THE SELF AND ITS AVATARS IN NEURO-PSYCHIATRY

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Musing about the similarities between reduplications of the self in neuropsychiatric disorders and personalized avatars in virtual reality (VR) video games invites questions fundamental to both cognitive neuroscience and cognetics (BOX): What are the conditions for embodiment? Is self-duplication possible? Can a "disembodied state" be induced? How can somebody made feel at a remote place, inhabiting another body, acting at a distance? What role plays perspective taking in real and virtual environments and how important are individual differences in the ability to switch perspectives? What if one's avatar looks like oneself, moves like oneself, feels like another self—yet, seeks to dominate oneself? Is there a thing like "thought insertion" by an avatar? Can avatars promote altruism? What makes them powerfull marketing agents?

The present essay is an introduction to the complex interactions between the self and some "natural avatars", i.e. variants of the self that may be experienced in neuropsychiatric conditions. It offers a systematic classification of autoscopic phenomena (BOX), i.e. of *doppelgänger*[1] as they manifest themselves with or without overt brain damage. The classification is based on phenomenology (Brugger et al., 1997); doppelgänger can be seen, merely be felt at a specific location in peripersonal space, or be experienced as a multimodal mixture of seeing and feeling. Neurological avatars, brain-generated reduplications of the self, may develop a will of their own and at times even oppose their owner's intentions. In fact, hostile interactions between a person and her antagonistic doppelgänger are among the most astounding distortions of self-experience. The belletristic literature is a rich source of descriptions (Dieguez, 2013)[2] and reflects the broad range of doppelgänger manifestations. I review the clinical literature by beginning with the least dramatic kind of doppelgänger, the mere visual reduplication of the self.

THE VISUAL DOPPELGÄNGER: AUTOSCOPIC HALLUCINATIONS

In an autoscopic hallucination, a patient sees an image of himself "as in a mirror". In the old French medical literature, these visual reduplications were consequently referred to as "hallucinations spéculaires", i.e. mirror hallucinations. Colors may be vivid and the focus is

1 The English language literature usually writes "doppelganger", avoiding the umlaut "ä". I use the German spelling (though with a small-cap "d"), which does not change the English pronunciation. Note that the German word has no "s" in plural; it is one doppelgänger and two doppelgänger.

2 The anthropological literature on doppelgänger phenomena is revealing as well. A classic is Rank (1914), whose psychoanalytic stance may be apologized, but whose treatment of the universal use of symbolic forms of reduplication (comprising the soul, shadows, reflections, self-portraits, twins and dolls) is impressive both in scope and detail. See also Todd and Dewhurst (1962).

