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Designing Fetal Imagery. How to Make Singularity Visible?

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Abstract
This research explores the manner in which images for visualizing the fetal stage initiate a cognitive loop that molds our perception of the prenatal environment and, concurrently, influences reproductive habits. From an examination of medical illustrations dating back to the 17th and 18th centuries – a seminal period marked by the medicalization of pregnancy – the study investigates the transformative process wherein fetal imagery not only singularizes the fetus into an icon but also disembodies women from the pregnancy experience. Furthermore, delving into the contemporary landscape, the research probes into the enduring influence of this historical iconization on modern AI-assisted imaging datasets, scrutinizing their role in shaping contemporary habits on human reproducibility. Ultimately, the investigation sheds insights on how fetal imagery, facilitated by advanced visualization technologies, navigates the realms of both visual replicability and biological reproduction.
Keywords: Fetal Imagery, Visualization, Singularity, Icons, Dataset.

> There can be no work on the image,
> no challenge to its powers of illusion and address,
> which does not simultaneously challenge the fact
> of sexual difference.
> Rose, *Sexuality in the Field of Vision*, 1986: 226.

HOW TO DEAL WITH FETAL IMAGERY[1]

On the 12th of November 1998, the MTV Europe Music Awards were celebrated in Milan. As an adolescent, I vividly remember immersing myself in the live broadcast of the year's event in the city in whose hinterland I grew up. The award for the best video was bestowed upon a clip featuring a fetus as its protagonist. Perhaps a more accurate description would be a life-sized animatronic puppet, crafted in latex, reproducing a lip-sync rendition of the song «Teardrop» by Massive Attack, the third single from their album *Mezzanine*. The video stages an

intrauterine environment, with extreme close-up shots focusing on the fetus's parts, the eyes, the hands, and the umbilical cord, underscoring the connection to a gestating body unseen throughout the entire clip. To my young perception, the presence of a fetus in a videoclip wasn't peculiar at all.

In our current era, we find ourselves inundated with fetal images, extending far beyond medical contexts. No longer confined to hospitals, specialized journals, or educational manuals, fetal imagery has permeated the broader media landscape, from newspapers and advertising campaigns to television productions, films, political discourses, and religious proclamations[2]. However, this ubiquity hasn't always been the norm. The pervasive prevalence of fetal imagery in our contemporary mediasphere is undoubtedly a result of a profound transformation in visualization techniques associated with pregnancy. Nevertheless, there is another issue to consider: the widespread dissemination of fetal images has also left a trace on societal perceptions of pregnancy, on habits prompting corresponding shifts in norms and behaviors. This dual interaction, with technologies producing visualizations and visual artifacts creating – and intervening in – imaginaries, forms the main framework for the following research.

Over the centuries, perceptions around gestation have evolved, transitioning from understanding the womb as an intimate *hortus conclusus*[3] to conceptualizing it as a space subject to public scrutiny, thereby influencing societal perspectives on life, pregnancy, and maternity. From a techno-historical perspective, two main stages contributed to this public scrutiny. The first pivotal moment was the introduction of ultrasound technology in 1956, perhaps the most significant turning point that reshaped the dynamics between women, fetuses, and the external world. Preceding this technological advancement, limited knowledge and visualizations existed about the developing fetus, necessitating doctors to rely on women's sensory observations for diagnostic purposes. In 1895, thanks to the invention of the X-ray by Wilhelm Rontgen, the first picture of the womb was realized, but «this method was less than desirable because the extra fat and amniotic fluid reduced the resolution of the image» (Troop 2013: 19).

The widespread adoption of ultrasound machines marked a significant change in the perception of pregnancy (Taylor *et al*. 2004). If early ultrasounds produced low-resolution images, primarily depicting fetal bone tissue, rapid technological advancements, including scan

converters and video technology, improved the ultrasound quality, enabling detailed views of the fetus's surface features. Already at the end of the 1990s, the language of film was adopted, allowing parents to customize their prenatal experience. New technologies, capable of producing DVDs with accompanying music, have emerged paving the way for an entertainment-oriented use of ultrasound. This legacy is still visible today in our hypermedia society, where similar ultrasound videos are commonly found on platforms such as YouTube, turning unborn children into protagonists of their inaugural musical video clips directly from the intrauterine (Troop 2013).

