

Hacking into Cybertherapy: Considering a Gesture-enhanced Therapy with Avatars (^{g+T}A)

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Abstract This paper will philosophically extend Julian Leff's Avatar therapy paradigm (AT) for voice-like hallucinations that was initially proposed for treatment-resistant Schizophrenia patients into the realm of gesture-enhanced embodied cognition and Virtual Reality (VR), entitled ^{g+T}A (gesture-enhanced Avatar Therapy). I propose an philosophy of technology approach of embodied rhetorics of triadic kinetic "actions" in the sense of Charles Sanders Peirce that transforms the voice hallucination incorporated by an avatar and that can confront acousmatic voice-like hallucinations with a method of gesture synchronization and dyssynchronization and gestural refusal of interaction that the player with the Avatar can resist in full embodiment. This paper therefore introduces a gesture-enhanced, extended version of Cybertherapy with Avatars that tackle multimodal bodily experience of voice-like hallucinations beyond mere visual or auditory stimulation. This is put forward theoretically in a 4E-cognition approach that expands Avatar Therapy with gestures into VR.

Keywords Gesture-enhancements; Avatar Cybertherapy; Philosophy of Technology; embodied habit change; Peirce; Voice-like Hallucinations.

1. Overview

Integrative psychosomatic and technological approaches convey the idea of enhancement in concepts of health (Lenk 2011) that include *quantifiable medical treatment* and *subjective qualitative wellbeing*. One of these recent developments is what can be called "Avatar Enhance-

ments¹" in which we include the development of AVATAR therapy (Leff et al 2014, Craig et al 2015, Craig et al 2017; Craig et al 2018; Sert et al 2018; Dellazizzo et al 2018; Craig 2019) to help patients with schizophrenia better manage for example their voice-*like*² "AV" hallucinations (AVH³) and gain more self-control over their body (Gerner 2016) besides *principle uncanny valley effects* not to be overcome (Gerner 2020: 2190) related to the double notion of embodiment and disembodiment. Importantly, patients with Command and voice-like hallucinations⁴ show gen-

1 The overview article on *Hacking the Brain* in relation to *Cognitive Enhancements* of Dressler et al (2019) does not explicitly treat Avatars, but in general refers to cognitive behavioral brain hacking. Hacking in the context of this article is understood here as a method of probing and investigation in the sense initially proposed by P.R. Samson (1959), of an unconventional or different application of technology that may enhance the potential of human experience by multiplying its energy, by transforming its habitual uses to open up new perspectives of interacting with and becoming an "Other".

2 The patients in Woods et al (2014) study spoke of: "resonant voices," "organ voices," "voices of conscience," "voices which do not speak with words," "false voices," "abortive voices," an "inner feeling in the soul," an "inward voice in the thoughts," something "between hearing and fore-boding," "the brain talk[ing]," "voices in the whole body," "murmurings and natural spirit-voices," "underground voices from the air," "telephone gossip," "good voices," and "whispering voices from the whole of mankind".

3 See the critic of the impressive "master" thesis of Franziska Stanke (2017) on vague AVS descriptions: "The term auditory verbal hallucination is probably only appropriate for a subgroup of the phenomena summarised under the term. How large this subgroup actually is, remains to be defined. In order to provide appropriate treatment options for person's who report what is called -hearing voices we need to understand their experiences better. We have seen that there is in many respects more to voice-hearing than the standard definition would suggest. By focusing on audibility, it dismisses that voices are not just simple" (Stanke 2017: pp16-17). See as well: Moritz & Larøi, (2008); Wilkinson & Bell (2016). A recent case for the overdiagnosis of schizophrenia by the symptom of "voice-hearing"- that appears as a wider hallucination phenomenon has been declared as first reason by Coulter, Baker and Margolis (2019): "Why might overdiagnosis of schizophrenia occur? We suspect 3 causes. First is an overly literal interpretation of patients' self-reported symptoms, especially "hearing voices". There is evidence that the experience of hallucinations, which may be common in the general population, is categorically different for individuals with schizophrenia. In addition, the term "hearing voices" may be used imprecisely by patients to emphasize extreme emotional distress. This may be particularly common in individuals with cognitive, communication, language, or cultural limitations in their capacity for self-description. As an example, we and others have found that individuals report hearing voices during panic attacks; however, the experience appears to have a different quality than the perceptions of individuals with schizophrenia. It has been hypothesized that anxious patients who ruminate on the content of their thoughts may experience these thoughts as auditory hallucinations". Coulter, Baker and Margolis (2019: pp.78-79).

4 Another neuroscientific approach should be scrutinized in the sense how structural and functional abnormalities in the brain seem to converge in the superior gyrus of the

eral cognitive deficits (Palmer et al 2009) and motor, movement and *socio-motor impairments* (Varlet et al 2012; Bleuler 1950), *deficits in nonverbal behaviors* (Walther et al 2015) and *nonverbal synchrony* (Kupper et al 2015), observed in structured and unstructured social interactions, that this paper will treat theoretically by introducing a possible gesture-enhanced extended version of Cybertherapy⁵ with Avatars that tackle multimodal bodily experience beyond mere visual or auditory stimulation. This is put forward theoretically in a multimodal 4E⁶ cognition approach that expands Avatar Therapy with gestures into VR.⁷ With the voice, face *and body* computer-modelled after the hallucinated patient's Avatar in VR, the disorder of the Verbal Hallucinations the Self that is affected in its *eccentric position* (Plessner, 1975) and thus the delimitation of the self and others (and its territories) should be rehearsed to

left temporal lobe and how "(t)he failure of activation in the anterior cingulate cortex could be a neuronal correlate of inability to inhibit internally generated 'voices' in the form of speech mis-representations, further enhanced by focusing of attention on the voices once they are elicited, as part of a dysfunctional fronto-parietal neuronal network". (Hugdahl et al 2009: 44).

5 Cybertherapies don't only refer to therapies related to the Internet, but include as well technologies and applications such as for example interactive Virtual Reality, augmented reality, mixed reality, therapies that are based on robot and Avatar interactions. Cf. Kothgassner & Felnhofer (2018: 7); Madary & Mezinger (2016). The "25th Anniversary Annual International CyberPsychology, CyberTherapy & Social Networking Conference (CYPsy25)" of 2020 planned -before the SARS-CoV-2 caused COVID-19 pandemic- to be held in June in Milan, Italy, refers to the following areas of research in which Cybertherapy is included and *AI applications* could be added to the following list: "Virtual Reality, Augmented Reality, Social Networking, Online Behavior, Robotics, Forensic Cyberpsychology (cybersecurity / cybercrime), Ethics related to Automation and Machine Learning, Avatars, e-Health, SMART applications, IoT, and other emerging applications". CYPsy25, <https://www.interactivemediainstitute.com/cpsy25/>.

6 The 4 E's stand for embodied, embedded, enactive, externalized cognition as "main central points of the 4E approach to cognition, namely the *importance of the bodily power of action*, (Embodiment), the *self-organizing properties of the living system*, who brings forth a personal point of view to meaningfully engage in motivated activities in light of the shifting demands of the environment (Enaction), and the *structural features of an agent's milieu*, which directly affects his or her intrinsic motivations and behaviors (Embedment), allowing some cognitive tasks to be offloaded in certain tools and devices of the agent's niche (Externalism)". Schiavio et al 2017:12.

7 Bailey, Casato & Bailenson "(...) demonstrated how VR could be used to examine the possible ways that systems of the body (e.g., visual, motor) may interact to influence cognition. The implications of this research suggest that visual feedback alone is not enough to alter space-valence associations. Multiple sensory experiences of media (i.e., sensorimotor feedback) may be necessary to influence cognition, not simply visual feedback" Bailey, Casanto & Bailenson 2016:222.

understand the limits of me/mineness in relation to the other in clinical studies in *cyberpsychology* and *cybertherapy* (Kothgassner & Felnhofer 2018). The reason Avatars were created to interact with hallucinating patients is the following: Pharmacological efficiency in schizophrenia treatment has limitations⁸ as described by Kane⁹ (2007, 2012). Besides excluding incorrect diagnosis (Dold & Leucht 2014; Kayser 2013)¹⁰ one main difficulty lies in the resistance to pharmacological treatment (Elkis 2007). Although antipsychotic pharmacological agents are seen as the first and preferred choice – for instance via blockade of brain-dopamine receptors and modulating effects on other brain neurotransmitter systems- with the most potent antipsychotic effects in successful clinical treatment (NICE 2014), nevertheless one out of four (Kane 2007) or three (Mouchlianitis et al 2015) patients -besides high levels of dopamine D2 receptor blockage (Kapur et al. 2000) - show pharmacological treatment resistance (Lindenmeyer 2000; Pilowsky et al 1993; Kane 2012) towards first-line antipsychotic medications despite adherence, named *treatment resistance schizophrenia* (TRS; cf. Kane 1988; Suzuki 2012). This high percentage (20–30%) in which standard pharmacological treatment does not show effects is as well related to comorbidity in patients with four to five lifetime adversities (Hassan 2015; Scheler- Gilkey et al. 2002) -

8 "Current dopamine modulating first-generation and second-generation anti-psychotics target mainly positive symptoms, but not/inadequately negative and cognitive symptoms. Additional challenges include non-adherence and adverse effects, especially cardiometabolic dysregulation(...) Schizophrenia is a still all-too-often chronic and debilitating psychiatric disorder that is characterized by a combination of positive and negative symptoms, cognitive dysfunction, affective and motor disturbances that often result in functional impairment and poor quality of life". Krogman et al 2019: 41; Another important limitation is that neuro-cognitive impairments are a core feature of schizophrenia (Green et al 2008) and that the most common remedy subscribed are based on dopamine D2/D3 receptor blockers and are not the only possible treatment option(cf. Kaar et al 2019).