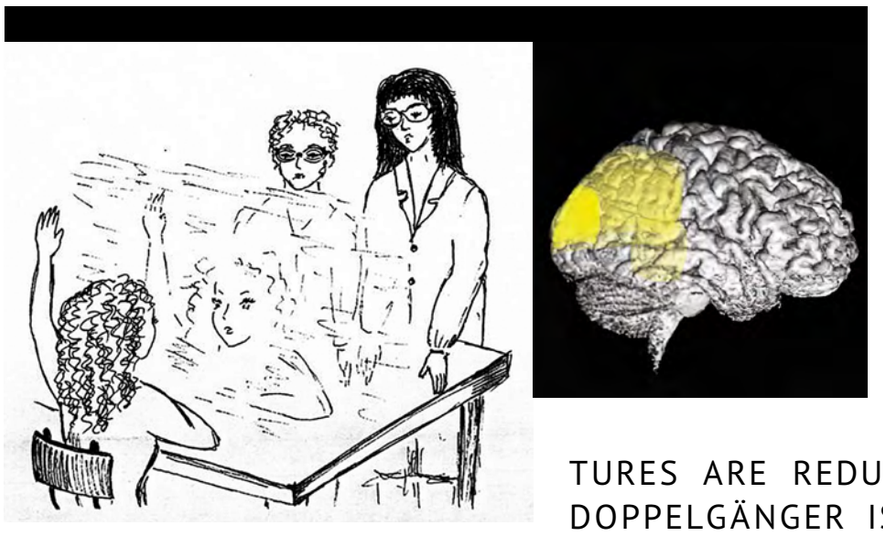

FIG. 1

IN AN AUTOSCOPIC HALLUCINATION, ONLY VISUAL FEATURES ARE REDUPLICATED AND THE DOPPELGÄNGER IS A MIRROR IMAGE. BRAIN LESIONS TYPICALLY INVOLVE THE VISUAL CORTEX, MORE FREQUENTLY OF THE RIGHT HEMISPHERE. LEFT: A PATIENT WITH A BILATERAL OCCIPITAL STROKE SAW HER DOPPELGÄNGER MIMICKING HER GESTURES. SHE NOTICED THAT MOVEMENTS WITH HER LEFT ARM MADE THE MIRROR DOUBLE MOVE ITS RIGHT. THE HALLUCINATED SCENE PARTIALLY COVERED OBJECTS AND PERSONS IN THE BACKGROUND

(FROM ZAMBONI ET AL., 2005, FIG. 2). RIGHT: ADOPTED FROM BLANKE AND METZINGER, 2009, FIG. 2.

on visual detail. Autoscopic hallucinations are always pathological and indicative of some damage to the "visual brain", i.e. its most posterior parts (Fig. 1, right panel). Right-sided lesions are more frequent than left-sided lesions, in accordance with the right hemisphere's stronger involvement in face processing, in particular in the processing of one's own face (Keenan et al., 2001). The duration of an autoscopic hallucination is variable, but tends to be short, especially when it occurs as a seizure manifestation.

THE SENSED PRESENCE: AN INVISIBLE DOPPELGÄNGER

The convincing awareness that somebody else is nearby has the same perceptual quality as a phantom limb, whose presence is only felt, vividly and precise with respect to spatial localization even in the absence of any visual confirmation. Although sensed presences are not always recognized as one's doppelgänger, an almost eery feeling of belonging evokes strong bonds with "the one out there"[3]. Identification as a second self occurs when the presence imitates a patient's bodily movements. Sensed presences have been conceived as "coenesthetic doppelgänger" (BOX coenesthesia), that is, duplications of the bodily sense, without any visual component. Accordingly, lesion location in cases of neurological patients is more anterior to the visual brain, i.e. mostly in the parietal lobes (Critchley, 1955) or in the region of the insula (Heydrich and Blanke, 2013; see Fig. 2), which processes nonvisual aspects of inner bodily functions. The sense of presence is also experienced by healthy individuals; it occurs especially frequent in single-hand sailors or mountaineers, when they are exhausted, dehydrated, socially isolated and in immediate danger (Suedfeld and Mocellin, 1987).

3 *Le Horla* is the one "out there" *(hors-de-la)*, which haunts Guy de Maupassant's protagonist in a 1886 novel. He describes in gripping diary style how the invisible being drives him mad. In the end, the protagonist decides to kill the sensed presence, only to recognize in the concluding sentence that, to effectively get rid of it, he will have to kill himself.

