Boxed Ego

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ABSTRACT
Boxed Ego is a double trap for the Self. A peep-show box waiting in a corner of the exhibition space first captures the curiosity of the observer - and then the observer himself. Although of an artistic flavor, from the research perspective this work is a preliminary experiment on the cognitive (and possible practical) aspects of artificial autoscopy (AS). In order to understand how artificial autoscopy can generate an out-of-body experience (OBE), we embrace the enactive approach to perception [1] and we further hypothesize that the *sense of self*, may be itself a second-order perceptual experience: that resulting not from the exploration of the world based on skillful mastery of the visual, tactile, proprioceptive or auditive sensorimotor contingencies (SMCs), but on exploring/acting on the world with skillful mastery of these SMC *as well as the rules governing the relations (extended in time) between these SMCs*. A first corollary of this hypothesis is that there may be different senses of self: at one extreme, those inextricably linked to each primal sense (and thus experientially ineffable), and at the other extreme, a more abstract sense of self that result from the knowledge of cross-modal contingencies. In between, there may be experiences rendering a more or less unified sense of self, which is precisely why this model seems to us ideal to explain OBEs. A second corollary of this view, is that attentional blindness may also pertain to the sense of self, a testable hypothesis.

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telexistence, out-of-body, autoscopy, self-awareness

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INTRODUCTION
That language and consciousness are inextricably interrelated is not a coincidence since language is a more or less natural formalization of conceptual reasoning, playing a crucial role in the process of self-representation and subjective consciousness [2]. But language alone is not sufficient and surely not even indispensable in order to provide organism self-awareness. How can someone/something incapable of describing knowledge of his/its internal states (even to oneself/itself) be capable of self-awareness? The paradox disappears if one consider that 'description' (internal or external) does not need to be propositional, but can be *enactive* [3].

With this remark in mind, we will leave aside the problem of language-based self-reference, and concentrate instead on enactive forms of self-awareness (as a passing remark, let's note that the ineffable character of enactive knowledge may be responsible for the ineffable part of the sense of self). For one, vision plays a fundamental role in the generation of an egocentric perspective on the world; visual artists have been experimenting in this arena well before science created the right tools or even the proper language capable to describe such phenomena. Self-referential pictures have been around from ten of thousands of years, and artificial mirrors are thousands of years old; however, it's the invention of magnetic recording and closed loop video that opened really new exploratory possibilities. 'Present Continuous Past(s)' by Dan Graham (1974) is perhaps one of the first interactive video-art installations challenging the special vantage point of the audience, and transforming the spectator into its own object of observation. Time delay is purposely used to trick the spectator into the belief that he is seeing a pre-recorded scene unrelated to himself, but then he would slowly gain understanding of his central role in the piece. This calculated spatio-temporal disembodiment brings confusion: as with the Necker cube, the perceptual content is of flipping nature: that of the filmed person being someone else or being oneself. Only very recently these experiments were reproduced in a controlled environment [4]. In this workshop, I would like to foster an informal discussion about the scientific, practical (and of course artistic) potential of this kind of experimentation by describing a media-art installation called 'Boxed Ego' [5].

BOXED EGO INSTALLATION

A pair of cameras are aimed towards a small platform on a corner of the exhibition space over which sits a cubic peep-show box. The holes of the peep-box are in fact the eye-pieces of a live-stereoscope. The separation of the video cameras in real space is set to about ten times the real inter-ocular distance, so that the viewer will see a ten times scaled-down version of himself inside an equally miniaturized exhibition space (hyperstereo effect). The box appears empty; however, if the observer talks or breathes, the box readily detects this human prey and traps it in its interior, effectively transforming the observer into its own object of observation. Indeed, a dwarfed, truly three-dimensional version of the observer (peering inside an even smaller box) will slowly materialize (figure 1). Perhaps the main difference between Boxed Ego and other works featuring artificial autoscopy (either in the Media Arts or in the field of experimental psychology [4]) is that (1) the object/subject is perceived truly in 3d, although miniaturized (thus combining autoscopy with micropsia, which are both phenomena that correlate somehow in the medical literature ; (2) the spectator is filmed from behind, and without a time delay it becomes impossible for him to see his own face (this makes the experience very different from that of a mirror or a camera on top of a screen, reminding us of Magritte's famous painting 'La reproduction Interdite'); (3) there is a limited form of correlated tactile feedback (the spectator can grasp the box and see himself grasping it, while at the same time feel the real box his hands); (3) lastly, although not sufficiently compelling in this experiment, the suggested infinite recurrence of observer-observers could potentially generate a sense of multiple body relocation (see below).