The second pivotal moment that contributed to the public scrutiny of pregnancy occurred less than ten years after the first introduction of ultrasonography. This moment was marked by the publication of the iconic photographic series by Lennart Nilsson in the magazine «Life», on the 30th of April 1965. The photographs of a fetus inside the womb set a new imaginary for the public visibility of the unborn. It is the «Nilsson Effect», as defined by the historian Barbara Duden (1993: 11), the instilling of a new fetal iconography: the fetus as a lonesome space traveler, detached from the gestating body, an astronaut floating in an extraordinary space. Nevertheless, despite the promise of an exploration into the *Drama of Life Before Birth*, as the title suggests, the *Life* service comprised solely one endoscopic photograph – that is, an image taken within the confines of the uterus – portraying a close-up perspective of the head of a 15-week-old fetus. This image, captured by Nilsson mere moments preceding a surgical abortion, stands as the singular representation within the entire collection. In contrast, all remaining photographs were derived from the remains of recently aborted fetuses, arranged within an aquarium to achieve the desired results for the photo shoot (Tripaldi 2023).

What do the latex puppet of the 1998 Best Video winner, the musicalized ultrasounds shared by eager prosumers[4] documenting the experience of parenthood on YouTube, and Nilsson's immortalized aquarium abortions have in common? From my perspective, they are all outcomes of a gaze that is asserted to be objective – because it pretends to depict a scientific fact – while it is capable «to represent while escaping representation» (Haraway 1988: 581). And what they represent is a fetus as a detached singularity, extracted from the intrauterine. Within this concern, the mentioned puppet, videos and the photographs are here considered as artifacts that visualize the iconic

transformation that intervene on a «material semiotic agents», to borrow again from Donna Haraway (*ibidem*: 588), such as the fetus is. In what follows I will sustain that fetuses, being material-semiotic agents, enact worlds through their material configurations, because:

> Their boundaries materialize in social interaction. Boundaries are drawn by mapping practices; «objects» [fetuses] do not pre-exist as such. Objects are boundary projects [and so are fetuses]. But boundaries shift from within; boundaries are very tricky. What boundaries provisionally contain remains generative, productive of meanings and bodies. Siting (sighting) boundaries is a risky practice (*ibidem*: 589).

THE FETAL THAT SURROUNDS US

The primary objective of my research is to explore the role of visualization in understanding the fetal stage. As already stated, the three fetal objects mentioned earlier can be categorized as artifacts based on three criteria: intentional production, manipulation of materials, and production for a specific purpose. Produced by the band, the parents, and the photographer; involving manipulating latex with moving images, ultrasounds with digital creation, and aborted fetuses with still images; with the purpose of creating a video, sharing emotions, and disseminating knowledge, they embody all the artifactual features. However, articulating these criteria can encounter challenges, primarily in determining their agencies, i.e. their conditions of action. Nevertheless, it is precisely within these challenges that the potential of artifacts arises.

If we accept the assumption that cognition is distributed among humans, non-human agents, and the environment, we can also consider material images as cognitive scaffolds that allow us to optimize tasks while influencing the processes of understanding our surroundings. Embracing this viewpoint emphasizes the intricate interplay between cognition and action, elucidating how images shape both facets of human engagement. Adopting a relational view becomes, hence, necessary: if we can recognize a symmetrical relationship between humans and artifacts, images can also exhibit their own agency. Given this conceptual framework, a question arises: under what conditions has fetal imagery contributed to conveying a value concerning human

reproductive habits, such as considering a fetus as endowed with singularity?

To address this inquiry, I will take into consideration two distinct corpora used for the fetal visualization. Firstly, illustrations extracted from medical treatises dating back to the 17th and 18th centuries. This historical period holds particular relevance as it signifies the transition from conceiving the body as gestating to framing it as a patient body. I am interested in this transformation because it contributed to the progressive singularization of the fetus and, consequently, the detachment, and thus the disembodiment, of women from pregnancy (Duden 1993). Secondly, to comprehend the legacy of that disembodiment in contemporary fetal AI-assisted imaging, I will consider images employed in designing datasets for training computational models in automated fetal face analysis.