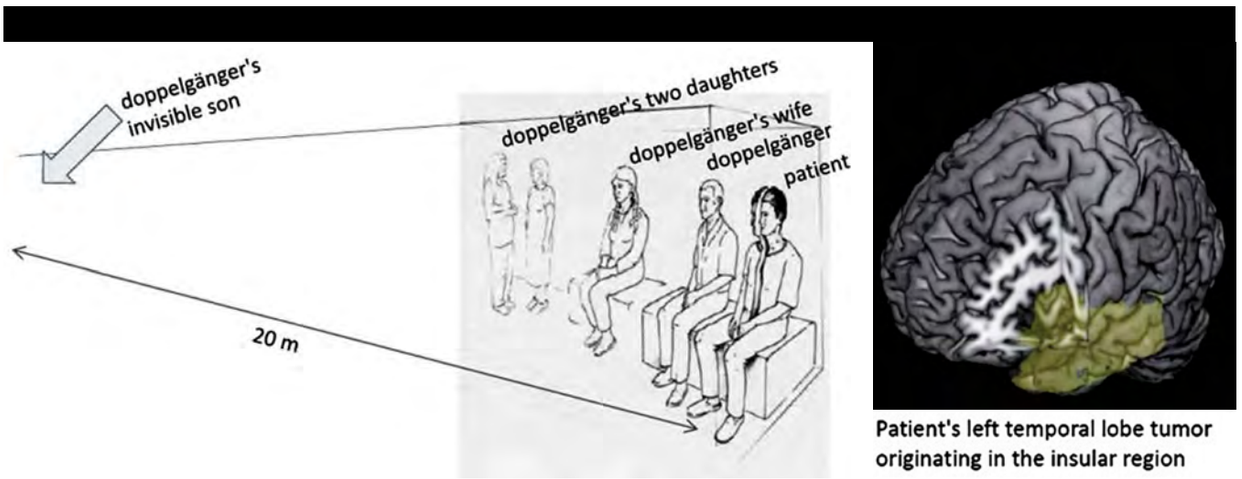

FIG. 2

A "SENSED PRESENCE" (ARROW) CANNOT BE DIRECTLY VISUALIZED. NEVERTHELESS, A PERSON CAN LOCALIZE HER INVISIBLE DOPPELGÄNGER IN THE SURROUNDING SPACE AS ACCURATELY AS AN ARM AMPUTEE CAN LOCALIZE HIS PHANTOM HAND. CORTICAL CORRELATES COMPRISE LESIONS TO THE PARIETAL OR TEMPORAL LOBES, BUT THE PHENOMENON IS FREQUENTLY EXPERIENCED BY NEUROLOGICALLY HEALTHY PERSONS. THE FIGURE DEPICTS AN INSTANCE OF A STRICTLY RIGHT-SIDED "POLIOPIC HEAUTOSCOPY" EXPERIENCED BY A MAN IN HIS EARLY FORTIES WHO, AS THE FIRST MANIFESTATION OF A TUMOR IN HIS LEFT TEMPORAL LOBE (RIGHT PANEL, ADOPTED FROM HEYDRICH & BLANKE, 2013, FIG. 1H), EXPERIENCED AN ENTIRE "DOPPELGÄNGER FAMILY", WHOSE MEMBERS KEPT A FIX DISTANCE TO HIS BODY WITH A DECREASING PSYCHOLOGICAL AFFINITY WITH INCREASING DISTANCE. THE SON WAS AN INVISIBLE DOPPELGÄNGER, NEVER VISUALIZED, BUT DISTINCTLY FELT AT A DISTANCE OF 20 M (ADOPTED FROM BRUGGER ET AL., 2006, FIG.2).

HEAUTOSCOPY: THE CLASSIC DOPPELGÄNGER EXPERIENCE

The term "heautoscopy" alludes to the self being split into a perceiving and a perceived part. In contrast to an autoscopic hallucination, a person does not see a mirror image of herself, but another self. Visual features are of secondary importance, the doppelgänger can look very differently, represent an image of oneself from a different age[4], or of the opposite sex ("heterosexual heautoscopy", Fig. 2). The defining feature of heautoscopy is the *feeling* that the seen figure is another self, a doppelgänger. Self-location can be ambivalent; at one instance the person appears to look at her doppelgänger, at another instance she may *be* the doppelgänger who looks back onto her body (see the next section). It is this existential uncertainty about who and where one really is that leads to a bewildering variety of most complex cognitive and emotional interactions between self and doppelgänger. No doubt, this is the reason for the fact that the motif of the double is abundant in belletristic treatments of neuropsychiatric signs (Dieguez, 2013). While beneficial interactions in the form of the doppelgänger taking the role of a guardian angel or of a consoler are described, hostile

