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Floriana Ferro

Human imagination and generative AI
A phenomenological perspective on design in MR environments

Abstract
The paper examines a phenomenological approach to generative AI in MR environments, focusing on its role in supporting human imagination. Drawing on Husserl's theories, it explores how AI supports phantasy through eidetic variation, producing digital objects that, while distinct from analogue ones, are fully real within an analogue-digital continuum. The study highlights a bi-directional and recursive exchange where AI externalizes imagination, merging human intentionality with machine-generated alternatives.

Keywords
Generative AI, Eidetic variation, Mixed reality

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Editing by: Agostino Bertolotti

floriana.ferro@uniud.it

1. *Introduction*

For decades, the field of design has engaged not only with the analogue objects we encounter in everyday life but also with digital objects. The recent advent of generative Artificial Intelligence (AI) programs has further transformed design practices, introducing previously unimagined possibilities. This development has reignited debates on authorship in the creation of design objects and artworks (i.e., Cascales 2023; Nawar 2024). This paper explores these issues by drawing inspiration from Husserl's research on imagination and phantasy, particularly as presented in *Phantasy, image consciousness, and memory* (Husserl 2005), and his discussion of eidetic variation in *Experience and judgment* (Husserl 1973). These concepts are applied to design within Mixed Reality (MR) environments (i.e., Augmented Reality and Virtual Reality), with a specific focus on the role of generative AI. The aim is to demonstrate how the internal imaginative processes of the human mind intertwine with externalized processes of imagination, as theorized by Galit Wellner, and how generative AI facilitates the creation of new objects within MR dimensions (Wellner 2020). It will be particularly emphasized how the influence between AI processes and human mental processes is both *bidirectional* and *recursive*. This influence is bidirectional because it entails a mutual interaction between AI and human processes: the images generated by AI can inspire new mental images and reshape human expectations of what is visually possible, while the prompts provided by the users, along with the selections and feedback, shape the AI's understanding of aesthetic preferences. This mutual influence is also recursive, as it changes through continuous feedback loops: the *output* of one image generation session influences the *input* for the next, and human adjustments are fed back into the AI's learning algorithms, enabling it to produce more refined and contextually appropriate images over time.

The paper is structured as follows. First, it examines Husserl's distinction between perceptual processes – closely tied to image consciousness – and phantasy, which operates independently from perception (Husserl 1973). A close analysis of Husserl's text identifies four key differences between perceptual and phantasy objects. It is argued that, in the creation of digital objects, generative AI enhances human imagination in supporting acts of phantasy, enabling new variations and the realization of real objects.

Second, the ontological status of MR objects is considered, challenging the notion that they are hallucinatory or illusory. Instead, it is argued that MR objects, while distinct from analogue objects, are fully real, existing

within new layers of reality made possible by the birth of digital technology. A definition of what is analogue and what is digital will be provided to distinguish the concept of "analogue" from what is commonly considered the "physical" or "real." This distinction is necessary; otherwise the idea of digital and mixed objects as real objects risks being misunderstood or overlooked. Moreover, the concept of a *transdimensional analogy* is introduced to describe the relationship between analogue and digital objects, which are situated within an *analogue-digital (AD) continuum*. This continuum reflects the intertwining of the analogue and the digital, producing dimensions spanning from natural reality to a hypothetical, fully immersive "Matrix-like" virtual environment.

Finally, the paper examines how variations created by generative AI produce "externalized" versions of human mental processes, aligning with Wellner's postphenomenological perspective. While AI-generated variations manifest as perceptual objects, human phantasy variations remain internal, existing as objects characterized by an "as if" modality (Husserl 1973). Generative AI thus externalizes processes analogous to mental ones, inspiring further internal variations within the human mind and the production of new objects. The outcome – a real object in MR – is ultimately a co-creation of human mental activity and AI-generated, which influence each other bidirectionally and recursively. This dynamic interplay leads to a posthuman, phenomenological theory of object generation in MR, characterized by the mutual intertwining and influence of human and machine-driven processes. This theoretical approach emphasizes the centrality of design as a field where an actualization of such intertwining occurs. Design is not merely a downstream application of these processes, but a domain where human phantasy and generative AI co-create perceptual realities in MR. As such, it functions as a domain for exploring how imagination, technology, and ontology intersect.

2. *A Husserlian approach to perception and phantasy*

This section draws on Husserl's theory of imagination to examine how MR objects are conceived before being translated into bits and integrated into mixed dimensions. It is important to clarify that Husserl employs the term imagination (*Imagination*) to denote, in general, both physical images – those that require a material substrate – and mental images – which do not rely on any physical support (Vanzago 2009: 14). In the initial stage of their generation, digital objects are first phantasized by their creators,

such as content designers. Here, the term *phantasy* is deliberately used to correspond to the German *Phantasie*, which denotes a specific kind of imaginative process distinct from others, particularly image-consciousness (*Bildbewusstsein*). Image-consciousness involves the creation of an image object (*Bildobjekt*), supported by an image thing (*Bildding*), in order to represent an image subject (*Bildsujet*). Husserl (2005: § 9) illustrates this with the example of a child in the flesh (*Leibhaft*), who is represented as a *Bildsujet* in a photograph. The material image of the child, displaying photographic colors, is the *Bildding*, while the *Bildobjekt* is what our consciousness apprehends.