9 "Schizophrenia is one of the most devastating psychiatric conditions markedly affecting patient functionality and family burden. Unfortunately, pharmacological efficacy has its limitations as one in four patients fail to respond to treatment with anti-psychotics" (Kane 2007: 35–40).

10 Cf. Šagud, 2015, notes that pseudo- treatment-resistant schizophrenia has to exclude false diagnosis such as (a) severe personality disorders, (b) mania or (c) depressive disorders with psychotic features that can be held for schizophrenia (cf. Dold & Leucht, 2014), (d) other brain diseases can mimic the presentation of schizophrenia, e.g. anti-NMDAR encephalitis. The most frequent psychiatric symptoms of autoimmune encephalitis, for instance, are delusions, manic mood and aggression (cf. Kayser et al 2013).

including childhood trauma (van Damm et al 2015; Üçok & Bikmaz 2007) and abuse- more severe symptoms and its auditory, thought-like and mixed phenomenology such as voice-hearing¹¹ in command hallucinations and thought insertion (Woods et al. (2015)¹², social stress (Veling et al 2016) and social factors beyond mere genetics (cf. Murray 2016), disabilities, higher suicidal risk (Mammo 2007), substance abuse (Gupta 1998) and lower quality of life. TRS makes up 60–80% (Kennedy 2014) of the all economic cost for schizophrenia treatment for example in the US society. Another difficulty is given in the fact that the onset of symptoms of schizophrenia can take over ten years.¹³ Besides finding better personalized pharmacological interventions by pharmacogenomics with stratified antipsychotic effects, we have to take additional non-pharmacological cognitive treatment strategies for hallucinatory symptomologies into consideration, not only when heeding the 20–30% of patients with TRS – for relieving psychic pain of these patients, in order to enhance their well-being and their social surrounding, but as well by emphasizing with psychological and socio-cognitive interventions such as cognitive behavioral therapies the cognitive basis of psychosis (Garety et al 1994; Bebbington et al; Garety et al 2001). In this sense, enhancing cognitive deficits may ameliorate executive functions (Medalia & Joy 2009) -e.g.

11 Important is the fact that voice hearing does not only apply to the symptomatology of psychosis, but as Pinheiro, Schwarze & Kotz (2018) underline the distinction of self-voice and non-self voice and the fact that voice hearing is more common than psychosis in which in AVH sensory feedback is altered: "Auditory verbal hallucinations (AVH) are a cardinal symptom of psychosis but also occur in 6–13% of the general population.(...) sensory feedback to self-voice is altered in people with an AHV predisposition. Specific alterations in the processing of self-generated vocal sounds may thus establish a core feature on the psychosis continuum". Cf. as well: Conde, Gonçalves, and Pinheiro (2018).

12 According to the study of Birchwoods et al (2014) most of the voices or phenomena of insertion consist on imperatives for performing actions: Imperatives for performing actions of self-harm, bad advise or negative judgement: ["Cut yourself"; "Drink bleach"; "Don't take your medication"] You are worth nothing!(b) Imperatives to harm others: ["Attack someone"; "Hurt your children"; "Smash him or her over the head" (c) Suicide Advice: ["Take an overdose and kill yourself"; "Jump off the bridge"; "Commit suicide"] (d) Kill others ["Stab your flatmate or sister"; "Kill your husband or wife with a knife"; "Strangle him" (e) Antisocial Conduct ["Start a fight" "Shout at them"; (f)Destroy property; (g) Major Social Transgression [Stealing from shops; running naked in the street](h) Direct Threats [We are out to get you" "We will kill you"].

13 "The onset of the illness consists of a decline in cognitive and social functioning, which begins in the early adolescent years and precedes the onset of psychotic symptoms by >10 years". Kahn, RS et al., 2015.

working memory by training remediations (Tripathi et al 2018)- and specially social cognition skills by exploring new technological based methods as for example Virtual reality (VR; (Valmaggia, Day & Calafell 2016) and Avatar creations modeled according to the voice hallucination characteristics of the patients and by this, investigate cognitive¹⁴ processes and mechanisms linked to onset and maintenance of psychosis as well as its therapy, one possible intervention of which I will treat in this paper: Avatar Therapy and its gesture-enhanced fully embodied VR extensions.

2. Methodology and Enlargement of Cybertherapies with Avatars for Treatment of Voice-and Command-hearing Phenomena

Julian Leff and colleagues¹⁵ created *Avatar Therapy* (AV) as a new therapy that allows treatment-resistant schizophrenia patients to model a virtual avatar head and voice with prosodic voice differences to render more real the entity they believe to be the cause of their symptomatology and start to enact in a dialogue with them. In which sense is a patient with symptoms of “voice hearing” possible to be influenced by distracting

14 Interestingly a protection against voice-like hallucinations seems to be given in blind people, as *blind* people have “perceptual and cognitive differences”, Silverstein, Wang & Keane (2013) “provide evidence that C/E blindness does not confer protection against other mental disorders (e.g., depression, anorexia nervosa) and finally we argue that other forms of C/E sensory loss (e.g., deafness) do not reduce the risk of schizophrenia. We conclude by noting the implications of these data for designing cognitive training interventions for patients and people at high risk for the disorder, and for developing interventions to prevent schizophrenia”. Blind people compared with people who see as Silverstein, Wang, & Keane (2013) resume research in the field have enhanced auditory capacities: such as enhanced a) auditory acuity for pitch, b) enhanced pitch discrimination, c) enhanced pitch-timbre categorization (Wan et al 2010), d) enhanced speech discrimination, e) enhanced sound localization, f) enhanced temporal auditory resolution, g) enhanced noise-embedded speech discrimination, h) quicker sound threshold for identification of pseudo-words, i) shorter latencies for auditory event-related potentials, and j) more tolerance for short stimulus-onset asynchronies in an auditory backward masking task.

15 Leff et al (2014), regard 8 different explanations for the effectiveness of the *Avatar therapy* (AV): (1) acknowledgement of the patient’s experience (2) the effort of establishing a dialogue with the schizophrenia multimodal modelled Avatar (3) the process of modification of the Avatar attitude towards the patient over time (4) tool for helping the patient overcome their fear of their prosecutors (5) experience of gaining control over the Avatar (6) achieving awareness in the patients of the link between their low self-esteem and critical statements from the voices (7) in cases of history of abuse (in childhood), reduction of the sense of own responsibility for having been abused (8) recorded Avatar sessions on a media player as a kind of “portable therapist”.

the patient's somatic body image and body-ownership given in its necessary multisensory synchronizations and de-synchronizations (Banakou & Slater 2014) and sensory motor embodiment (cf. Gerner & Guerra 2014; Gerner 2015)? Could motor efference copies in which "Motor actions are preceded by an efference copy of the motor command, resulting in a corollary discharge of the expected sensation in sensory cortex" (Ford et al 2014: 804) be a reason for voice hearing?

An important field to study in physiology of voice hearing is what Knolle et al (2019) call "Auditory Predictions and Prediction Errors in Response to Self-Initiated Vowels". This research field starts with the idea of actuality of sound production in contrast with prediction of what that sound should be and who should be the actual producer of this sound (uncertainty of ascription of ownership) in which voice hearers ask: *Was that me?*, "Did I do that" (cf. Ford et al 2013).

Changes or disruption in sensory-motor processing (tactile, motor cues and proprioception) and their multimodal synchronization might be important factors as a case study of the induced feeling of a presence (Arzy et al 2006) by electromagnetic stimulation of the temporo-parietal cortex shows. If we observe these phenomena in relation to the proprioception of the body-image and of another being present, similar phenomena could be responsible for Voice/ command or auditory hallucinations. Pairing the introduction of an auditory-visual coupling and their synchronization might make this an exciting research field for schizophrenia therapy with VR immersion and social Avatar interactions. Gestural motor-following tasks have been discussed for early onset (non-genetic) biomarker approach (Slowinski 2017). Another approach recently showing positive results is the Avatar mediated 12 weeks/ 24 weeks follow up dialogue therapy (Craig et al 2017). Others with recent new results are short-term electromagnetic brain (Dollfuss et al 2018; de Weijer et al 2014; Kindler et al 2013) stimulations therapies.

Transformation possibilities through phenomenological and social-gesture approaches extended body technique and body rhetoric by training

different action modes in varying degrees of immersion and various forms of embodiment¹⁶, e.g.

- 1) with a triologue between patient-avatar-doctor mediated via a computer-assisted screen
- 2) with interactional and gestural extension of a full-body avatar model extended into virtual reality in virtual reality
- 3) compared to theatrical interactions of an actor and a mask¹⁷ as a counterpart, which is made of a haptic-material production by an Avatar-Persona.
 - a) Leff-Craig *Avatar Therapy* and its methodological variations: The patient is able to relate to an external representation on a Computer

16 Instead of a body-neutrality position, embodiment and the often-used term *4E cognition* imply embodied, embedded, extended (not limited only between sensory input and motor-output but open to external tool enhancements and extended mind approaches (Clark & Chalmers, 1998), and enactive approaches (perception as interactive process including action in perception (Noe 2004) to cognition.