The underlying hypothesis driving this research posits the existence of a cognitive feedback loop in engaging with images, asserting that they can extend our comprehension of the prenatal environment and influence reproductive habits. Furthermore, I will try to understand how a particular type of image, specifically the visualizations of fetal facial features, initiates a mutual reinforcement in comprehending the discourses surrounding reproductivity. Given that facial perception inherently engenders a profound sense of singularity at the cognitive level (Bruce, Young 2012; Reid *et al.* 2017; Todorov 2017), this process is further accentuated when the face under consideration is emotionally proximate. Speaking in terms of singularity, I consider this feature not in a quantitative sense (in a numerical sense, or better, in a numerical-cardinal sense), but in a qualitative one. Retrieving the semiotics of Charles S. Peirce, we can affirm that singularity always refers to the individual and concerns the nature of the index and the kind of object for which the index stands for. In this sense, the object of an index is always an individual thing featured by singularity. For example, a particular cloud of smoke is an index of a particular, singular fire, just as the trail of an airplane is the trace of a specific aircraft. Within this same proposal, the image of a face can be used to convey an index of humanity and, following this same perspective, images visualizing the indexical trace of the face can expand and foster the perception of a singularity.

Another aspect, however, has to be taken into consideration. For recognizing the condition under which fetal images convey a sense of

singularity, the coupling (Clark 2010) between the world as perceived by us and the surrounding environment is key. Acknowledging this «form of participatory sense-making which deals with the structural coupling between a "community of interpreters" and an "environmental world of interpretants"» (Paolucci 2021: 67) will enable us to recognize, at least, two coupled levels of understanding. Firstly, the phenomenological experiences within the purview of interpreters and, secondly, the expanded cognition as it is influenced not only by individuals' prior knowledge but also by the collective knowledge circulating within the community.

The emergence of cognition indicates the activation of a phenomenological dimension within individual nature, leading to the development of a transpersonal dimension inhabited by interpreters. This proposal can be translated by revisiting Peirce's famous definition of a sign: «A sign, or representamen, is something which stands to somebody for something in some respect or capacity (CP 2.228)». In this description, we encounter a triadic and recursive process involving the community of interpreters and the environmental world of interpretants, objects included.

Consider, for instance, an image functioning as a sign: it serves to represent an object within a network of pre-existing knowledge shared among interpreters. Moreover, this network circulates within the community, where both the object and the interpretant arise from the structural coupling of the world and the environment. The gradual regularization of interpretations, facilitated by the image, can transition into the constitution of habits. In accordance with Peirce, «the whole function of thought is to produce habits of action» (CP 5.400). This highlights the dynamic interplay between internal cognitive processes and external stimuli. Delving into this perspective facilitates the recognition of the nature of knowledge, encompassing individual and communal influences, while also acknowledging the impact of external artifacts on the cognitive process.

VISUALIZING THE ICON OF SINGULARITY

The fetal iconography identified in medical and anatomical treatises from the 17th and 18th centuries has played a pivotal role in reshaping perceptions related to reproductive habits. This iconography has had a

profound impact on both scientists and expectant individuals, promoting a medicalized perspective towards pregnancy. In the course of this process, the fetus – as a material-semiotic actor (Haraway 1988) – actively engages in its own production process, undergoing evolution and generating meaning within the framework of its own production. As a result, the fetus establishes boundaries that either confirm or challenge women's awareness of pregnancy, articulating a gradual singularization of itself within the womb.

The concept of habit holds a key position in Peircean semiotics and in understanding the processes of incorporating socio-cultural dynamics (CP 5.493). Habits are the conduits through which individuals tend to act and express themselves in specific ways, as well as produce discursive forms in particular manners (Voto 2022). In this regard, habits facilitate the recognition of experiences and the strategic organization of actions, either by conforming to or resisting prevailing models within a given society. Applying this perspective, it can be asserted that reproductive habits are modes of deploying specific features of pregnancy from the myriad cultural understanding of gestation. These habits manifest an inclination to highlight certain aspects as more pertinent than others. As argued in these pages, the introduction of the fetus's singularity has given rise to a characterization of certain habits that were previously lacking.