4 Most frequent (and terrifying) is a pronounced age-progression of the doppelgänger (Galant, 1929), culminating in seeing it dying or attending its funeral (Lhermitte, 1951).

interaction predominate both the belletristic and clinical literature (Brugger, 2007). Many writers describing doppelgänger phenomena in their work have reportedly experienced heautoscopy themselves. Probably the most famous example is Fjodor Dostoevsky ("The Double"), whose autoscopic experiences were triggered by temporal lobe epilepsy (Menninger-Lerchenthal, 1946), but also Johann Wolfgang von Goethe gave an autobiographic account of heautoscopy, which he experienced, neurologically healthy, in a critical moment of his life (Menninger-Lerchenthal, 1932). In clinical practice, the theme of "heautoscopic suicide" illustrates that the literal killing of oneself may be avoided by having one's doppelgänger commit suicide (Arenz, 2001) or by attempting to kill one's virtual rather that one's real self (Lukianowicz, 1958; Ames, 1984). These symbolic ways of extreme self-harm have also been famously described in the work of renowned writers. In "William Wilson", Edgar Allen Poe has the hero stab his doppelgänger and Oscar Wilde ("The portrait of Dorian Gray") describes how the protagonist, who intends to attack his self-portrait,

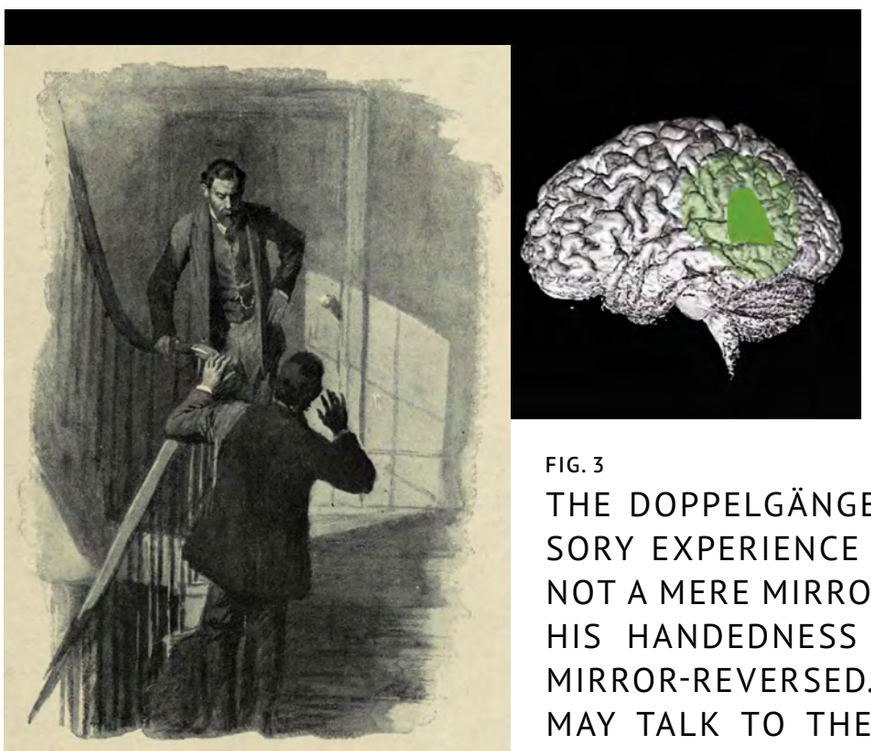

FIG. 3

THE DOPPELGÄNGER IN THE MULTISENSORY EXPERIENCE OF HEAUTOSCOPY IS NOT A MERE MIRROR IMAGE OF ONESELF. HIS HANDEDNESS IS PRESERVED, NOT MIRROR-REVERSED. IT IS SEEN *AND* FELT, MAY TALK TO THE PERSON, OR SHARE THOUGHTS TELEPATHICALLY[5]. ITS SUDDEN APPEARANCE IS OFTEN FRIGHTENING (LEFT PANEL FROM BANGS, 1898, P. 116). IF EXPERIENCED IN THE COURSE OF BRAIN DAMAGE, THE LESIONS GRAVITATE TO THE LEFT TEMPORAL LOBE (THE RIGHT PANEL, ADOPTED FROM BLANKE AND METZINGER, 2009, FIG. 2, DEPICTS A LESION OVERLAY OF SEVERAL CASES).

is found with a knife plunged in his heart. Assaults by one's own doppelgänger have also been described, both in literary accounts and medical case reports. Thus, the hero in Dostoevsky's "The double" is first humiliated, then physically attacked by his doppelgänger. A patient of Bakker and Murphy's (1964) was found with her tongue cut. She denied self-injury, but insisted that her aggressive doppelgänger had attempted to strangle her and attacked her with a knife. Less dramatic appear fictious accounts of persons, who kill themselves in order to escape the burden imposed by heautoscopy; Rudyard Kipling ("At the end of the passage") and Friedrich von Gerstäcker ("Der Doppelgänger") each provide an example. However, the same motif found in medical records may provide a most dramatic read.

5 Apparent telepathy is often experienced in autoscopic encounters. It is as virtual as the doppelgänger itself; extrasensory perception does not exist in the real, physical world (Brugger and Taylor, 2003).

Arthur Wigan, an early scholar investigating psychiatric aspects of functional hemispheric specialization, reports the case of a gentleman, who day and night felt persecuted by his doppelgänger. He finally shot himself to stop the horror (Wigan, 1844/1985, p. 96). We described an epileptic patient's fenestration in an attempt to "stop the intolerable feeling of being divided in two" (Brugger et al., 1994, p. 839).