The idea behind this installation was to explore, in an artistic way, the links between *curiosity and voyeurism*. While peering inside the box, one can see oneself in every detail, and to a certain extent play with one's own avatar (in particular thanks to some time delay in the video loop). At the same time, one cannot see the other people in the exhibition space (see video in [5]). The installation was exhibited for a week at SonarMatica Media Art festival in Barcelona (2008) with much success. A commentator later reasoned that this could be because 'the theme of self-voyeurism is unsurprisingly very popular with the festival goers.' We agree with this remark (after all, even a simple mirror always retains some magic), but the question remains open: why are we so attracted by these devices? Of course there is a practical aspect to the experience (e.g. tighting your necktie); however, we hypothesize that there is more to this: this sort of setup brings us close to an out-of-body experience which is interesting per se: it give our minds the opportunity to better itself in the mastery of the sensorimotor contingencies in an unusual territory.

THE OUT-OF-BODY EXPERIENCE

Out-of-body experiences (OBEs) are a culturally invariant neuropsychological phenomena that can take a variety of different forms, ranging from seeing one's own body from an elevated visuospatial perspective (the placement of the stereo cameras in the Boxed Ego installation tries to capture this) to the less known 'heautoscopic' hallucination, consisting on perceiving a duplicate of ones body in extrapersonal space [6]. Although the etiology of the OBEs varies widely (organic dysfunctions such as epilepsy, sleep-paralysis, psychological disorders or traumatic experiences but also episodes without a know trigger), direct electrical stimulation of the cortex in pre-operatory brain surgery for intractable epilepsy as well as less invasive experiments (trans-cranial electrical or magnetic stimulation [7]) and fMRI performed during paroxystical hallucinations, all point to the involvement of a very specific area in the brain, namely the *temporo-parietal area* [6].

Figure 1. Stereo pair as displayed inside the box (without optics)

Complete distal attribution and OBE

It is interesting to note that although classical OBE imply whole visuospatial relocation in space, it is also possible to have relocated *parts* of the body. This partial relocation is a relatively common occurrence described in the medical literature [9], but also easily reproducible on healthy subjects [10]. It may be argued that 'relocation' of sensation is a normal way of functioning of the sensory-motor apparatus: for any practical purpose, it *must* feel like the sensation is precisely located at the site of stimulation (e.g. on the tip of our finger), instead of, say, inside the head. We always feel *located sensations*, and in particular located in a part of the world that we perceive as 'ours'. *Distal attribution* is the technical term for a very common phenomena, that of situating the stimulus where the action responsible for it is taking place - even if this part is extracorporeal. That's why we feel the texture of paper at the end of the pen, not on your fingers where the force is actually sensed. Distal attribution is exploited in robotic telexistence systems (the user can operate the robot on the same room, or be in another continent for that matter). However, there seems to be a threshold of sensory immersion and sensory-motor correlation that when reached, transforms the fairly common experience described as distal attribution into something qualitatively different: *it elicits a sense of presence in extracorporeal space*. It is therefore tempting to see OBEs as the consequence of a full body relocation in which the experiencer can still see his original body (an experience with an entirely different phenomenology).