In this regard, the ostensibly objective and impartial portrayal of the fetus in manuals from the Modern Era has progressively contributed to deploying the pregnant individual as a medical object and the fetus as an icon of singularity. Following this line of thought, it can be asserted that fetal iconography has significantly played a role in perpetuating a specific habit: the disembodiment between the fetus and the gestating body. The inclusion of anatomical plates, meticulously crafted with visual languages endowed with scientific objectivity, shaped such predispositions toward pregnancy. The languages employed in designing illustrations featured in the manuals which I refer to did not merely represent the world; instead, they formulated categorizations and gave form to contents that established precise habits. The widespread use of reproductive techniques in modern society brought forth a transpersonal dimension inhabited by collective interpreters engaged with gender politics, productive and reproductive differences among men and women, and socio-cultural biopolitical regulators. Considering the inherent nature of artifacts for visualizing the fetal

imaginary, and hypothesizing that they have the capacity to mold and substantiate reproductive habits, it is essential to acknowledge that «vision is always a question of the power to see – and perhaps of the violence implicit in our visualizing practices» (Haraway 1988: 589).

The fetuses, it can be possible to state, are not conceived within uteri but whereby scientific visualization technologies outside them. The inquiry into the condition of materialization of fetuses, in the sense of the reifying presentation to the medical eye of the unborn as an autonomous body, has long been a focal point of scientific and philosophical discourse. Particularly this is true within feminist discussions, since the «representations of the mother-fetus relationship in medical illustrations must be interpreted as conduits for economic, informational, and ideological exchange» (Adams 1994: 128). From this perspective, it becomes apparent that the development of fetal singularity initiates prior to birth, commencing with the conceptual and procedural ratio of human reproduction. This progression unfolds through the stages that surround and influence pregnancy, culminating at birth and leading to subsequent social interactions. Within this intricate process, configurations of power are deeply entrenched in the social, technological, and economic frameworks surrounding birth. These configurations shape identities within a transformative process that turns reproductivity into a vehicle for the ideological perpetuation and reinforcement of pregnancy as something to be singularized, starting from the gestating body.

In her seminal work *Bodies that Matter: On the Discursive Limits of Sex* (1993) Judith Butler elucidates the ideological and coercive nature of discourses that impose the transition from an undifferentiated pre-persona to a gendered identity during pregnancy. In the same direction Karen Barad, in her work *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (2007), extended Butler's contemplation by scrutinizing the material apparatuses that enforce social attributions of sex and gender in the fetus. This prompts a broadening of the intricate process of identification and singularization of fetuses. In Barad's work, quantum mechanics is invoked to assert that bodies derive their identity, and thus their power, from a network of material intra-active relationships:

> The fetus is not a preexisting object of investigation with inherent properties. Rather, the fetus is a phenomenon that is constituted and reconstituted out of historically and culturally specific iterative intra-actions

> of material-discursive apparatuses of bodily production. The fetus as a phenomenon «includes» the apparatuses or phenomena out of which it is constituted: in particular, it includes the pregnant woman (her uterus, placenta, amniotic fluid, hormones, blood supply, nutrients, emotions, etc., as well as her «surroundings» and her intra-actions with/in them) and much more. The object of investigation is constructed through the enactment of particular cuts and not others (*ibidem*: 217).

Expanding on these precedents, I contend that artifacts visualizing fetal imagery wield substantial influence in shaping perceptual regulations, thereby profoundly affecting cognition in a holistic manner. The particular facet of perception that requires my research revolves around the intra-action between the artifacts designed in medical-anatomical imagery and the fetus functioning as an icon of singularity.