Identification with the doppelgänger in heautoscopy is greatly enhanced over identification with one's mirror image in an autoscopic hallucination. This is because in the latter form of reduplication only the visual features are mirrored, and they are mirrored in a literal sense: the autoscopic doppelgänger waves its left hand if the person waves her right (Fig. 1). In contrast, one's heautoscopic double has always the same handedness as its owner; not only visual features are projected into the image, but also body schema which represents non-visual bodily sensations such as size, heaviness, interoceptive feelings and motor asymmetries, including hand preference. Awareness of the sum of these nonvisual properties of one's own body is sometimes designated as "coenesthesia" (BOX). It is these non-visual components that bring about the uncanny dimension of autoscopic phenomena, including ideas of persecution and the urge to kill the doppelgänger (see also footnote 3).

THE OUT-OF-BODY EXPERIENCE: FROM SEEING TO BEING ONE'S DOPPELGÄNGER

Investigations of out-of-body experiences (OBEs) were long frowned upon in the established medical and psychological sciences. They belonged to the domain of "psychical research" or parapsychology. These fields provide valuable descriptive accounts of the phenomenon, but have added little to an understanding of the underlying mechanisms. Naturally occurring OBEs give testimony to the tight interplay between emotional and spatial processing. In situations of life-threatening danger, the person feels detached in a double sense: the (apparent) physical detachment from the body is accompanied by a corresponding emotional detachment. Thus, during a fall, a mountaineer may watch a body fall, discover with amazement that it wears the same cloth and an identical rucksack as he does, and matter-of-factly but emotionally unconcerned, conclude that this must be himself (Brugger et al., 1999; Blanke and Dieguez, 2009). This protective function of an OBE is particularly well illustrated by accounts from those who were convinced to face death, but the double-detachment is a more general feature of autoscopic phenomena, specifically heautoscopy. When death is not immediately imminent, the doppelgänger may still act as a consoler. Thus patient often ascribe their suffering to the one nearby and ask the medical personnel to first care about their doppelgänger, as it would be *him,* who actually was in great pain. Even more prosaic is the instance of the doppelgänger, who did the lawn-mowing a patient was expected to do, but felt too fatigued and unmotivated (Devinsky et al., 1994, case 9). The concept of transitivism (Wernicke, 1900), i.e. the projection of own symptoms, intentions or actions onto others, is crucial here; some scholars devoted entire monographies to this transitivistic role of autoscopic phenomena (e.g., Müller-Erzbach, 1951; Mikorey, 1952). Transitivistic projections come in degrees: while unilateral somatic signs are usually projected onto other people in a mirror-like fashion (Gloning et al., 1957), they respect handedness when projected onto one's own doppelgänger, i.e. a left-sided hemiparesis manifests as such also on the doppelgänger (Brugger, 2002[6]). In OBEs, protective split of the self into two selves just goes that far, that a person will rather *be* than *see* a doppelgänger. It is this complete illusory projection of the bodily self (BOX) into extracorporeal space, which consoles an individual