> If the appearing image were absolutely identical phenomenally with the object meant, or, better, if the image appearance showed no difference whatsoever from the perceptual appearance of the object itself, a depictive consciousness could scarcely come about. This is certain: A consciousness of difference must be there, albeit the subject does not appear in the proper sense. The appearing object is not just taken by itself, but as the representant of another object like it or resembling it. (Husserl 2005: § 9, 22)

This passage suggests that for image-consciousness to be possible, there must be a discernible difference between the image and the object it represents. If the image were phenomenally identical to the object itself – if it mirrored the perceptual experience of the object without any variation – there would be no room for depictive consciousness to emerge. This argument draws on a crucial phenomenological insight: representation requires a consciousness of difference. It is not enough for an image to simply *appear*; it must appear *as representing* something else, which presupposes that the observer recognizes it as *distinct* from the thing it depicts. According to Husserl's idea of the image-consciousness, the image serves as a medium that points towards something else, inviting the observer to engage with its representational character. In this context, artistic production, design, and other forms of representative activities rely on the creation of objects that are meant not to coincide with the subject they represent but instead to recall it. When our consciousness grasps an image-object, it recognizes it as standing for something else; this awareness of difference is crucial for the development of *Bildbewusstsein*. Image-consciousness, therefore, pertains to present perceptual objects, which function as representations of other objects.

In contrast, phantasy involves the production of images without any physical support. These images are detached from perceptual objects and belong to non-existence. Through phantasy, I can generate several images in my mind – some resembling real entities without corresponding to any

specific instance (e.g., a tall blonde woman, without reference to an actual perceived person), while others are not meant to exist at all (e.g., a unicorn). Husserl is explicit on this point: "the phantasy image does not truly exist at all" (Husserl 2005: § 10, 23). Whereas image-consciousness relates to perceived things, phantasy does not. To clarify the role of phantasy in this discussion, it is necessary to examine the key differences between perception and phantasy, which can be defined as "two qualitatively distinct forms of experience" (Rozzoni 2024: 2).

The first distinction arises from Husserl's differentiation between acts of presentation (*Gegenwärtigungen*) and acts of representation (*Vergegenwärtigungen*). In Husserl's words:

> We characterized perception as an act in which something objective appears to us in its own person, as it were, as present itself [*selbst gegenwärtig*]. In phantasy, to be sure, the object itself appears (insofar as it is precisely the *object* that appears there), but it does not appear as present. It is only re-presented [*vergegenwärtigt*]; it is as though it were there, but only as though. It appears to us in *image*. The Latins say *imaginatio.* (Husserl 2005: § 8, 18)

Perception presents objects in their full presence: they appear to us "in their own person"[1]. Phantasy, by contrast, involves objects appearing as absent: it does not present but rather represent them. The phantasy image lacks a physical substrate. However, this does not mean that phantasy is completely detached from perception. According to Husserl, all subjective acts originate in perception, but phantasy does not refer to specific perceptual objects present in a given moment. For this reason, phantasy oper-

[1] In this context, it is crucial to consider also Husserl's distinction between *Wahrnehmung* (perception) and *Perzeption* (perception without belief). This nuanced differentiation between a positional (*Wahrnehmung*) and non-positional (*Perzeption*) kinds of *perceptio* (Rozzoni 2024: 17) sheds light on how images are experienced phenomenologically. In Husserl's framework, *Wahrnehmung* is more than mere sensory awareness; it implies a form of *taking-as-true* (according to the original meanings of *nehmen* and *wahr*), an acceptance of what is perceived as actually existing. For example, when I perceive a tree in front of me, my perception is not just a registration of sensory data; it is imbued with the belief that the tree is real and present in the world. This dimension of belief is essential for *Wahrnehmung* to function as genuine perception in Husserl's sense. *Perzeption*, on the other hand, represents a form of perception devoid of this commitment to truth. It is perception *without belief* – an awareness of an object that does not necessarily involve the conviction that the object is real. Husserl describes *Perzeption* as a more fundamental act that may or may not elevate to the level of *Wahrnehmung*. It is entirely possible, therefore, for something to be *perzeptiv* (compliant with *perceptio*) without being *wahrnehmungsmäßig* (perceptual in the full sense of belief in its reality) (Rozzoni 2024: 17).

ates *representatively* rather than *presentatively*, functioning similarly to memory. Husserl clearly states that intentionality is differently oriented in perceptual and phantasy processes: in perception, objective intention has its filling in sensation, whereas in phantasy, it has its filling in phantasms (Husserl 2005: § 42, 93).