17 Cichocki 2016: 9: "Over 5 days Mr B. made a face in clay, which subsequently, impressed in paper-mâché, painted, and adorned with hair, took on the form of a mask. As well as the patient, the other participant in this stage was an art therapist with both an art education and many years' experience of working with psychotic patients. The stage involving creation of the avatar – the mask – is the first, but also a crucial element of the therapy process, because the mask is a reflection of what the patient feels, sees and hears, and what is often material inaccessible to the therapist. The mask made by the patient is a self-portrait of his inner experiences; already at the stage of creating the mask, the patient is revealing something that was hitherto deeply, often unconsciously concealed. Moreover, creating a mask that is to personify the voice he hears is a way of confronting it, even at this stage. What had previously been invisible can now be seen by Mr B. in reality, and it is possible to become familiar with something that had previously elicited fear. Over the course of the week-long workshop, he sculpted a mask of a woman with long hair, slightly terrifying, or perhaps terrified, as suggested by her large, wide-open, somewhat exaggerated eyes that attract attention and provoke a range of emotions, as we found out in our discussion after the first session as we attempted to answer the question "What do we see in this face?". Fear, sadness, a smile that is not a smile, terror and shame, as intimated by the red cheeks. A whole gamut of emotions, perhaps a reflection of the feelings harboured by the patient for his mother" made of clay-papmaché by the patient (cf. Cichocki et al 2016) and later reenacted by an actor with the mask. In the making/ process of the mask a strong impact of the ergotic (Roth 2003; cf. Luciani 2007: 5) gesture aspect, working on and transforming the physical reality of the world containing epistemic transformation by touch, semiotic transformation by envisioning faciality and affects provoked by the building of the mask and its enactment in relation to the patient.

screen and eventually directly¹⁸ with the therapist. How can this Avatar way of accessibility to self-others/ externalization of the hallucination (ex-bodiment of episodic self with voice hallucinations), its aesthetic make-up and its specific interaction in proximity or distance actually alter the perception of self and the relation to the other person and influence the proper schizophrenic episodes and its frequencies?

b) Virtual self-gaming with different stages levels of immersion: Will results of ^{g+T}A differ in Visual avatar on a 2-D screen from immersive 3D space setups?

c) Motoric and gestural coordination and touch stimulation in encounters with the avatar

As Motor skills are critical for efficient nonverbal communication, transformational epistemological approaches not only explore the significance of the physical experience of motorics and movement gestures in embodied space in technologized and virtual environments, but also their mutability, e.g. via changes in the body perception of self and action planning and timing with others movements and in relation to their socially synchronized gestures and their mutability with Avatars.

d) How can we obtain neuropsychologic evidence of the working of virtual avatar therapy?

Moreover, we should ask: How important is empathy, and what type of *empathy* and its transformation in VR? In which sense is a self that has voice-like hallucinations able to be influenced by distracting its somatic

¹⁸ Recently the study of Stefaniak et al (2019; cf. Stefniak 2015) introduces the following variation to the initial Leff study setup emphasizing shared presence of patient Avatar and therapist: "Contrary to the Leff et al. study, the patient sat in the same office with the therapist and the on-screen avatar. The avatar used an animated head with synthetic voice (Sorokosz et al 2017). No voice conversion nor face modification were applied. During the initial sessions, the avatar's utterances were a reflection of the content of the "voices" heard. In the subsequent sessions, they also contained messages that would help the patients in opposing the "voices". " Stefaniak et al 2019: 115.

Their study hinged on the speech synthesis as a proof of concept: "The patient sat in front of the screen with the avatar displayed and watched the animations, which were discretely controlled by the therapist. The therapy session was divided into two phases:/ 1. In the first (offline) one, the therapist prepared an individualized set of prompts for a given patient (i.e., with content of hallucinations) and the video files with animations were generated. /2. In the second one, the patient, accompanied by the therapist, interacted with the avatar, which played back a required animation in a way that was controlled by the therapist". Sorokosz et al 2017: 87.

body image and body-ownership (Gerner & Guerra 2014; Fuchs 2014). Given in its necessary multisensory synchronisations and de-synchronisations and sensory motor embodiment? By amplifying within further embodiment Leff/Craigs computer assisted 2D screen Avatar schizophrenia therapeutic doubling such as full body immersion with the Avatar, as well other factors should be taken into account in clinical follow-up research in the Lab: (1) human factors in Avatar studies different to (2) autonomous computer-controlled agents (Fox et al 2015), Virtual humans- human intimate interaction (Fox & Bailenson 2009; 2013; Bailey et al 2016). When designing the Avatar with the voice-hearing patient of outmost importance is the degree of visuospatial similitude, attractiveness or even degree of uncanny repulsive reaction towards the Avatar and the patient's proteus (Yee & Bailensen 2007; Yee 2014; Sabolius 2016) effect as for example researched in "uncanny valley" (Mori 1970; MacDorman 2005; MacDorman & Ishiguro 2006; Tinwell et al 2011; Slotovsky et al 2015; Gerner 2020) effects and that Fuchs recently shifted the focus from concrete technological objects to uncanny atmospheres: In this sense Thomas Fuchs describes the beginning atmosphere of delusion and reality loss within the concept of uncanny in the context of the atmospheric that creeps in slowly and in growing fearfulness condense towards an atmospheric sphere of fear that develops into horror. In this horror scenario, the atmosphere has a reality derived from existential thereness or existential feeling of being. On the other hand, this concrete being has an ecological dimension of reality that belongs to the outside and is connected to the existence of other living beings.

Until now the idea of giving an hallucination a face- with face and head modeling computer assistance tools-and by this means enter in a semiotic interaction with the perpetrating voice has not heeded strongly enough the therapeutic potential that the face-to-face interaction as the foundation of social relation (Gerner 2019) might entail, besides the important distinction between the semiotic machine of faciality, the head and its movement and the different notions of embodiment of faciality and head inside a body. While in the classical Avatar Therapy situation, the therapist controls the commonly created Face/Head avatar and guides the patient through a series of psychotherapy sessions allowing the patient after several sessions to take more and more control of his

symptoms in order to better his experience and existential feelings of being and diminish the frequency of the voice-like hallucinations or commands, this method seems to interfere with the limits of self-identification and self-representation in relation to the now externalized technical Avatar-object. What has to be taken into account is as well the delayed, anticipated or desynchronized temporality of bodily self-perception and interaction of different levels of physical sensory-motor coordination or its unitary disruptions of ownership and self-perception, such as in creating *phantoms* for instance by temporal self-anticipation or "prolepsis" (Rieger 2014) – "*Sich-vorweg-Sein*" - in which oneself temporally is *anticipated* from the actuality of the presence of one's actual somatic body into the potentiality of future virtual bodies. We should ask how (neuro-) pharmacological drugs and technological tools or technical procedures applied to "the" self or the investigation of its aspects, influence and enhance the proper "self" (ownership, mineness, agency, interaction, decision-making, self/other-experience), tracing, changing and transforming the phenomena of "hearing voices" either what is already predefined from the start as self or taking into account just a specific theory of the self in the following levels:

- I. cognitive self and nootropic alterations
- II. affective self and the alterations of (negative) existential feeling or mood
- III. ecological and social self and the enhancement of pro-social behaviour
- IV. the moral self (and change of ethical decision making/judgment and moral action)
- V. virtual body self and its social aspects in VR.

For Craig (2019) the expansion of the Therapy Form using Avatar is inherent as it seems likely to him that *Avatar Therapy* can be offered as a component of a more holistic psychological therapy for psychosis, possibly in combination with other advanced approaches to paranoia and cognitive impairment based on digital technologies. I want to elaborate theoretically on such an extended proposal that does not only augment the phenomena treated but as well the application modi and technological means, such as introducing Avatar Therapy into cyberspace: First,

on the basic embodiment level of the minimal action-perception self the link of motor-gesture-auditory relation in how this could be significant in the cause of voice-hearing phenomena. This includes for instance research on a) the *Cerebellum* (Knolle et al 2012; 2013) contribution to predicting self-initiated sounds, motor-to-auditory predictions b) the failures to distinguish interoceptive and perceptive sensory signals (Conde et al 2016) and the attribution of mineness and otherness (my voice, stimuli of my body, someone's else's voice, external noise/ sound. Voice hearing phenomena can be induced not only in schizophrenia but as well by anxiety (Ratcliffe & Wilkinson 2016) and other negative affect stimulations and is in strong need of a phenomenological -philosophical (McCarthy-Jones et al 2013; McCarthy-Jones et al 2014a; McCarthy-Jones et al. 2014b) including affective, social cognition perspectives (Krueger 2016; Hufendiek 2016; De Jaeger & Di Paolo, 2007), cultural extended mind approaches(Durt & Fuchs, 2017; Kirchhoff 2012), in its description alongside with neuroscientific research.

2.1 The Importance of Enhancement of Self-Other Perspective Taking and Self-Other Distinction by (Vr) Avatar Therapy

Another important issue to be addressed in relation to self-other relation is the following: a perspective in interaction and intersubjectivity is always already given, but as well able to be modulated in a *bodily anchored perspective*. In schizophrenia, according to Blankenburg (1991) this is not only limited to the most affective embodiment and our perceptive capacities of the self, but as well is given in all levels of thinking, reasoning and judging. Thus, with Blankenburg we can distinguish three modes of embodied plural perspectives: (1) A own perspective is related to (2) the perspective of the other and (3) becomes thematically reflexive in comparison of a plurality of viewpoints.

This means that embodiment of the self deals with three types:

- (1) Being embodied (*body-schematics*)
- (2) Having a body (*body-imago*) and
- (3) Knowing about my/ the other's body as *body-knowledge* (Breyer 2015).