SENSE OF PRESENCE: A SENSORIMOTOR ACCOUNT

An ineffable sense of self

As noted in [1], a subset of the 'apparatus-based' sensorimotor contingencies (SMCs) relevant to the sense of vision may derive from sensorimotor laws relative to an 'observer oriented coordinate system'. Learning these laws would provide the system with a rudimentary (enactive) notion of self. For instance, objects (or other people) generate stimuli that can be removed and put back into the visual scene, while sensation about one's own body is always potentially available. Furthermore, some parts of the perceived environment can be controlled at will (i.e. in a manner independent to the motion of the sensory apparatus) while others not (e.g. we don't need to look away in order to hide our own hand). We can generalize this claim as follows: things that are *not ourselves* generate stimuli that can be removed or put back into the *visual, auditive or tactile scenes*, while our own body generates stimuli (including this time proprioceptive information) that cannot be so easily removed. Therefore a sense of self-location is brought by active exploration of the world with (implicit, practical) knowledge of the structure of *egocentric* sensorimotor contingencies. (If the observer was not physically located in a particular place in space, these sensorimotor contingencies would be of a very different nature; perhaps one day a robot with pervasive sensors and actuators - like HALL9000 supercomputer from '2001: Space Odyssey'- will tell us what it's like to have an ubiquitous sense of self).

Sensorial awareness and sense of self

SMCs determined by the character of the 'sensory apparatus' would roughly correspond to the crude character of 'sensation', while those related to the character of the explored objects would form the basis of 'perceived content' [1]. In other words, *awareness* of the character of the experience (is it visual, auditive or something else?) as well as understanding of its content (for the purpose of thought, planning and speech behavior) may be worked out by a concurrent neural mechanism responsible of recognizing and analyzing each particular pattern of SMC. In fact, there may be different levels of 'understanding' (each more or less accessible to consciousness). At the top of the hierarchy, we may have abstract knowledge relative to the occurrence of *some form* of sensory experience, as long as the SMC has some recognizable, familiar structure (perhaps learned late in life). In other words, we may be aware of *being experiencing something* without paying attention to the actual content of the experience. This could contribute to (or even form) a sense of self: if while actively exploring the world, familiar patterns of SMCs appear, then you may not only experience something, but you may experience being a Self experiencing that; if, on the other hand, you fail to recognize any patterns, then you may not just be sense-blind: you may not even experience *being* someone at all.

IDEAS FOR EXPERIMENTS AND PRACTICAL USES

Altering in a controlled way the SMC pattern for a particular sensorial modality may be more or less easy to achieve (the inverted-glass experiment [11] is a classic example). However, altering in a controlled way all the sensorimotor contingencies as well as their inter-relations (including time correlations) may be more difficult to do. To start with, the altering device should be multi-modal. An immersive virtual reality environment could be an ideal setup, but the technology for haptic and proprioceptive actuators is not nearly as developed as auditory or visual displays. For example, while it is easy to set an inverted vision experiment, it is not so easy to conceive –left alone design– a setup for 'inverted haptics': it would mean for instance than when touching something with my right hand, I would feel the object on my left hand.

Attentional self-ness for human computer interfaces

Another interesting consequence of this view is that it should be possible to apply the same principles behind attentional blindness (i.e. *experiential* blindness while retaining sensation) and induce *attentional self-ness*. It turns out that this may be a normal occurrence in everyday life: we do perform repetitive tasks automatically, sometimes without even registering in memory the fact that we did them. (In a sense, we are all *philosophical zombies* from time to time.) However, it would be interesting to be able to control this, perhaps in order to reduce cognitive load from tasks that can be done by a machine and don't need attention from part of the user.

Medical Applications

The temporo-parietal junction seems to be the common lesion site in patients suffering from disturbances of the egocentric spatial-relationship with extrapersonal space (a conditional called *visuospatial neglect*). This is not surprising if we believe the results reported in [8]: this region is in fact very involved in the real-time integration of proprioceptive, tactile, visual and vestibular sensory input, generating a three-dimensional, dynamic representation of the body in space. Therefore, one can wonder if artificially manipulating these inputs may lead to some degree of control over the way the body is represented in space, for therapeutic or at least for palliative care. An example related to this may be the 'revival' of phantom-limbs for the purpose of treating associated pain [9]. Another interesting possibility may be the treatment of higher cognitive dysfunctions, such as dissociative identity disorders; indeed, it has been found that OBEs correlate in people with these disorders [8]. In short, we hypothesize that the availability of a machine through which one is capable of artificially creating and manipulating autoscopic imagery may render a sense of control over otherwise contradictory or poorly organized sensorimotor feedback.

Super mirrors?

