state 5 | Speech Synthesizer |
| | Speech Recognizer | User reply contains "No", "Maybe" or "Not" | Go to state 6 | |
| | Speech Recognizer | Any other reply | Say "Just be honest. Do you know yourself?" | Speech Synthesizer |
| 5. Dialog part 3 | Motion sensors change | User move in front of caterpillar | Gaze at user** | Move Neck and Eye servos |
| | Speech Recognizer | User reply longer then 10 sec | "That was not said right! Are you sure you are this child?"<br>Go to state 6 | Speech Synthesizer |
| | Speech Recognizer | Any other reply | Say "Then, are you sure you are this child?"<br>Go to state 6 | Speech Synthesizer |
| 6. Monologue | Motion sensors change | User move in front of caterpillar | Gaze at user** | Move Neck and Eye servos |
| | | | Say "Listen to me, I will tell you something important. I am a Caterpillar as you can see. One day, I will turn into a Chrysalis. And then into the most beautiful butterfly! Why would I worry about who I am right now? Why would you? So, do you want to change?"<br>Go to state 7 | Speech Synthesizer |
| 7. Dialog part 4 | Motion sensors change | User move in front of caterpillar | Gaze at user** | Move Neck and Eye servos |
| | Speech Recognizer | User reply contains "You" | Say "We're talking about you, not me. Do you want to change?" | Speech Synthesizer |
| | Speech Recognizer | Any other reply | Say "Well, you'll get used to it in time. Have a nice day!"<br>Move body away from user<br>Go to state 8 | Speech Synthesizer<br>Stepper Motor rotate -180º |
| 8. Epilogue | Motion sensors change | User move away from caterpillar | Move body towards user** | Stepper Motor rotate 180º |

| | | | | |
|---|---|---|---|---|
| | | | Say "By the way, one side makes you grow taller, the other side makes you grow shorter"<br>Move body away from user<br>Say "Of the mushroom of course! | Speech Synthesizer<br><br>Stepper Motor rotate -180º<br>Speech Synthesizer |

* This movement continues throughout full interaction script
** This action is semi-contingent to improve life-likeness