At this moment another exciting point of Blankenburg (1965; 1971) is considered by Thomas Fuchs (2012): one has to be able to integrate

the egocentric as well as an allocentric perspective without losing one's bodily center *permanently* as could be the case in a schizophrenic hallucination. If we take into consideration the topic of perspective-taking in Avatar Virtual Reality Schizophrenia therapy, we should clarify what exactly we can enhance by distinguishing at least the following necessary forms of perspective-taking that might be altered in a technological application of the technique of perspective taking:

Enhancement of Self-Other perspective by embodied Self- Avatar Self_{ii} technique
I Enhancement of self-other perspective taking Transformation of affective perspective taking in relation to <i>virtual other</i> (Fuchs 2014)
Transformation of kinesthetic perspective-taking in kinetic and gesture based Avatar -Self Interaction with synchronisation/ de-synchronisation dynamics
Transformation of motivational/intentional/ volitional perspective taking
II Enhancement of self-other distinction and self-other separation
III Enhancement of Self-Integration and embodiment in encounters with Avatar self_{ii} in the sense of a) self-location in space (spatiality of the encounter) b)self-synchronisation (inner and inter-temporality of the encounter with the other (cf.Gerner 2020)

Table 1: Enhancement of Self-Other perspective

Following the importance of inner bodily and interbodily synchronizations of motor-coordination, we consider the significance of another point: modulating the allocentric perspective taking in VR Avatar schizophrenia therapy. Experience of allocentric perspective-taking (Braithwaite & Dent 2011) and the illusion of body swapping (Petovka & Ehrsson 2008) or technically induced *OBE in Virtual Reality* (Lenggenhager 2007; Slater 2010; Ehrsson 2007; Blanke & Metzinger 2009) might be candidates to allow not just pain experience to be distracted/attenuated, but as well should be considered as a research area for Avatar VR therapy. Analog to the induction of a shadow person by robot-induced synchronised stimulation (Blanke et al 2014), a strange sensation that someone is proximal in the *peri-personal space*- described as psychiatric (Brugger et al 1996;

Critchley 1955) condition- could hold hints to understand how we could inverse the process by projecting an Avatar self with whom the patients can interact and immerse within different modes and how to reintegrate and make the critical issue to explore is how we could use the change in styles of embodiments (in- body-experience) and its exteriorisation and re-interiorization of *Avatar self_{ii}* in order to help foster the self-other distinction and a different form of in-body experience after the first interaction with the Avatar. Herby the *virtual embodiment* (Osimo et al 2015) in a life-size Virtual body (VB)- can lead to changes not only in perception, or implicit attitudes but as well in behaviour based on attributes of the VB in VR in which the Leff´s paradigm applied to immersive dialogue with a VR therapist could be a follow-up paradigm to be explored. Another issue that has to be more considered is the *human social relational factor* in Avatar studies, distinguishing our approach to interactions with mere autonomous computer-controlled agents, as the „mere perception of humanity in a digital representation can be powerful enough to amplify social responses within virtual environments“ (Fox et al 2015: 421). The necessity to attribute the status of intentional agents to the Avatar and sharing or non-sharing of attention- important as well in difficulties of schizophrenia patients to address social groups - as shown in children-robot relational studies (Melzoff et al 2010) - has to be considered and in Avatar VR schizophrenia therapy sessions as well. The idea of putting schizophrenia patients into a Virtual World- interacting with their schizophrenic Avatar Self- needs to address with what we deal with in VR Experience in the first place in the sense of four critical elements of Virtual Reality Experience “The key elements in experiencing virtual reality—or any reality for that matter—are a virtual world, immersion, sensory feedback (responding to user input), and interactivity” (Sherman & Craig 2003: 38) as well as *integrative synchronicity* between a) multimodal experience of senses among each other, including b) bodily movement/postures & gestures and c) different modes perspective taking that would be scrutinized as variables already in my gesture enhanced Therapy with Avatars (^{g+T}A) proposal, but that need to be enlarged in scope in relation to different forms of perspective taking and how they could be enhanced in the encounter with the virtual Avatar. What we should take into further considerations in the design of

clinical studies on the effectfullness of VR/Avatar schizophrenia therapy is not only the limitations of existing studies and their variation (from 2-D Avatars to enactive VR environmental encounters of projective and avatar selves and their gesture and plural kinesthetic levels as well as a) human factor in Avatar studies has to be more considered in difference to b) autonomous computer-controlled agents, as the „mere perception of humanity in a digital representation can be powerful enough to amplify social responses within virtual environments”. (Fox et al 2015.)

2.2 On the Technological Virtuosity of the Virtual “uncanny” in Cybertherapy with Avatars- Ethical Difficulties of VR Enhanced Avatar Therapy

This dynamic of changing between “my” and “your” position is given in a dynamic process (Plessner 1975: 132- 146). Plessner had envisioned that the positional character is as well related to embodiment and our self-body relation (Plessner 1975: 129). The human self –body relation is changeable, and transformable in which the lived body experience is not put into perspective as a permanent unified phenomenon, but the self “inhabits” different points of view or aspects about its body and the other. The body extends itself, may resist or stand against the self (“Ihm entgegen”), can incorporate and be immersed (“in ihn hinein”), can be transcended (“über ihn hinaus”), and besides being able to be embodied can as well be exbodied in a perspective outside of itself: “the body is out of itself and inside itself” (Plessner 1975: 129, my translation). This means that perspectivity (having ones’ own perspective and distinguish it from the other, as well as taking on the perspective of the other) is an essential mode of being in the world and being towards the other as well in experiencing voice-like hallucinations. The problematic of hearing voices in the case of schizophrenic thought insertion can be described as uncanny voices. For Thomas Fuchs (Fuchs 2019; cf. Gerner 2020), the intersubjective dimension of time is given in the synchronization/ a-synchronization dynamics between world time and subjective time. Hereby an *uncanny atmosphere* (Fuchs 2019) of delusion and reality loss is given when “hearing voices” might creep slowly into experience. It implies a tension between self and the others time and shows up in experience always already as a “too early” (acceleration; waiting/boredom, impatience, agitation, mania) or a “too late” (retardation; in illness, grief,

guilt, depression, time pressure). For a projective self by using virtual worlds as philosophical tools for polycentric (Gualeni 2015; Plessner 1975) positionalities in order to reduce cognitively, and even discriminatory bias (Banakou & Slater 2016), in enhanced VR -Avatar experiences. Technologically mediated Full-body illusions (Blanke & Mezinger 2009) among other forms of the illusion of embodiment- e.g. autoscopic experiences (Blanke et al 2015; Brugger 2002; 2006) - can have uncanny lasting effects- e.g. derealization (Madary & Metzinger 2016) or feeling of detachment/substitution.

We have to admit ethical challenges that this kind of VR therapy might trigger. Virtual Reality (VR) and the use of doubling Avatars can be considered *personality altering technologies*. Though VR is not permanent like the *proof of principle* of personality altering technologies of *DBS* (Deep brain stimulation) is, the orthodox and important difference of invasive and non-invasive in relation to the intervention or not in the skin of a patient, might not hold in the case of VR their therapeutic enhancements and its proper perils, as in a patient using these VR/Avatar technologies and encountering a double schizophrenic self in the middle and long run might confuse psychological principles by creating not just temporary altered states of reality- artificial disembodiment, but even permanent altered states or reinforce existing ones. As Black expresses this well: “the prospect of projecting one’s ego-center into a virtual space beyond the real body: it could be destabilizing and destructive “ (Blank 2013: 47-49). Thus, one can ask: will VR become not only habitual in gaming and recreational use but as well in medicine and mental health care and by that in the future create depersonalised addicts? Avatar VR therapy introduces modifications in the plasticity of both notions of the self in embodiment and self-other relation. Selves are socially embedded or *exbodyed* by self-technologies introducing change by Avatar-self relational technology. The Plasticity in the Human Mind and the risk and Potential for Deep Behavioral Manipulation in which VR can induce a situation in which the user’s total environment is determined by its creators and under full control of an external experimenter (Sanches-Vives & Slater 2005) of a virtual world inducing, for instance, the illusion of owning a virtual body (Kilteni et al 2012) or having externalized a schizophrenic voice of an *Avatar ii* and can be transformed by interaction, dialogue or

resistance towards the Avatar. Can we expect analogue effects of the illusions of owning a Virtual body that effect changing perceptual responses (Llobera, Sanchez-Vives and Slater 2013) in relation to changing Voices heard in schizophrenia patients by VR Avatar therapy? Could this also be the case in relation to adding to the voice hallucination a specific kinesthetic behavior that not only mimics but as well interacts on the gesture/embodiment level? Can we change the temporal and spatial schematics of the hallucination experiences by introducing changes of embodied parts, that can be as well artificially induced in the Rubber Hand Illusion (RHI; Slater et al 2010)? In schizophrenia patients, the RHI is quantitatively and qualitatively stronger¹⁹ than in healthy controls. Secondly, to understand how the modelling of an Avatar on the visual and musicing (Krumhansl 2002; Krueger 2004; Small 1998)²⁰/sound acoustic and language based dialogic level on different levels of embodied entrainment and immersion and with extracorporeal interaction and encounters a) on basic gestural entrainment synchronization levels, the entrained socio-resonant synchronized/desynchronized musicing/listening level up to the highly complex semiotic pragmatic speech dialogue level and in how much these can diminish AVH's in their frequency, stressful appearance etc. The quality of experience of listening to distressing hallucinated voices

19 Thakkar et al (2011) relate a case of RHI induced Out-of-body Experience (OBE) of the case R.M. with awake OBE's with psychotic episodes, a link that should be explored in further studies- is described without any associated neurological disorder. The described visual phenomenology of the OBE in R.M. consisted in an alternation between seated and elevated visuospatial perspectives, as well as gradual re-embodiment into the patient's physical body. In a second RHI induced OBE in the patient R.M., he described a feeling of numbness in feet and hands during the OBE. Both OBE episodes were accompanied with an internal "silencing out" of acoustic stimuli or gestalts, described as an impossibility of hearing anything: "it was a silence about it" (Ibid., p.6) In general the patient referred, that he had had OBE's since the age of 16, and described his elevated or virtual "second body" as "puppeteer", and evaluated this second body as endowed with a stronger sense of ownership (Ibid., p.7) than the somatic body that is viewed down on the ground, the "marionette".