Perfectly reflecting surfaces capable of creating an image indistinguishable from reality is a relatively recent human invention that can be traced back to the first century AD [12]. Yet it was a luxury object; Modern ubiquitous mirrors are a much more recent invention Therefore one should be surprised more than not about how comfortably we seem to get along with these artifacts. It is well known that most animals do not pass the 'mirror test', and fall pray once and again to the illusion of reflexions, so one has the right to wonder if our getting used to these ubiquitous reflexions is not because of an intensive exposure in our daily lives (fun house mirrors do make us uncomfortable!). However, since a mirror breaks

the natural egocentric visuospatial perspective, one can suspect that their intrusion in the visual field may still disrupt the normal integration of visuospatial information. In fact, researchers have shown that the temporo-parietal region is activated when one tries to mentally superimpose one's body on a front-facing schematic human figures, while the same region is not activated when one observes back-facing characters [8]. It is like the mere idea of seeing oneself from an outside perspective had a special experiential content – everyday mirrors may not be so innocent after all! Perhaps a device that could give finer control of this disruption would be more efficient or safer. This remark is particularly important if one is to consider the use of mirrors on vehicles. A (wearable?) 'autoscopic super mirror' could display a 3d model of the observed/observer as seen from any arbitrary position in extrapersonal space, and this position could be naturally controlled by the user after learning a properly designed artificial SMC scheme that *would not disrupt the sense of self in a way that is counterproductive or dangerous for the task at hand*. In the future this may be achieved by mounting several cameras and reconstructing the scene from an arbitrary point of view. Uses of this could range from 'enhanced mirrors' for dancers that could see their own body from any location during rehearsal, to their use on cars, as an enhancement or substitute of the front and rear mirrors (this can be achieved by collecting images from street cameras or from cameras mounted on other cars, or more simply by using a unique fish-eye camera could be mounted high on the car). Research on telexistence systems is solving part of the problem [13]; indeed, these 'super mirrors' are *autoscopic telexistence* systems.

CONCLUSION AND FURTHER WORK

The system described in this paper tampers with two of the sensory stimuli that seems directly involved in the construction of body self-awareness, namely visuospatial input as well as a limited form of tactile feedback. This experiment does seem to generate a mild form of OBE (or at least the feeling of being in a 'twilight zone' and that without care one can be induced an OBE - and be absorbed by the box). A more objective study is needed in order to asses the efficacy of the illusion, but this was not the goal at this stage of the experiment. In this paper we have deliberately concentrated on a rudimentary notion of the self, one that could account at least for some form of body self-perception. Borrowing the terminology of the sensorimotor contingency model, we may say that being-in-the-body is a way of acting on objects in the world. OBEs would result from the *alteration of normal sensorimotor dependencies as well as cross-modal dependencies*. (This view suggests that synesthesia and out-of-body experiences may be co-morbid phenomena, a view for which there seems to be some medical evidence [14]). If this alteration is consistent in time (something that could be done with the help of 'device that alters perception' more complex than a movable mirror for instance), then one can expect that a functional sense of self could be regained once one comes to grips with the new set of artificial SMCs. This may indeed happens in everyday circumstances. For instance, we usually don't experience any severe disturbance of the sense of self when looking at a mirror, nor is our self disintegrated when playing a first-person shooter game. There may be fundamental reasons for that immunity (such that too few sensorial modalities are involved in these experiments), but it may also be that we have learned enough about these abnormal situations so as to 'flip' the whole set of sensorimotor contingencies, and tune to the one that makes more sense (a bistable form of adaptation similar to the one observed in the limited-time inverted glasses experiment [11]). In any case, it would be interesting to design a device capable of a deeper alteration (although controlled and consistent) of the whole scheme of sensory motor contingencies. A first concrete step would be to include some form of synchronized visuo-tactile stimulation in our own experiment; however, instead of passive stimulation as in [4], it would be interesting if the participant could be himself at the origin of the stimulation. For example, the box could have an opening for a hand, through which the participant would reach the head of his avatar; at the same time, some actuator would touch the real head. Another idea would be to set the whole installation on a moving platform that would tilt as the user tilts the box in his hands, thus instantiating a form of vestibular feedback.

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