This distinction leads to a second key difference between perception and phantasy. Perceptual objects appear "in their own person", as stable and real, whereas phantasy objects appear in an *"as if" modality*: "*Phantasy* […] lacks the consciousness of reality in relation to what is phantasied" (Husserl 2005: § 1, 4). Pure phantasy objects, such as centaurs, are explicitly recognized as non-existent: they cannot be related to any real object from the past, present, or a possible future. During pure phantasy acts, the subject is deliberately and completely disengaged from reality. As Rudolf Bernet notes, this involves a process of neutralization, in which the subject neither affirms or denies the real existence of the imagined object (Bernet 2020: 217).

Third, perceptual objects generally appear as stable, whereas phantasy objects are defined as being *protean*. Husserl describes them as follows: "The phantasy objects appear as empty *phantoms*, transparently pale, with colors wholly unsaturated, with imperfect plastic form, often with only vague and unsteady contours filled out with *je ne sais quoi* or, properly speaking, with nothing, with nothing that one would assign as a defined surface, colored in such and such a way, to what appears" (Husserl 2005: § 28, 64). Phantasy objects thus possess shifting contours, vague forms, and indeterminate content. While perceptual objects can sometimes appear unstable, this instability results from variations in sensory stimuli and their interaction with our perceptual apparatus. This relates to the concept of *absolute thresholds*, understood as the extreme boundaries of sensory experience (Bozzi 1990; Lanfredini 2020: 126-7). Beyond these thresholds, sensory experience ceases, even if a stimulus can still be individuated by the subtlest physical measurement. Unlike perceptual objects, however, phantasy objects are inherently unstable: their contours fluctuate, and any momentary stabilization of the phantasm occurs briefly.

The final distinction concerns the *independence* of perceptual objects from subjective activity. When a transcendent object (i.e., a chair, a fence, a cat) appears in our visual field, we cannot help but see it. Phantasy objects, in contrast, arise from the productive acts of subjectivity. These acts may be intertwined with other activities. For instance, in historical reconstruction, the subject refers to documented events. In the case of pure phantasy, in-

stead, the production of images occurs through invention (Husserl 2005: Text no. 7, 306).

This particular aspect of phantasy is significant and is explored not only in *Phantasy, image consciousness, and memory* but also in *Experience and judgement* (Husserl 1973: Part III, Chap. II), particularly in relation to *eidetic variation*. The method of eidetic variation, which primarily aims at the search for essences, operates through phantasy when free variation is performed. Free variation constitutes the initial stage of this process. The other two stages – namely the unitary linking in continuous coincidence and the active identification of common elements – are less relevant here, as they do not directly concern design activity.

Husserl describes free variation as follows: it "is based on the modification of an experienced or imagined objectivity, turning it into an arbitrary example which, at the same time, receives the character of a guiding 'model', a point of departure for the production of an infinitely open multiplicity of variants" (Husserl 1973: § 87, 340-1). For this reason, content designers frequently employ free variation, not to achieve the empirical or pure generality of the thing (Ferro 2024b: 73-5). They are not interested in *generality*, but in *specificity*: they aim to find the proper object for their purposes. In MR environments, designers create objects, characters, and backgrounds by leveraging various forms of imagination. Free variation typically operates through phantasy: either before or during the process, designers engage with a sequence of phantasms, constituting multiple variations of the same object. Once this process is complete, the object is translated into bits and becomes perceptible within MR, transitioning from a phantasy object to a perceptual one. This transition is not merely a technical act of translation, but a design operation that must take into account the constraints and affordances of the chosen medium, such as VR or AR. Moreover, this operation is the culmination of a design process where imaginative variation is shaped into an external object. Design, in this sense, operates as the hinge between internal phantasy and externalized perception, guiding the passage from objects appearing in the "as if" modality to perceptual ones through intentional, situated choices. In MR contexts, design thus emerges as the active practice through which new objects are brought into being.

3. *The reality of mixed objects*

Before beginning an investigation into the reality of MR objects, it is necessary to clarify the use of the terms "analogue", "digital", "physical", and "real". The emergence of digital technology is commonly associated with its reliance on discrete values, whereas analogue technology is typically based on continuous variation. However, it is important to emphasize that being *digital* does not preclude being *physical* or *real*. In this framework, both analogue and digital objects and environments are understood as *hybrid* and, more importantly, as physical and real, as I will argue in this section. Although analogue technologies are generally associated with continuous signals, and digital ones with discrete signals (such as the 0 and 1 in binary systems), this distinction should not be mistaken for a division between the physical and the virtual, or the real and the unreal. Digital technologies, despite their reliance on abstraction and binary logic, are fully embedded in physical processes (e.g., electronic circuits, hardware components). The so-called Digital Revolution thus enables the creation of new, multiple dimensions of reality, as illustrated later in fig. 2. What distinguishes *mainly analogue* from *mainly digital* objects is not their ontological status, but rather the nature of the signals involved, which phenomenologically shapes our perception of specific kinds of hybrid objects. In common usage, when referring to MR objects, we usually mean objects in AR and VR – that is, digital objects existing at the intersection of digital and analogue dimensions. These objects are initially generated through a process of phantasy, which may involve pure invention or intertwine with other processes, such as memory. As clarified in the previous section, free variation plays a crucial role in this process. However, once these objects are translated into bits, they become perceptual objects that can be seen, heard, or otherwise manipulated.