20 In a complex view of different degrees of *strong* or *weak Interaction Theory* ecological causal factors of interaction have to be critically analyzed in respect to "the much-disussed coupling-constitution objection (Adams & Alzawa 2001, 2008): the objection that, just because a given cognitive process is *causally* dependent upon an environmental process, it does not follow that the environmental processes thereby becomes a *constitutive part* of the causal process" Krueger 2014: 9.

will be put into parallel to protomusical/telemusical²¹ listening enactive behaviour and perceptive-active gestures loops in music theory.

Even the creation or re-staging of “social hallucinations” (Madary & Metzinger 2016) could be possibly induced in mental and behavioral manipulation with virtual technologies, calling for ethical conduct in relation to the use of such VR technologies. This has to be taken into account when considering in moving from a clinical scenario of Avatar schizophrenia therapy towards a personalized user-based home scenario, in which the recent technological development of accessible and relatively cheap VR systems including VR headsets for example *Oculus* (Facebook), *HTC*, Valve’s *Vive*, Microsoft’s *HoloLens*, or Sony’s *Morpheus* among others, is a growing reality and cost-effective VR schizophrenia therapies of TRS patients could become a midterm future possibility to reduce economic costs and give patients new technical VR Avatar tools at hand, to use on a daily basis in their home environment. How to conceive more precisely the therapeutic and technological possibility of morphing and differentiating the projective *Self*, and the *VR-double self*, and their interaction for the purpose of schizophrenia therapy will be a task of further research. One point that needs further empirical and theoretical clarification and methodological exploration, as well as clinical testing, is how illusions and hallucinations of embodiment, the duplication of self in Avatars, and immersive encounters, dialogues or bodily interaction lead to changes in perspective taking or on the contrary may lead to self-absorption or in the best case foster the distinction of self-other. This research might in the future be more informed by parallel research in autoscopic hallucinations, Virtual doppelgänger, multisensory own-body-illusions (Ehrson et al 2005; Ehrson 2007, Lengenbagger et al 2009; Weiskrantz et al 1971) phantom limb experiences, the rubber-hand illusion, full body illusion, *Body Integrity Identity Disorder* (Anathaswamy 2015) that hopefully give way to more efficient and cost-effective hallucination therapies. Under terms such as “immersion”, “presence” or “incorporation”, psychological, philosophical and cultural studies approaches have investigated such

21 “repertoires of shared gestures and sounds enacted by infants and caregivers to communicate emotional states and bodily needs do involve parameters that are employed in musical dynamics (intensity, duration, rhythm, timbre, pitch, phrasing, and so forth)” Schiavio et al 2017: 1.

embodied spatial experience over the past ten years (cf. Slater 2009; Calleja's (2011) player involvement model; critical: Farrow & Iacovides (2013)). Such spaces of experience and their scientific evaluation have also become increasingly relevant for approaches to embodied cognition. Until now, however, gestures have played a marginal role as possible empirical research objects for the transformations of gestures in for the epistemological reflection on such spatial experiences.

2.3 On Gesture-enhanced Therapy with Avatars (^{g+TA})

Patients with delusional symptoms are associated with altered gesture perception (Walther et al 2019a; Bucci 2008; Walther et al 2015; White et al 2013). Walther et al (2019) indicate that nearly half of schizophrenia patients have problems producing gesture and as Vanbellingen et al (2010) show, around a third (27%) qualify for apraxia according to the score of TULIA (Vanbellingen et al 2009). Clinical correlates in this sense include chronicity difficulties, motor abnormalities, frontal lobe dysfunction and negative symptoms including notion of impaired action planning that contribute to poor social functioning in psychosis.

Moreover, we should take heed of gesture performance (Walther & Mittal 2016; Walther et al 2019a; b) and non-verbal communication skills as well as motor impairments in schizophrenia patients and even in discovering early on symptoms of schizophrenia and other psychic alterations. In the doubling or estrangement of an avatar or parts of it (voices/thoughts etc.) in the case of schizophrenia, the lost *self-control* (*as reduction of external real-world social resonance by negative thoughts and voice-like phenomena*):

Our proposal asks, how the self can reintegrate voices and commands, transforming and attenuating them. How are these voice hallucinations able to be influenced by transformed **body-ownership** given in its necessary **multisensory synchronizations and de-synchronizations** (Banakou & Slater 2014) to achieve or better body ownership in relation to and the mediation of the Avatar? This is an important point to be tested in future²² clinical trials with Phase III/IV/V Avatar therapy. The possibil-

²² Ben Alderson-Day & Nev Jones (2017: 3) hint at the ecological assessment of transformations introduced by the Avatar therapy that should be assessed in future longitudinal

ity of restructuring negative habits by using VR to restructure thought is another point to be aware when enhancing the Avatar Therapy initial design of giving voices an Avatar face and transform therapeutically the dialogue with the “talking head”. Thus, the idea of actively getting a grip²³ (in Virtual space) on the situation a patient is in is a possibility to be heeded with care. When introducing a gesture (Walther et al 2019b) and kinesthetic interaction level based on non-verbal communication skill training we have to assume that gesture abnormalities and their nature in schizophrenia are poorly understood yet (Walther et al 2019a).

The stance of ^{g+TA} is given here in a theoretical outlook on Avatars and VR. The immersive interface using personalized Avatars in VR environments is a new phase in relation to the traditional computer-assisted interface system of a monitor, a keyboard and a mouse, in which the patient enters a fully embodied and gesture driven dialogue with his schizophrenic Avatar on the 2D screen. In “immersive self-enhancement” the patient is not only immersed in a Virtual world in which he can encounter the schizophrenia Avatar, but the proper Immersive virtual environment (IVE’s) can be used for working on issues of embodiment in patients with altered selves. Several parameters can be rehearsed and experimented such as the concept of virtual agents (VA), (2) the type of immersive interface and environment, (3) the patient-therapist relation mediated by the Avatar, (4) the embodied and inter-corporeal interactions with the Virtual reality Avatar and (a) how to keep more distance (Bailenson 2003) or even avoid collision (Bönsch et al. 2015) or on the contrary, switching to absorption/ command mode (Avatar-self_{ii} command states and mingles or collapses into the immersed Self_i (Avatar self_{ii} is absorbed in VR. IVE can be manipulated in real-time by movement tracking and can let the person with schizophrenia, experience different levels of immersion. The VR techniques of a first-person for the enhanced user

qualitative studies: “Longitudinal qualitative research, possibly combined with ecological momentary assessment, could elucidate the potentially diverse and multifaceted factors contributing to changes relevant to the voice-hearer. We should applaud the efforts of the AVATAR team and the considerable benefits they have enabled for voice-hearers in their trial, but put simply, the question now is this—how does the conversation continue?”

23 Cf. Pudenazzi et al (2019) and Lindner et al (2019) in relation to enactive behavioral therapy in VR space concerning depression.

VR Avatar method	Enhancement of self-embodiment	Diminishment of negative voices and command hallucination	Enhancement type
I Externalization of schizophrenic self in modelled schizophrenic Avatar _{ii} II Immersion of the patient in VR body, perspective and IVR environment	Immersive ownership Enhancement: enhancement of ownership as <i>my voice vs a strange voice</i> (or other, e.g., God)	Enhancement of verbal content appearing and how the Self _i is able to distance himself or herself from the command or negative influence of the voice and verbal content	Enhancement of immersive agency/ interaction
III Encounter of the patient VR self with the Avatar Self _{ii} with therapeutic dialogue or	Immersiveness in self-other relations and resistance to absorption compliance to voice commands	Enhancement as diminishment of frequency of appearing of negative voices	Enhancement of ownership
IV kinesthetic interaction between VR-self and altered Avatar Self _{ii} - dynamic between static face-to face interaction/ dialogue and side by side gestication or full body movements such as walking - synchronizations/ desynchronizations in <i>mimicry/ non-mimicry</i> social behavioral contexts e.g. of rapport, empathy or <i>pro-social priming</i> (Raffard et al 2015) for enhancement of feeling of connectedness	Embodiment enhancement, by kinesthetic-gestural and verbal synchronization with the help of Avatar and immersive VR world tools. Training of different synchronizations (e.g. motor-acoustic) of gestures of differing and immersing in a proximity/distance game of social relations while playing and interacting with the Avatar	Gesture and movement-based Enhancement as attenuation of the severity of the voice and command to add nonverbal communication skills against socio-motor impairments, training with hand gestures to foster social perception and coordination or kinesthetic and gestural disengagement from threatening other: training of refusal rejection and negation gestures in relation to the Negative Avatar	Self-other distinction enhancement; social gesture enhancements
V Touch/ Materiality of Mask/ World-making	Ergotic-epistemic gesture transformation	enhancement of self-feeling/ touch-embodiment	Enhancement of gestures of appropriation and distancing from the transformed object/ enhancement of agency/ interaction

Table 2: Possible Stages of Future Enhancements to Therapies with Avatars including gestures ^{9+TA}

immersion include a head-mounted display (HMD) and for example a 5.1 channel headphone or might be using a CAVE full body immersive

system, making the interaction between the user and the Virtual Reality Environment system be natural with head tracker and data gloves.