6 This reference for an extensive discussion of the joint role of somatic and psychological perspective-taking.

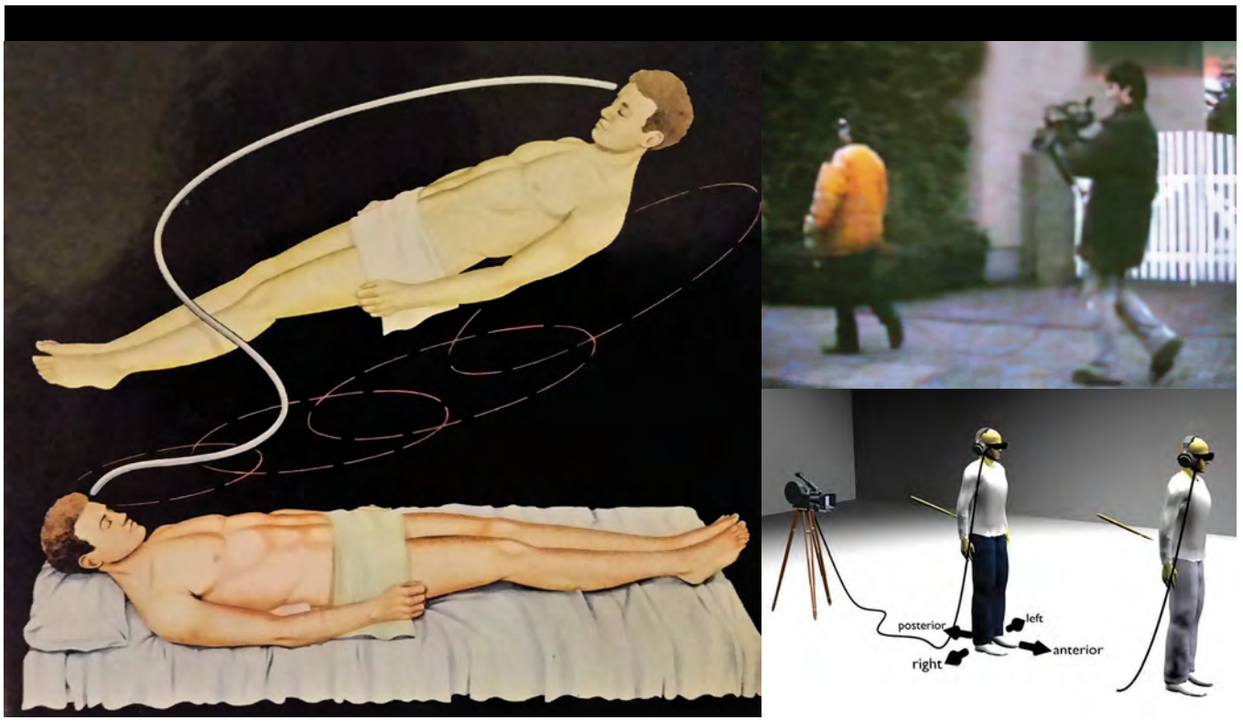

FIG. 4

IN AN OUT-OF-BODY EXPERIENCE THE OBSERVING SELF APPEARS TO BE LOCATED OUTSIDE THE BODY. THE PERSON NEVER REFERS TO ANY DOPPELGÄNGER, BUT REPORTS SEEING THE *OWN BODY* FROM OUTSIDE (LEFT PANEL FROM THE COVER OF BLACKMORE, 1982).