To further elaborate on this point, it is crucial to acknowledge a broad agreement with David Chalmers' definition, which equates *virtual reality* with *digital reality*. Here, Chalmers does not refer to the philosophical concept of the virtual[2], but rather to VR understood as a digital dimension. This paper aligns with Chalmers' virtual realism, which asserts that digital

[2] The concept of the virtual can be examined through both Merleau-Pontian and Deleuzean perspectives. Within this framework, the virtual is understood in terms of a dynamic and processual idea of reality and is characterized by several key aspects: it presupposes an epistemological and ontological monism, implies relationality, and is intertwined with (rather than opposed to) the "real" or "actual" (Colombo, Ferro 2023; Ferro 2024a).

dimensions and objects are fully real. In *The virtual and the real*, Chalmers argues that digital objects "can be regarded as data structures, which are grounded in computational processes which are themselves grounded in physical processes on one or more computers" (Chalmers 2017: Sect. 3). Digital objects are thus neither fictional nor unreal: while they are produced by computational processes (unlike physical objects), these processes are, in turn, grounded in physical processes (just like physical objects). Even though fictional stories and characters can exist within digital dimensions – such as in videogames – the same holds true for fictional stories and characters played in the analogue dimension. For instance, a videogame inspired to Tolkien's *The lord of the rings* exists in a digital format, just as a theatrical play or a film adaptation of the same story exists in the analogue reality. The characters, environments, and objects within the videogame have a real underlying structure, just as actors, sets and props in a theater production have a real underlying structure despite their fictional roles (Chalmers 2017: Sect. 3). Chalmers further argues that digital worlds are not necessarily fictional: while some, like videogames, involve fictional narratives, others – such as Second Life (Chalmers 2017: Sect. 6) or, more recently, the Metaverse – do not. In *Reality+*, Chalmers expands on this point by asserting that digital reality consists of bits, just as analogue reality consists of atoms, both being ultimately rooted in underlying quantum states (Chalmers 2022). The shared physical structure of both analogue and digital worlds, he contends, constitutes their reality.

From a phenomenological perspective, however, the analogy between bits and atoms as fundamental physical structures of matter is insufficient to define digital objects. While recognizing the significance of the scientific understanding of reality to which Chalmers appeals, phenomenology operates within a different conceptual framework. Rather than grounding itself in an objective physical ontology, phenomenology focuses on our experience and its conditions of possibility, known as the *transcendental*. It is concerned with subjectivity and the way we experience ourselves, others, and the surrounding world (*Umwelt*). We do not experience atoms or molecules directly; instead, we encounter objects in their givenness – tables, books, pets, loved ones, etc. The physicist Sir Arthur Eddington, in highlighting the distinction between scientific analysis and lived experience, famously describes the "scientific table" as "mostly emptiness", contrasting it with the solid, tangible table of everyday life (Eddington 1928: xi-xv). Phenomenology, concerned with the latter, does not rely on the underlying nature of things to explain how we perceive and conceive of objects (Hui 2012:

381). On the contrary, we should perform a preliminary *epoché* regarding the existence of MR objects, in order to investigate the structural conditions of their givenness (De Warren 2014). In this regard, the position sustained here diverges from Chalmers' realism.

From a phenomenological standpoint, MR objects are experienced as real, even though they are perceived as distinct from analogue objects[3]. This distinction is essential for recognizing the specificities of MR objects in their mode of givenness across distinct dimensions. For instance, the givenness of VR objects presents specific features that differ from those of AR objects with regard to sensory spheres, figure-ground relations, affordances, and persistence (Ferro 2023). Despite their perceptual differences, both digital and analogue objects share a fundamental structural characteristic: the relation between the whole and its parts. This relationship constitutes the intrinsic structure of a *Gestalt*, or perceptual form (Ferro 2023). Gestalt structure enables us to recognize an analogy between objects perceived in different dimensions (i.e., between an analogue red ball and its AR or VR counterpart). However, even illusory or hallucinatory objects exhibit Gestalt-like properties that define their perceptual boundaries. To distinguish real objects from other types of objects, this argument must be further developed.

First, digital objects cannot be considered hallucinatory. Hallucinations are defined by their existence solely for the individual experiencing an altered state. Consider a subject with a high fever, a mental disorder, or the effects of a hallucinogenic drug[4]. Such a subject might perceive something, for instance a coloured dragon, but this object exists only for them

[3] The debate on the reality of digital objects remains open. In the case of AR, objects are embedded in a hybrid dimension that blends analogue and digital elements, thereby granting them some of the characteristics typical of objects outside digital environments. By contrast, VR objects are often regarded as the product of purely digital technologies. For this reason, some scholars working within a phenomenological framework question the ontological status of virtual objects, even while acknowledging their perceptual affinities with analogue counterparts (Wiesing 2009; O'Shiel 2022). Similar concerns apply to virtual images, whose specific features are shaped by the user's kinaesthetic involvement (Bandi 2023). Nevertheless, the reality of virtual objects is also supported by other thinkers who adopt phenomenological approaches. For instance, Bédard (2023) endorses Chalmers' claim that virtual objects are real, while at the same time adopting a different perspective that foregrounds the role of embodiment in shaping VR experiences and the perception of virtual entities.