A question in this situation arises: How does “immersive enhancement” change and modify the possibilities of a self and its relation to its body in space, and how does this different feeling of embodiment change the separation of self-other in relation to “hearing of voices”?

a) Leff’s Avatar Therapy and its methodological variations: The patient is able to relate to an external representation on a Computer screen: How can this Avatar way of accessibility to self-others/ externalization of the hallucination (ex-bodiment of schizophrenic episodic self), its aesthetic make-up and its specific interaction in proximity or distance actually *alter* the perception of self and the proper schizophrenic episodes and its frequencies? In the discussion, Craig et al (2015) explain that “Recent developments in treatment for distressing voices, which focus on the interpersonal relationship between voice-hearer and their voice, include a specific cognitive therapy for *command* (Birchwood et al 2014) hallucinations. The brevity of the therapy and its success in decreasing the frequency of the voices, their volume, and their negative impact on individual’s lives requires both replication in a methodologically rigorous randomized clinical trial and an exploration of the possible mechanisms for these effects on experiences which have failed to respond adequately to psychotic medication (Leff et al 2014)”

b) Virtual self-gaming with different stages levels of immersion: Will results of Phase II differ in Visual avatar on a 2-D screen from immersive 3D space setups.

c) How in Phase III can we vary temporal synchrony and immersive embodiment modes in motoric coordination and touch stimulation in varied encounters (in relation to face-to-face or presence control situation) with the avatar

d) How can we obtain neuropsychologic evidence of the working of virtual avatar therapy, that critics of the Phase II proposal asked to obtain additionally? Moreover, we should ask:

e) how important is in Phase IV the **social gesture-enhanced** proximity dynamics between VR immersed Self and schizophrenic Avatar self_{ii}

f) How important is empathy, and what type of compassion and its transformation in VR (Fuchs 2014) immersed VR body-schizophrenia Avatar encounters? In which sense is the self with hallucinations possible to be influenced by distracting its somatic body image and body-ownership, given in its necessary multisensory synchronizations and de-synchronizations (Banakou & Slater 2014) and sensory-motor embodiment (Gerner & Guerra 2014)? This question could be studied within the paradigm of the *Rubber Hand Illusion* (Botvinick & Cohen 1998). The Rubber Hand Illusion is an illusion in the coordination of vision, touch, and posture (proprioception) and social posture coordination (Gueugnon et al 2016) that has to be taken into account when introducing the change of body schema and the social bond to the modelled Avatar. Another form of possible research would be the coordination of touch and proprioception (Ehrsson et al, 2005; 2007) that have to be considered as reasons why Leff's Avatar enhancement therapy could be successful. Thus, we should research in the field of proprioception, multimodality and ownership in relation to hearing voices and commands in TRS, and clarify in clinical trials what happens when we externalize the voice-like phenomenon and give it a visible "face to dialogue with" (*Phase I*) b) to not only provide the avatar with a 2D representation on a computer screen, but as well a visible, kinesthetically enactive full-body (including and allowing the use of gestures and body postures as well varying the proximity between the experiencing self and the Avatar), and to enable the interventive possibility to control and manipulate the encounter of the patient in an immersive Virtual Reality with the Avatar in *Phase II* (cf. Sanchez-Vives and Slater 2005) in respect to its environment (Rizzo and Kim 2005).

In *Phase III*, the embodied movement-gestural dimension besides early screening, deduction of symptomology this means psycho-physical treatment of patients with voice-like hallucinations lies at the core. Thus, the immersed self of the patient in VR would be enabled to go for a walk with his/her Avatar_{ii} - for reasons of creating a stronger immersive presence (Slater et al 1995) including shared kinesthetic experience and interaction through movement. In this way, the patient would be able not only to face the Avatar directly but, additionally, be enactively involved in a second person relation of dynamic change from face-to-face communi-

cation, and active-enactive to passive-still modality, in which merely a sensing of the presence of the Avatar (including sound markers of presence) nearby is felt, but visibility is impaired, and even walking parallel to the Avatar without visual contact is possible.

Besides psychotherapeutic dialogue sessions between patient and therapist, mediated via the Avatar, the issue of multimodal transformation and externalization has to be further explored in future research. In VR embodiments “a virtual body can be felt as one’s own” (Martini et al 2014).

Every encounter is based on capacities to switch between your own embodied perspective and the perspective of others, and, at the same time, to distinguish both angles in order to assert yourself in front of the other. Therefore, Avatar *Virtual reality* (VR) therapy envisions that we technically inhabit a self on a physical level and that we can technologically alter our own embodied >Avatar_i< person immersed in the VR environment. This can happen when a fictional self is projected or externalized, and through that may contribute to enhancing the distinction between myself and a self-alike modelled²⁴ exbodyed hallucinatory VR double of a second >Avatar_{ii}<- self, with which we enter into bodily contact, proximity and dialogue, mediated by the therapist in computer-assisted training.

By giving the patients, suffering from TRS with command/ voice hallucinations the possibility to interact with a concrete externalized position of its schizophrenic Avatar in VR, an externalized form (morphology) and expression, a way of embodied interaction, and thus a social and ecological model to interact with, we expand the interaction with hallucinated voices by visible face and full- body-interaction with the suffering phenomena, and thus emphasize the fact that the visual sense and visual stimulation are predominant in relation to the sense of touch (Durgin et al 2007; Rohde et al 2011) leading to change in body schema, body image and body knowledge.

The idea of putting patients with hallucinations into a Virtual World interacting with their Avatar Self needs to explain with what we deal with

24 cf. <https://www.youtube.com/watch?v=aYfG53fgwXc>

in experience inside Virtual Reality in the first place in the sense of four elements of Virtual Reality Experience: “The key elements in experiencing virtual reality—or any reality for that matter—are a virtual world, immersion, sensory feedback (responding to user input), and interactivity” (Sherman & Craig 2003: 38).

3. Outlook: Towards the Development of an Embodied Neuropragmatics of Acousmatic Hallucinations Following Charles Sanders Peirce

An embodied Neuro-pragmatics following the semiotics of Peirce in which gesture-based embodiment 4E cognition approaches prevail, is still missing.²⁵ On the level of the manipulations of body-schemata and gesture-enhanced transformations it is important to understand why the externalized encounters and the embodied dialogue with an avatar can be therapeutically effective, and how to prove this in neuroscientific studies and not only behavioral studies, in order to transform the appearance of voices and alter the possibility of externalized dialogue into a social and fully embodied encounter.

In a semiotic stance triadic kinetic “actions” are transformed by Avatar therapy by which the dynamics of the reality of voices without bodies are re-embodied with the artificial interaction object of the Avatar. The negative commands or attributions of excessive self-criticism (cf. Falconer et al 2014) such as “You are worthless!” can be treated within VR through

25 Neuropragmatics is not understood here in a narrow sense of neuroscientific underpinning of language structures such as described by Stemmer, B. Schöne, P. (2000) Neuropragmatics in the Twenty-First Century, *Brain and Language* 71, 233–236, here: p.233: “Neuropragmatics is concerned with how the brain and mind uses language, that is, how it comprehends and produces pragmatic verbal behavior in healthy as well as neurologically impaired individuals”. Other language-based Neuropragmatics analyze emotional prosody in speech such as the Pell Lab https://www.mcgill.ca/pell_lab/. First steps that go beyond language in Neuropragmatics have been undertaken by biosemioticians such as by Schilhab, Stjernfelt & Deacon (2013) and cognitive multimodal gesture studies. This implies a new approach coming from Peirce in what concerns a sign in voice hearing based on a transformation of the semiotic threefold of relation to *Firstness*, *Secondness* and *Thirdness* and a) the sign of voice hearing b) the object of voice-hearing and c) the interpretant of voice-hearing- in the Peircean semiotic stance: “a sign stands for its object on the one hand, and its interpretant on the other, in such a way as to make the interpretant stand in relation to the object corresponding to its own relation to the object”. (Kockelman 2005:233).

training self-compassion (cf. Falconer et al 2016). Such semiotic actions relink the real distressing voices inside the head to an externalized reality in which the dynamics of index and subject of assertion becomes crucial for a change of conduct in attending to voice hallucinations in which “tones and looks act dynamically upon the listener and cause him to attend to realities”. (Peirce 1955: CP 2.337).

From a philosophy of science and technology perspective the language conception-metaphor problem involved in joint empirical endowed neuroscientific-philosophical approaches to voice hearing phenomena is still a residuum of research. Hence, in the future the language metaphors of “inner speech”, “dialogue”, “verbal” etc. will have to be clarified and pragmatically-semiotically described in their different perspective in the hallucination phenomena and their aesthetic experience. A concept that is too verbal-language based will have to be questioned in its assumptions and if auditory-verbal hallucinations are described as a misnomer - in the absence of external stimuli- to stimulate the auditory cortex. Musicking/ resonance and the pragmatic gesture-motor-auditory based communicational framework has to be developed within music aesthetic theories of resonance/ musicing musical entrainment with the threatening “voices” phenomena and its specificity for example in VR and in Avatar therapy. Moreover, an epistemological map of issues that might hinder good scientific conceptualizations would have to focus on epistemological problems when technological means – e.g. TMS- or Avatars or VR are used for therapeutic interventions in schizophrenia therapy and at the same time results of for example the stimulated brain areas are presented as having found the anatomical brain region that causes or are fundamental in schizophrenia for an upcoming publication of a study on TMS. Positive Treatment outcomes in Avatar therapy will be investigated in comparison to other therapy forms such as TMS stimulation therapies or relating therapy (Hayward et al 2017).