THIS ILLUSORY EXPERIENCE CAN BE ELICITED BY ELECTROCORTICAL STIMULATION, ESPECIALLY OVER THE RIGHT TEMPORO-PARIETAL JUNCTION, A MULTISENSORY AREA FREQUENTLY AFFECTED IN NEUROLOGICAL PATIENTS, WHO REPORT OBES. HOWEVER, OBES CAN ALSO BE EXPERIENCED BY HEALTHY PERSONS, ESPECIALLY IN LIFE-THREATENING SITUATIONS. THEY CAN BE SIMULATED BY WATCHING A MOVIE OF ONESELF TAKEN FROM BEHIND AND FED ONLINE INTO A HEAD-MOUNTED DISPLAY. THE SIMULATION IS MOST EFFECTIVE IN REAL LIFE SITUATION

(TOP RIGHT PANEL: THE AUTHOR WALKING THROUGH THE STREETS OF COLOGNE; FROM THE MOVIE "DER ZWEITE LEIB" BY DANIEL MÜLLER, KÖLN, 2003),

BUT CRITICAL FACTORS CAN BEST BE CONTROLLED IN A LABORATORY SETTING

(BOTTOM RIGHT PANEL ADOPTED FROM LENGGENHAGER ET AL., 2007).

facing death. And it is the universal occurrence of OBEs under these circumstances (Sheils, 1978) that may console whole subcultures in contemplating the mortality of the person after bodily death.

NEUROLOGICAL AND DIGITAL DOPPELGÄNGER: POINTS OF CONTACT

Avatars are doppelgänger in the sense that they are digital representations of a person's self. Rather than brain-created, they are created by a computer algorithm, which simulates the presence of a second self. This simulation comprises different components. In part, the feeling of relatedness toward one's avatar rests on visual similarity. By uploading self-face photographs, players can make a generic character take their own appearance. Such photo-realistic resemblance not only increases identification with the avatar but also leads to an enhanced Proteus effect (BOX; Yee and Bailenson, 2007). This effect refers to a change in a player's behavior caused by the type of avatar used; identification with an attractive avatar, for instance, makes a player more gregarious and behave more socially. Age-progressed avatars make players more future-oriented and increase saving behavior (Hershfield et al., 2019). However, visual similarity based on facial configurations, is just one thing. Its contribution to the feeling of embodiment is relatively modest. As in an autoscopic hallucination, a doppelgänger-avatar merely mirroring one's facial identity will not be embodied persuasively. The sense of embodiment, a key factor for both the neuroscience of the self and VR game design, relies on three dimensions (Blanke and Metzinger, 2009); self-location and corresponding perspective (e.g., if I feel located in a body and perceive the environment from that particular point in space), ownership (I experience the body and its single parts as my own), and agency (I can move the body intentionally). VR simulations of OBEs quantify the degree of embodiment by "proprioceptive drift", that is the indicated shift of self-location away from that of the real body towards the virtual body. Such drift is induced by having research participants observe themselves being touched on the back in a real-time clip taken from behind (Lenggenhager et al., 2007; cf. Fig. 4). Although visual similarity does play a role (there is no proprioceptive drift towards a non-anthropomorphic object), the key factor is visual-tactile synchrony and synchrony of the intention to move an avatar's limb and instantaneously seeing it move accordingly. Synchrony-dependent multisensory and sensory-motor integration is necessary for an optimal identification with any object, being it one's real body, a doppelgänger or an avatar. Accordingly, designers of immersive VR games strive to add more senses than just vision to the experience of exploring digital environments — from haptics to 3D audio and even to scent and taste (Ranasinghe et al., 2017). In the future, adjustment of an avatar's heartbeat such that it follows its owner's rhythm may further contribute to the emergence and sustainability of embodiment (Aspell et al., 2013).