[4] As Pietro Montani (2022) observes, even dreams exhibit a hallucinatory character. However, since the paper is aligned with Chalmer's virtual realism, the view that VR images are hallucinatory in the same way as dream images is not subscribed.

and not for others present in the same environment. Even individuals who share a similar altered state (i.e., due to LSD consumption) will not perceive the same objects – one might see a coloured dragon, another a giant, and another one a deceased relative. By contrast, digital objects are intersubjectively shareable and possess consistent characteristics within digital dimensions. For instance, if my brother and I watch a movie on a computer screen, we will both perceive the same visual and auditory elements – i.e., a tall, blonde man speaking to a thin, dark-haired woman. Because of this shared experience, we can discuss and analyze the film afterward.

The same principle applies to VR experiences. If I wear a VR headset and activate a roller coaster simulation, I expect other users to experience the same trajectory, surrounding objects, and auditory stimuli as I do. This expectation is confirmed if, midway through experience, I pass the headset to another person: they will perceive the same objects and environment I did just moments before. The shareability and consistency of such experiences support the claim that digital objects and environments are real and cannot be dismissed as hallucinatory.

One possible objection is that hybrid and digital environments allow for personalization (i.e., Valmorisco et al. 2024), potentially leading to experiences that resemble hallucinatory phenomena. Customization is common in e-commerces and social media, where users receive personalized advertisements, posts, or videos tailored to their interests without explicitly requesting them. Similarly, Digital Twin (DT) systems enable personalized services across various domains, offering significant advantages to the users[5]. However, even these "customized objects" remained perceivable by others. Personalization in VR, which is more immersive than on-screen or AR experiences, may seem more complex. For example, a videogame may automatically adapt to a player's preferences, displaying objects or avatars aligned with their past gameplay. As a result, a different player starting the same game might encounter a different initial configuration. However, this does not mean that these objects are not sharable. Once the game begins, all connected players experience the same virtual environment – without requiring immediate headset transfer between

[5] The concept of DT was initially developed for NASA and the U.S. Air Force to model and simulate aerospace vehicles (Glaessgen, Stargel 2012) before being extended to other domains, especially healthcare (Katsoulakis *et al*. 2024). A general definition of this technology is as follows: "DTs can be defined as (physical and/or virtual) machines or computer-based models that are simulating, emulating, mirroring, or 'twinning' the life of a physical entity, which may be an object, a process, a human, or a human-related feature" (Barricelli *et al*. 2019: 167656).

individuals. This parallels everyday experiences. When I leave my house and walk to work, I follow a specific route. My colleagues, departing from different locations, take different routes. However, once we arrive at our workplace, we share a common perceptual environment. Those who did not take my route do not typically question my experience of the sidewalk beneath my feet or the wind on my face. They would not classify these perceptions as hallucinations unless I were in an altered state. Similarly, in VR, customization does not equate to hallucination.

Secondly, digital objects cannot be regarded as intrinsically illusory. Illusions are perceptual phenomena that deviate from ordinary perception, as exemplified by the Müller-Lyer case (Fig. 1). Such phenomena are intersubjectively sharable because, under identical conditions, all individuals perceive them in the same way. In the Müller-Lyer case, for example, we all see one segment as longer than the other, even though they measure the same length.

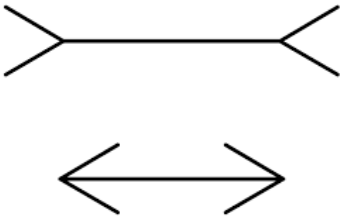

Fig. 1: The Müller-Lyer illusion

Artists and creators widely employ illusions in their works (Gombrich 1960). Given that this paper focuses on generative AI, this issue warrants careful consideration. Since experiences in digital and hybrid environments differ from those in the natural world and, given that digital objects are sharable, as demonstrated by the argument against their hallucinatory character, does this imply that digital objects are illusory? The answer is no.

Chalmers (2017: Sect. 5) argues extensively for the reality of digital objects, especially in the context of VR. Building on this, the paper emphasizes that illusory phenomena can also occur in MR dimensions. For instance, the Müller-Lyer illusion is observable not only in the analogue world but also on screen or in AR. Just as illusory phenomena in the ana-

logue world are distinguishable from ordinary perceptual phenomena, so too are illusions in MR dimensions. However, some perceptual illusions may not manifest, or manifest differently, across different dimensions. The Müller-Lyer illusion, for instance, may be less pronounced or function differently in VR due to variations in the perception of straight lines and three-dimensional space. Similarly, the rubber hand illusion[6] can occur both in VR and in the analogue world, though with slight differences in bodily temperature or proprioceptive drifts (Kocur *et al.* 2022). Moreover, certain illusory phenomena emerge exclusively in MR environments and do not usually occur in the analogue world. One example is the very long arm illusion (Kilteni *et al.* 2012), in which participants, under specific experimental conditions, experience a sense of ownership over a virtual arm up to three times the length of their physical one. In such cases, my perception of a virtual object–my arm–is deliberately altered by software engineers to induce a perceptual illusion. While I still perceive my arm as my own, the way I experience it is illusory. However, the existence of such illusions in MR does not imply that all experiences in digital worlds are illusory. When I see a digital dragon in VR, I am perceiving a real object with real properties, an object that other users on the same platform can also perceive.