Peirce’s semiotic-rhetorical approach is significant in this theoretical take on the computer-assisted Avatar therapy, since (1) Peirce’s notion of signs is not only functional, but also encompasses perceptual, (inter-) action and imaginative parts (Fricke 2007) and (2) because it defies current pragmatic models of virtuality (e.g. Barricelli, Gadia, Rizzi, Marini 2016), as well as purely verbal-linguistic communication and dialogue

models with avatars (Deamer & Wilkinson 2015: 817). This means that a possible gesture-based multimodal extension of Avatar therapies that include social gestures and focus on music/rhythm/synchronicity of gestures between the patient and the avatar show advantages to classical dialogue head Avatar approaches, for instance when sign reception and decoding is not only seen as an enrichment of musical information in between a sort of a composer, score, interpreter, performance and listener (Tiits 2002: 66), but can enhance unseen voices or noises we hear without knowing what is causing it. A philosophical framework integrating phenomenological, pragmatic-semiotic (Peirce), and philosophy of technology approach on voice-hearing in schizophrenia and its *inner resonance*, *phantom resonance*, *xenoresonance* and what in music aesthetics is called *acousmatic* sound in which the *sound source is non-identified* and the *cause of sound* is unknown should be developed, researching on derivative efabulated/ invented or fictionalized hyper-reflective phenomena (Waldenfels), second-order immediate/dynamic object generation (voice) and subsequent significant dialogues (object-sign-interpretant triangulation) about these “mysterious” voices and their tacit dimension. As a result of this musical and gesture-based diagrammatic transformation of the hallucinated voices in dialogue and interaction (with oneself or with the externalized modelled Avatar) a techno-phenomenologically re-embodiment is put forward with externalized digital Avatar face/body and a mediated dialogue.

The semiotic situation of the “listener” of voice-like phenomena can be determined by the rhetorical methodology of Peirce (MS 318; EP 2: 403; EP 2: 326). The vocal assertion²⁶ that imposes itself on the speaker-listener is said to be externalized in the avatar therapy within the action range of multimodal manipulability and experimentation/ variation from identification to distancing from the hallucinating voice-sign to the avatar-sign. With Peirce, we can enter the realm of Avatar enhanced Therapy

26 “The assertion consists in the furnishing of evidence by the speaker to the listener that the speaker believes something, that is, finds a certain idea to be definitely compulsory on a certain occasion. There ought, therefore, to be three parts in every assertion, a sign of the occasion of the compulsion, a sign of the enforced idea, and a sign evidential of the compulsion affecting the speaker in so far as he identifies himself with the scientific intelligence”. Peirce, MS 787, 1897.

in relation to hallucinations in which we draw on universal rhetorical art proposed by Peirce as *rendering signs effective* by achieving physical results (EP 2: 326) that can be described in the patient-avatar-therapist relationship with Peirce's triadic categories in terms of sign, object (immediate and dynamic) and interpretant (Peirce 1955, 275–277) in which the “speaker-listener” with *joint attention*²⁷ to the therapeutic Avatar as jointly attended object enters the *missing third* of the semiotic communication situation.

3.1 From Hallucinations/ Fancies to Socially Shareable Percepts

This signifies that Avatar therapeutics could be transforming the forcefulness²⁸ of hallucinations into Avatar-fancies and these into enactively modulated *percepts*.²⁹

3.2 Habit Modification

Central for the reembodied Avatar therapy is the idea of introducing *habit*³⁰ *modification*³¹ in the voice hallucination listener. This is not only a

27 “Semiosis underlies many important practices that are not usually understood as semiotic. For example, joint-attention is a third. In particular, a child turning to observe what her parent is observing, or turning to look at where her parent is pointing, involves an interpretant (the child’s change of attention), an object (what the parent is attending to, or pointing towards), and a sign (the parent’s direction of attention, or gesture that directs attention). Joint attention is, in some sense, the exemplar of semiosis. (...)" Kockelman 2005, The Semiotic Stance, S. 237.

28 “The real world cannot be distinguished from a fictitious world by any description. It has often been disputed whether Hamlet was mad or not. This exemplifies the necessity of indicating that the real world is meant, if it be meant. Now reality is altogether dynamic, not qualitative. It consists in forcefulness. Nothing but a dynamic sign can distinguish it from fiction. It is true that no language (so far as I know) has any particular form of speech to show that the real world is spoken of. But that is not necessary, since tones and looks are sufficient to show when the speaker is in earnest. These tones and looks act dynamically upon the listener, and cause him to attend to realities. They are, therefore, the indices of the real world". Peirce, CP2.337.

29 “Every sane person lives in a double world, the outer and the inner world, the world of percepts and the world of fancies”. Peirce, CP5.487.

30 “What chiefly keeps these from being mixed up together is (besides certain marks they bear) everybody’s well knowing that fancies can be greatly modified by a certain nonmuscular effort, while it is muscular effort alone (whether this be “voluntary,” that is, preintended, or whether all the intended endeavour is to inhibit muscular action, as when one blushes, or when peristaltic action is set up on experience of danger to one’s person) that can to any noticeable degree modify percepts”. Peirce, CP5.487.

31 “A man can be durably affected by his percepts and by his fancies. The way in which they affect him will be apt to depend upon his personal inborn disposition and upon his

chance to change the patients' dispositions but his or her actual habits. A proposed evolutionary habit change³² lies at the center on how to deal with hallucinated voice phenomena and how to enhance the reaction to them by resisting mere indexical brute force of the forceful of internal binary signs of command into 4E-triadic³³ gestures. Although Peirce³⁴ is specifically interested in the *logical interpretant* as effected by the *energetic interpretant* which itself is effected by the *emotional interpretant*, my question is if there could be a therapeutic effect by inducing logical interpretants as habit change in relation to the voice hallucination by enhancing the dynamics of emotional and energetic and movement interpretants in the voice hearer by technical aid of gestures, body movement and Avatars. Therapy with Avatars becomes a means of *virtualizing habits* of hallucination into virtual "dreams"³⁵ and by that transform (bad self-) commands into recommendations that we might retrain within the

habits". Peirce, CP5.487.

32 "Habits differ from dispositions in having been acquired as consequences of the principle, virtually wellknown even to those whose powers of reflexion are insufficient to its formulation, that multiple reiterated behaviour of the same kind, under similar combinations of percepts and fancies, produces a tendency the habit actually to behave in a similar way under similar circumstances in the future". Peirce, CP5.487.

33 We can as well speak of training of introduction of triadic semiotic kinetic "actions" and the habits of attending to the hallucinated voices that can be transformed by the Avatar therapy by which the dynamics of reality of voices without bodies are externalized and re-embodied in an external Avatar. These semiotic actions relink the distressing voices to reality in which the dynamics of index and subject of assertion becomes crucial for change of conduct in which "tones and looks act dynamically upon the listener and cause him to attend to realities". Peirce, CP2.337.

34 "...the logical interpretant is an effect of the energetic interpretant, in the sense in which the latter is an effect of the emotional interpretant. Desire, however, is cause, not effect, of effort. As to expectation, it is excluded by the fact that it is not conditional. For that which might be mistaken for a conditional expectation is nothing but a judgment that, under certain conditions, there would be an expectation: there is no conditionality in the expectation itself, such as there is in the logical interpretant after it is actually produced. Therefore, there remains only habit, as the essence of the logical interpretant". Peirce, CP 5.486.

35 In the sense of Peirce's dream concept Donna West(2017, 52) showed 7 functions of dreams enumerated in Peirce that could be helpful when thinking about hallucinations and their transformations: (1) Dream maturation (2) Isomorphism between iconic sign and object (3) Icons of a general event template (4) Daydreams (fancies) of inward potential habits (5) Novel event relations/verbs (6) Percepts and fancies dependent upon habits (7) Actions engendered by self-hypnotized imperatives, or self-controlled imaginary hallucinations.

Avatar therapy to negate or turn into a forced manipulation of action and behavior not taken: “I would prefer not to!”. Thus, Peirce’s different interpretants can be put into a therapeutic transformative dynamics: By this we can reach from a “Sign being a command” in which *Meaning as Interpretant* is an “impulse to obey, which the sign excites” towards the appeal to an assertion to evade influence³⁶ of a bad hallucinatory habitual (hallucinatory) utterance. Hence, I propose a theoretical preparation of a future interdisciplinary study on the transformation of a “monologue”, the hallucinated “inner speech” associated with a widespread bilateral network including left and right superior temporal gyri, precuneus, posterior cingulate and left inferior and medial frontal gyri towards a dialogic discourse and interaction level in the sense of transforming primary activation associated with entrained musicing/ gesture based entrainment and disruptions as well as dialogic (Iderson-Day et al 2015) scenarios in which patients are trained for example via Avatars to resisting the hallucinated voices and commands. The introduction of social Gestures aim at the transformation from *solipsistic hallucination in AVH* towards a *creative fiction with the Avatar* (not of the obsessional or social type) at will (eg. triggered by the *creation of* and dialogic, gesture-based as well as musical-resonant *interaction with fictitious avatars* as strategy of empowerment³⁷ (cf. Dona West (2017) who treats dreams and **virtual**

36 “[W]hat is called [...] ‘Meaning’ is that which a sign communicates. This may be nothing but a feeling or emotion, which is all that a performance of instrumental music, for example, commonly expresses. Or the Sign being a command, such as the order ‘Ground Arms’, its Meaning may be the impulse to obey, which the sign excites. A question is a sort of command. Or the Sign may be an appeal to reason by an argument consisting of known premisses, the synthesis of which, which Synthesis will be its meaning, may be a new thought. Or the Sign may be an assertion, or ‘Proposition’, to use the logical term, when the Meaning is the substance of an assent to it. Or it may be a mere suggestion to imagination or memory, such as [a] single word may convey. Many ‘Utterances’, as all acts of using Signs will here be called, are purposeless. But a serious Utterance is usually intended to influence either a single act or the reasoned conduct of the Interpreter or Interpreters, and its meaning is that general kind of Conduct that it virtually recommends”. MS 637:33–34 (1909).

37 This is made clear by when stating that the Avatar therapy makes possible that “the patient is encouraged to talk back to the voice, becoming more assertive and less dominated by the experience. This differs from voice dialoguing, which typically encourages acceptance and recognition of voices as functional reactions to emotional distress. Visualization of the avatar might render the voice an easier object of control. An emphasis on equipping the voice-hearer with responses, challenges, and answers of their own implies

habits as “vivid directional icons of events” in Peirce as the “bedrock for conceiving many meritorious insights”). The philosophical point of a 4E-cognition philosophy of the embodiment of voice-hearing phenomena is that the interaction of the components (neural processes and neurophysiological (dys-) functions, proprioceptive feedback-loops of an organism and its failures in voice-hearing, the involved body schemata and their diagrammatic transformations, nature of affordances and niches in the environment, which are all in permanent interaction, requires for the realization of a cognitive-affective capacity that everything should be well coordinated, synchronized, entrained or in -tune.