What the study of autoscopic phenomena unequivocally shows is that the observer's perspective matters a great deal. While a disembodied perspective experienced during fright-induced OBEs signals the loss of concern about the body's fate, perspective-taking also matters in dreams and personal memories. Dangerous scenes or fear-loaded memories are typically remembered from a disembodied, third-person perspective while neutral or positive-emotional memories are remembered as originally experienced, i.e. from a within-body location (Nigro and Neisser, 1983). There is experimental evidence that cues encoded during a simulated out-of-body perspective are less well remembered than the same cues picked up from a body-centered first-person perspective (Bergouignan et al., 2014). These are neat illustrations of embodied cognition. They also give testimony to the interactions between emotion and space. Clinical wisdom has it that, statistically, benevolent

doppelgänger approach a person primarily from the right side of space while malevolent reduplications rather prefer to manifest themselves along the left side of one's body[7]. Game design could profit for implementing algorithms, which allow a sudden switch of perspective depending on situational details in a game.

As emphasized by Bailenson (2012), what makes a conventional avatar a doppelgänger avatar is the ability to act independent of the associated human agent. The psychological effects of such "avatars who ignore their owners" (Bailenson and Segovia, 2010), are manifold and powerful. Fortunately, the negative, self-destructive properties of brain-derived doppelgänger reviewed above will not pay out for the gaming industry nor for other commercial VR applications. There are many ways to profit from a potentially beneficial impact of digital doppelgänger (Rheu et al., 2020, for a review of the use of avatars to promote health behavior). Imagine you immerse in a game-like video observing your personalized avatar in everyday situations. It is programmed to gain weight after a week you neglected physical exercise and to loose weight once you vigorously trained. There is empirical evidence that your exercise behavior can be positively influenced after receiving such vicarious reinforcement by your doppelgänger (Fox and Bailenson, 2009). "Avatar therapy" (Gerner, 2020, for a philosophically informed overview) provides a growing means to treat a broad range of psychological disorders, from phobias to hallucinations and other psychotic symptoms. Perhaps, it will also prove useful to treat "digital depersonalization" (Bezzubowa, 2020), a confusion between real and virtual self, which may manifest after repeated shifts between physical and virtual realities?

SOME TECHNICAL TERMS FROM CLINICAL AND COMPUTER SCIENCE

Autoscopic Phenomena	A class of illusory reduplications of body and self. Comprises the four types of doppelgänger discussed in the present chapter plus negative heautoscopy (not seeing oneself in a mirror) and inner heautoscopy (visualization of inner organs in extracorporeal space).
Bodily self	The experience of oneself as an embodied being, who perceives the environment from a particular location in space with a corresponding perspective and whose motions follow one's intentions.
Coenesthesia	The general awareness of one's body arising from aggregated non-visual, mostly interoceptive impressions about one's bodily state.
Cognetics	A branch of robotics that unites robotic technology and the cognitive neuroscience of bodily awareness and self-consciousness to develop machines capable to accommodate self-other differentiation, empathy and social interactions.
Proteus effect	The modulation of a person's behavior by properties (perceptual or personality-related) of her avatar.
Transitivism	The projection of a patient's symptoms onto other persons or a doppelgänger of herself

7 This rule, quantitatively supported in the case of visual hallucinations (Walters et al., 2006) is one manifestation of a more universal law, valid in all humans and animals with a bilateral body symmetry and right-sided motor preferences: the association of "good" with "right" and of "bad" with "left" (Tamagni et al., 2009 for the literature).

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