By refuting the views that consider digital objects as either hallucinatory or illusory, Chalmers' argument for their reality is reinforced, and the same applies to MR dimensions as a whole. To further develop this perspective, the concept of *the analogue-digital (AD) continuum* (Ferro 2024b) is introduced. This concept is inspired by Merleau-Ponty's notion of *flesh* as a multi-layered element (Merleau-Ponty 1968). According to Merleau-Ponty, the flesh constitutes the common fabric of the world, dynamically unfolding between opposing poles. This chiasmatic dialectic, shaped by processes of reversibility and divergence, gives rise to a stratified Being.

Applying this framework to the emergence of mixed dimensions resulting from digital transformation, we can identify two primary poles: *the analogue* and *the digital*. These poles engage in a dialectical relation-

[6] "The rubber hand illusion (RHI)" is a tantalizing illusion, where the feeling that a rubber hand belongs to one's body (feeling of ownership) is brought about by stroking a visible rubber hand synchronously to the participant's own occluded hand" (Rohde *et al.* 2011).

ship, and their interaction generates new dimensions. The multiple layers of the flesh can thus be interpreted as layers of MR, as illustrated in Fig. 2.

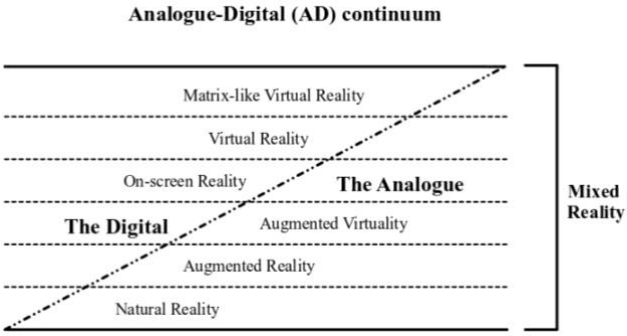

Fig. 2: The Analogue-Digital (AD) continuum

The analogue and the digital intertwine and revert into each other without annihilating their counterpart. As indicated by the dot-and-dash line, the boundaries between these poles remain blurred, giving rise to multiple layers of MR. These layers are considered as different dimensions, ranging from natural reality to a hypothetical "Matrix-like" VR. This conceptualization builds upon the reality-virtuality (RV) continuum introduced in computer science (Milgram et al. 1994; Milgram & Kishino 1994) and later revisited by Skarbez et al. (2021)[7]. Philosophically, this continuum has been further developed to encompass also on-screen reality – a digital but minimally immersive MR dimension that contrasts with the high immersion of VR[8]. These layers are interconnected through the concept of *trans-dimensionality*. This idea posits that reality consists of distinct dimensions, each defined by boundaries that, while present, can be crossed. In fig. 2,

[7] Bédard (2023) draws on the RV-continuum theory to argue that, when we refer to Virtual Reality (VR), we are inhabiting a hybrid reality with our body—specifically, one that corresponds to Augmented Virtuality (AV). My position closely aligns with Bédard's; however, I maintain that all forms of predominantly digital or analogue dimensions fall under the broader category of Mixed Reality (MR). From this perspective, there is no such thing as a purely digital reality — even VR, or what Skarbez *et al.* (2021) describe as Matrix-like VR, should be regarded as a form of MR.

[8] The role of screens in perceptual processes and the implications of their pervasive use in the digital age are central themes in Mauro Carbone's Philosophy-screens (Carbone 2019), which draws on Merleau-Ponty's phenomenology to explore the transformative impact of screens on our experience of reality.

all dimensions are represented as having the same width, though this does not precisely reflect current reality. For instance, Natural Reality is significantly broader than Matrix-like VR (which has yet to be realized), and Augmented Virtuality (AV) should be characterized by a higher proportion of digital elements. This decision to depict all dimensions with equal width reflects the ongoing evolution of reality and the increasingly pervasiveness of digital technologies. In the near future, the digital is likely to occupy an even greater portion of human life.

Within this framework, both analogue and digital objects are understood as part of a continuous, multifaceted reality. Digital objects are not "less real" than their analogue counterparts, although the distinctiveness of objects belonging to different dimensions is preserved. As Yuk Hui (2012: 394) observes, objects in natural reality exhibit strong transcendence – they are difficult to destroy or modify. In contrast, virtual or on-screen objects have weaker transcendence. However, the relational fabric of digital objects tends to be more intricate and pervasive. By considering the concept of *transdimensional analogy* (Ferro 2023) and the unique characteristics of mixed objects, we can affirm both the reality and specificity of MR objects without contradiction. The coexistence of these characteristics – reality and specificity – has significant implications for the way digital objects are produced and experienced in MR dimensions. This paper primarily focuses on the implications for production.