3.3 Gesture Enhancements

The patient’s hallucinations are rendered clearer, in order to gain more self-control and empowerment by manipulating and dishabituation of the voice-like hallucinations in resisting them³⁸ and by reiterating³⁹ other habits⁴⁰ with the Avatar that not only represents a past hallucination, but as well a *future* self with less recurring voices. This underlines the importance on the techno-phenomenological level of transformation⁴¹ of

that the voice hearer is changing, but their voices might not be”. Alderson-Day, Jones 2017: 2.

38 “Moreover (...) every man exercises more or less control over himself by means of modifying his own habits; (...)" CP5.487 (=>gain of self-control and gaining distance to voices as other to be interacted with).

39 “(...) reiterations in the inner world fancied reiterations if wellintensified by direct effort, produce habits, just as do reiterations in the outer world; and these habits will have power to influence actual behaviour in the outer world; especially, if each reiteration be accompanied by a peculiar strong effort that is usually likened to issuing a command to one’s future self”. Peirce, CP5.487.

40 The behavioral transformation studies (Jalal et al 2020: 4) in changing compulsive obsessive disorders by creating *deshabituatiion* effects via Rubber Hand illusions speak of “(1) contaminating the fake hand during the RHI in OCD (...) (2) such exposure over time leads to habituation” in which “RHI contamination” in OCD patients in the RHI condition would result in greater contamination sensations such as disgust, anxiety, and handwashing urges, thus RHI habituation in OCD patients in the RHI condition would have to be treated with habituation assessment.

41 “When we come to study the great principle of continuity (...) and see how all is fluid and every point directly partakes the being of every other, it will appear that individualism and falsity are one and the same. Meantime, we know that man is not whole as long as he is single, that he is essentially a possible member of society. Especially, one man’s experience is nothing, if it stands alone. If he sees what others cannot, we call it hallucination. It is not “my” experience, but “our” experience that has to be thought of; and this “us” has indefinite possibilities”. Peirce, CP 5.402.

experience of a voice hearer in a shared experience with technical help to open up a semiotic space of operation. The training of new habits in attending and interacting in proximity- distance dynamics with the Avatar in modes fostering more (1) proximity or more (2) distancing between the immersed Self and the Avatar-Self⁴¹ is related to the recent study of Velling, Brinkman, Dorestijn, and van der Gaag (2014b) that found that first episode psychosis patients in VR would keep smaller distance to Avatars than healthy controls. Moreover, the *training of verbal and gestural >away gestures⁴² < of a too close or too loud Avatar with voice-hallucination based commands as holding away gestures in pragmatic function⁴³ including gestures of refusal, spatial distancing and negation gestures* (Bressem, Stein & Wegener 2017: 177) in relation to an Avatar and his voice-like commands might be an therapeutic strategy of empowerment of the patient with voice-like hallucinations. The idea would be in the construction of the therapeutic situation inside a

42 Bressem categorizes 4 types of away-gestures: 1. "sweeping away" (Bressem 2014, p.1596-7) 2."holding away" (Ibid, p.1597-8), 3. "brushing away" (Ibid, p.1598-9), 4. "throwing away" (p.1599-1600) and sees with Teßendorf (2014) the following action schema in away gestures: "(i) Point of departure: unpleasant situation (ii) Cause: annoying objects in the immediate surrounding (iii) Action: the back of the hand brushes these objects away (iv) Endpoint/goal: objects are removed; end of unpleasant situation and recovery of a neutral situation." Teßendorf cit. in: Bressem 2014, p.1600.

43 "Research has shown that gestures with pragmatic functions are able to "relate to features of an utterance's meaning that are not a part of its referential meaning or propositional content" [...]. As such, gestures fulfill performative function by indicating a request, a question or refusal [...]. Furthermore, they may "serve in a variety of ways as markers of the illocutionary force of an utterance, as grammatical and semantic operators or as punctuators or parsers of the spoken discourse". [...]. By taking over modal function, gestures indicate the speaker's stance towards the proposition uttered [...]. They qualify something as negative, obvious or particularly noteworthy and thus operate on the speaker's own utterance. Accordingly, researchers have argued that such gestures show functional analogies with modal particles [...]. However, gestures with pragmatic function may not only be an indication for the speaker's attitude towards the proposition of the utterance but also have the capability of highlighting properties of discourse. By taking over 'parsing'[...]or 'interactive' function [...], gestures contribute to the marking of various aspects of the structure of spoken discourse and provide visible anchor points for connecting or separating parts of discourse [...]. Accordingly, Kendon [...]has discussed pragmatic gestures with discursive function as 'discourse unit markers', highlighting the fact that gestures may be able to "mark discourse units differentially as topic in contrast to comment" and may serve to "mark discourse units which are 'focal' to the theme or argument of what is being said". In doing so, gestures with pragmatic functions may have the same functions as discourse markers or rising intonation in spoken language [...]" Bressem, Stein & Wegener 2015: 49. Cf. Kendon 1995.

VR situation that the Avatar would come too close entering peri-personal space and had to be thrown out and away by gesture distancing or negation of proximity of the spatial and psychological penetrating Avatar.

3.4 From Disembodied Acousmatic Hallucinations to Embodied Communication

Beyond disembodied acousmatic (Kane 2014; Battier 2007; Dolar 2006; Schaeffer 1966; Peignot 1960; Gerner 2020) listening and its musical object that seems merely phantasmagorical, the reality techniques of modelling an avatar as imagined and continuous interaction with this Avatar not only distracts from the voices but supplement them by creating a different index in a sharable social experience including shared attention and gaze-following as well as introduces the possibility of training with the Avatar interaction certain gestures of distancing, negating in an empowering way the proximity of the bad command, and as such training the *self-other distinction*. An embodied neuro-pragmatic framework for voice-hearing phenomena in better clarified Schizophrenia descriptions and possible therapies are meant to describe the transformation of the *interpretant-object-sign* relations in the sense of Charles Sanders Peirce and his categories of *Firstness*, *Secondness* and *Thirdness* in neurophysiological phenomena. The aim would be to transform obsessive and uncontrolled hallucination that are solipsistic, to a common sensical or “our”⁴⁴ experience in which the command as interpretant is made accessible to a social situation and made to be able to distance. Another aim in Transformation of Hallucination in the sense of Peirce would be the introduction of fallibilism of *experiences misunderstood*⁴⁵ in which external stimuli might counteract obsessions with

44 “When we come to study the great principle of continuity and see how all is fluid and every point directly partakes the being of every other, it will appear that individualism and falsity are one and the same. Meantime, we know that man is not whole as long as he is single, that he is essentially a possible member of society. Especially, one man’s experience is nothing, if it stands alone. If he sees what others cannot, we call it hallucination. It is not “my” experience, but “our” experience that has to be thought of; and this “us” has indefinite possibilities”. Peirce, CP 5.402, Footnote 2.

45 “By experience must be understood the entire mental product. Some psychologists whom I hold in respect will stop me here to say that, while they admit that experience is more than mere sensation, they cannot extend it to the whole mental product, since that would include hallucinations, delusions, superstitious imaginations and fallacies of all kinds; and that they would limit experience to senseperceptions. But I reply that my

“internal” voices as “direct experiences”⁴⁶, without external stimuli part of a perceptual⁴⁷ situation. In relation to “social hallucinations”. Peirce⁴⁸ in his time put up an interesting form of self-preservation, the introduction of a photo-camera as a device of proof for the reality of an experienced situation or its documental refutation. Instead of the photo-camera and its documentational value in the 19th and beginning 21th century, today, the embodied interaction with an Avatar with the possibility to *interact* not just verbally but *multimodally* including gestures to probe and train an embodied double negation: a gestural negation of negative commands and hallucinated voices-like phenomena that could be an important socio-technical, therapeutic tool to explore for patients with voice-like hallucinations.

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statement is the logical one. Hallucinations, delusions, superstitious imaginations, and fallacies of all kinds are experiences, but experiences misunderstood; while to say that all our knowledge relates merely to sense perception is to say that we can know nothing not even mistakenly about higher matters, as honor, aspirations, and love”. Peirce, CP 7.492.

46 “145. Ah! but it will be said, you forget direct experience. Direct experience is neither certain nor uncertain, because it affirms nothing it just is. There are delusions, hallucinations, dreams. But there is no mistake that such things really do appear, and direct experience means simply the appearance. It involves no error, because it testifies to nothing but its own appearance. For the same reason, it affords no certainty. It is not exact, because it leaves much vague; though it is not inexact either; that is, it has no false exactitude”. Peirce, CP1.145.

47 “Supposing it to be perceptive, the perception must be immediately known as external not indeed in the sense in which a hallucination is not external, but in the sense of being present regardless of the perceiver’s will or wish”.Peirce, CP 5.462.

48 “But peradventure I shall be asked whether I do not admit that there is any such thing as an illusion or hallucination. Oh, yes; among artists I have known more than one case of downright hallucinatory imaginations at the beck and call of these {poietai}. Of course, the man knows that such obedient spectres are not real experiences, because experience is that which forces itself upon him, willhe nillhe.Hallucinations proper obsessional hallucinations will not down at one’s bidding, and people who are subject to them are accustomed to sound the people who are with them in order to ascertain whether the object before them has a being independent of their disease or not. There are also social hallucinations. In such a case, a photographic camera or other instrument might be of service”. CP 5.117.

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