4. *Externalized imagination and generative AI*

David Chalmers, previously mentioned for his theory of virtual realism, is also influential in discussions on the *extended mind*, a concept he developed with Andy Clark (Clark, Chalmers 1998). In the introduction to their eponymous article, the authors write:

> Where does the mind stop and the rest of the world begin? The question invites two standard replies. Some accept the boundaries of skin and skull, and say that what is outside the body is outside the mind. Others are impressed by argument suggesting that the meaning of our words 'just ain't in the head', and hold that this externalism about meaning carries over into an externalism about mind. We propose to pursue a third position. We advocate a very different sort of externalism: an *active externalism*, based on the active role of the environment in driving cognitive processes. (Clark, Chalmers 1998: 7)

According to Clark and Chalmers, the human mind is not confined to the biological brain but extends into non-biological circuits through active

coupling with the environment. This form of externalism, grounded in cognitive science, highlights how cognition emerges from the dynamic interaction between internal processes and external resources. From a phenomenological standpoint, this implies that the mind is not only embodied but also extended, intertwined with technological and material affordances. While Husserl discusses imaginative processes, he does not particularly address the role of technology in this domain. Consequently, contemporary scholars have revisited classical phenomenological concepts, particularly in light of the increasing hybridization of human bodies and digital technology. Postphenomenologists, especially Galit Wellner, focus on this intersection, exploring how imagination is *externalized* through technological means, most notably, AI-powered generative programs in MR environments.

Wellner explicitly references "Sketch RNN" (Wellner 2022: 1446), a recurrent neural network capable of generating multiple sketches of the same object (i.e., a lighthouse) based on a few initial lines drawn by the human user. Popular generative AI programs, such as DALL-E and Midjourney, operate similarly by generating entire images from written "prompts". These programs do not require proficiency in complex computational languages; instead, prompts are given in natural language. A simple word (i.e., "dog", "book", or "table") or a more detailed phrase (i.e., "black dog", "heavy book of philosophy", or "big round table with three legs") suffices to generate various alternatives. If the results are unsatisfactory, users can refine their instructions or select from different styles.

Before the advent of generative AI, software such as Photoshop and CAD programs facilitated the externalization of imagination by strictly following user instructions to produce objects, images, or plans (i.e., altering shapes, colors, and other properties). These programs allowed users to visualize specific images of what they were phantasizing. However, generative AI programs extend this capability further. They expand the possibilities of human phantasy, by suggesting new variations users may not have considered on their own. In a sense, these programs engage in a form of "phantasizing" themselves, assisting in the process of free variation by generating an increased number and variety of alternatives.

Wellner explains this phenomenon through the so-called *layer paradigm*, which she defines as "a dynamic mode of operation in which changes in the order of the layers can produce new meanings and eventually new imaginings" (Wellner 2018: 60-1). Her perspective is grounded in the idea that generative processes are multi-layered, with digital technologies introducing additional levels of information. In this sense, imagination is exter-

nalized and relocated outside human brain, with AI programs actively modifying some of these layers (Wellner 2022). These developments in digital technology allow for a further elaboration of Clark and Chalmers' idea of the extended mind, applying it to generative AI systems. By the layers of imaginative processes, these programs significantly influence creative generation within MR environments.

The relationship between design and generative AI systems is characterized not only by the possibility to externalize mental processes, but also to do it bidirectionally and recursively. AI systems not only execute instructions; rather, they become active participants in a recursive feedback loop that influences and is influenced by human cognition. The user initiates a process (e.g., via a prompt), and the AI responds with multiple variations. These outputs, in turn, affect the user's mental imagery, stylistic expectations, and subsequent prompts. This dynamic illustrates a bidirectional influence: human imagination shapes machine's outputs, and machine-generated variations reshape the human's imaginative horizon. Crucially, this influence is not linear but recursive. Outputs from generative AI are not merely stimuli; they are reintegrated into the user's cognitive process, prompting new phantasms, new selections, and new variations. Over time, the aesthetic expectations of the user and the probabilistic models of AI systems co-evolve. In systems that incorporate reinforcement learning or user feedback, this process becomes even more explicit: the AI system refines its generative pathways based on iterative human interaction. In this sense, imagination becomes a hybrid process distributed across human and non-human agents.

Design plays a pivotal role in this process. It is not simply the aesthetic dressing of an object, nor a post-production phase. Rather, design constitutes the operative layer where the recursive interaction between human and machine imagination becomes materially and perceptually articulated. Designers act as intentional agents who channel the open-ended generativity of AI toward meaningful configurations. Their task is not only to select but to shape the recursive loop itself: by intervening in prompts, feedback, evaluation, and output refinement, they co-determine both the process and the form of the final object. In this framework, the designer operates simultaneously on multiple levels: epistemic, by steering the AI toward meaningful outcomes, and ontological, by contributing to the constitution of real entities within MR environments.

Drawing on Galit Wellner's *layer paradigm*, design acts as a structuring interface between layers. It guides the reordering of these layers and introduces discontinuities or reconfigurations that would not occur spon-

taneously. Design, in this view, is not merely reactive but generative and formative. Digital technology profoundly changes human imagination (Wellner 2020: 1446). The work of designers and artists is increasingly shaped by these new technologies, which facilitate engagement with AR and VR settings. From the interpretation of the AD continuum sustained in this paper (see Sect. 3), Wellner's insights can be extended to the entire MR spectrum, encompassing the dynamic intertwining of analogue and digital poles of reality. However, it is important to clarify that applying the layer paradigm to the MR spectrum does not imply full alignment with the postphenomenological approach. Whereas postphenomenology is grounded on mediation theory (Verbeek 2008; Wellner 2020; Liberati 2024), the perspective adopted in this paper, rooted in Merleau-Ponty's philosophy, conceives of the relationship between our bodies and technology as a *chiasmatic intertwining*. Technology is not external to the body but folds into it as an extension of its perceptual and imaginative capacities. Generative AI becomes part of the *flesh of the world* as a digital, responsive layer in which human subjectivity leaves its traces and, in turn, is reshaped. Within this framework, technological devices are not merely *mediators* between humans and the external world; rather, they function as *extensions* of our body, which, on the subjective side, is deeply interwoven with the objective side of the world. In this hybrid ecology, imagination is no longer confined to the silent theatre of the mind. It unfolds in dialogical space, in the tension between suggestion and selection, machine variation and human vision. The digital object that emerges is thus not the product of a single mind, nor of a deterministic algorithm, but the outcome of a recursive, embodied, and material interaction between subjectivity and code. This *monist* and *posthuman* approach reframes design as the *locus of recursive co-imagination*, where mental and machinic processes are neither separable nor reducible to one another. Rather, they are co-constitutive, entangled in a loop of mutual modulation — a loop that ultimately produces new forms of objectivity in the stratified spaces of MR.

Within this framework, the potential for *hybrid imagination* emerges: a process in which human phantasy, guided by Husserl's notion of free variation, is expanded and transformed through generative AI. Design plays a critical role in shaping this dynamic. It acts not only as a process of intentional structuring but also as a recursive interface where the open-ended production of AI is channeled into perceptually coherent forms. Far from merely responding to machine output, the designer inscribes subjective vision into the evolving configuration of digital objects, co-creating

artifacts that are the outcome of a reciprocal, posthuman intertwining between mind and machine.

5. *Conclusion*

This paper has explored the complex dynamics between human imagination and the generation of digital objects within MR environments, bringing the phenomenological theories of Husserl (2005) and Merleau-Ponty (1968) into dialogue with contemporary technological innovations. Husserl's theory of imagination and eidetic variation has provided conceptual tools to distinguish between perceptual and phantasy objects, showing how internal imaginative acts give rise to "as if" objects that may later be externalized into perceptual objects through design and technological mediation. Merleau-Ponty's late conception of a stratified and chiasmatic reality has offered a framework for understanding the intertwining of analogue and digital dimensions as layers within a unified but complex world.

Drawing inspiration from Chalmers' theory of virtual realism (2017: 2022), this paper has argued that digital objects, while originating as products of imagination, acquire their own reality when transposed into MR environments. The introduction of the concept of the *AD continuum* and the proposal of a *transdimensional analogy* (Ferro 2023; 2024b) have allowed digital objects to be framed not as mere hallucinations or illusions, but as real entities, as parts of a continuous, yet layered reality where perception, interaction, and meaning emerge through novel configurations.

A crucial aspect of this interaction is the bidirectional and recursive relationship between human phantasy and generative AI. Rather than functioning merely as tools, AI technologies, such as DALL-E and Midjourney, participate in an ongoing, dynamic loop of co-imagination: users provide prompts and aesthetic cues, while AI-generated outputs reshape their cognitive horizons, stimulating new variations, ideas, and perceptual expectations. Over time, this interaction evolves through feedback and refinement, revealing a recursive ecology of human-machine generation. Within this ecology, design emerges as a central domain, not merely as a practical application, but as a theoretical and ontological domain. Through design human intentionality and machine-generated variation converge into meaningful and perceptually coherent artifacts. It operates between layers of imagination, directing the transformation from internal images

to externally realized objects. Designers do not simply respond to machine suggestions; they shape the dialogue, modulating the recursive process through epistemic decisions and ontological commitments.

This paper supports a monist and posthuman perspective, in which the human and the machinic are not oppositional but intertwined. Generative AI becomes part of the "flesh of the world", co-constituting subjectivity and objectivity in MR environments. Imagination, in this context, is no longer a private, interior faculty, but a distributed, dialogical process that unfolds across hybrid environments. Ultimately, the philosophical implications of this study point toward an expanded understanding of reality – one that is dynamic, co-produced, and layered. In a world increaseingly shaped by digital technologies, design practices grounded in a phenomenological understanding of imagination can illuminate how we produce and inhabit this evolving reality. MR environments thus become privileged spaces for investigating how subjectivity, technology, and objectivity are deeply intertwined in generation processes.

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