I am interested in this kind of icons due to their capacity to establish connections, positioning themselves as sensibly observable objects that can serve as a starting point for uncovering new hypotheses and novel relationships among people intra-acting with them. Pursuing this line of thought, the iconic dimension within the scientific realm, which guarantees the stabilization of forms in an image, precisely pertains to «the transformation of traces of phenomena and data into a visualization of concrete scientific objects» (Dondero 2009: 1). In this regard, it can be asserted that illustrations found in manuals, functioning as artifacts visualizing fetuses as icons of singularity, have progressively justified the stabilization of the fetus's form as disembodied from the maternal womb in accordance with the expectations of doctors and anatomists of the epoch. Let us delve deeper into this subject.

FETAL IMAGINARY IN MODERN ERA: THE ANATOMICAL TREATISES

Images have consistently undergone meticulous craftsmanship through technological advancements, where morphological patterns intricately engage with both knowledge and experiences. In this context, what capabilities do fetal images, as visualizations, possess in shaping reproductive habits?

Throughout the 17th century, the portrayal of fetuses started to be linked with public visibility, a development attributed to the evolution of medical perspectives on pregnancy and the dissemination of

reproductive biopolicies (Devis-Floyd, Dumit 1998). This marked the initial conceptualization of the fetus as a recognizable and diagnosable entity. Before its medicalization, pregnancy was acknowledged through the tactile experience of the «quickening» (Duden 1993: 59), the movement intimately felt by women. Due to this practice, gestating women did not envision the figure of a fetus when perceiving themselves as pregnant. «Not everything that comes from the birth parts of a woman is a human being», wrote the German physician and philosopher Wilhelm Gottfried von Ploucquet in his treatise *Violent Ways of Dying* in 1788 (quoted in Duden 1993: 97). The transition from personal haptic sensing to the creation of visual artifacts has shaped the fetus into an entity requiring recognition, measurement, and, ultimately, singularization.

While the sensation of the unborn's initial movement denoted a status shift perceptible only by the gestating body, modern habits affirm a diagnosed experimental reality. The consequences of these transformative shifts are twofold. Firstly, the imagery representing the fetus has come into focus, subject to scrutiny by both medical-scientific interpreters and the general public. Concurrently, the experience of pregnancy has entered a domain where visibility and modeling are not only conceivable but increasingly prevalent and necessary. This is especially true in the context of disease prevention or malformation assessment for the individualized unborn. How does the concept of quickening transition into the realm of visual artifacts, evolving into a phenomenon that necessitates visualization and discernment? Moreover, what does the shift from haptic experiences to optical engagement signify in terms of the emergence of singularity?

A model for visualizing pregnancy, persistent well into the 18th century, reveals certain isotopies and recurrences. Notably, the conceptualization of the uterus as distinct spatiality from the female body, and the unborn being represented as an anonymous child. A primal treatise illustrating these themes is Muscio's *Gynaecia*, dating to around AD 500, which draw heavily from the second-century Ephesian physician Soranus's inquiries. It portrays various gestating uteri, depicted either as vessel-like structures or with horn-like or ear-like appendages (Fig. 1).

FIG. 1. Muscio's *Gynaecia*, AD 500.

The fetal depictions are likewise entirely conventional and unrealistic, portraying pudgy figures in extremely plastic and gymnastic poses. These early illustrations delineate a specific interpretative pattern: the uterus as separated from the female body, and the fetal figure as autonomous and already formed, complete with hairstyles and distinct facial features. These features have remained largely unchanged for centuries.

When scrutinizing the collection of wax anatomical models from the mid-17th century – still conserved at the Obstetric Museum of the University of Bologna -, the scholar Karen Newman concedes that the models of uteri and fetuses fall short of representing a fetal form or stages of development. As she observes:

> Each uterus contains a fetus with sculpted hair, tiny curled hands, eyes sealed shut, in appropriate fetal positions. Instead of having the enlarged head, scrawny limbs, downy skin, and squinting eyes of the full-term fetus or neonate, these fetuses look like babies two, even three months old-plump, hirsute, with filled-out cheeks, in peaceful slumber (Newman 1996: 62).

The reproduction of the fetal face is at the core of her observations, and confronts us with the depiction of the fetus not as a biological entity but as a precise type: the child or, maybe, we can also say the

homunculus[5]. The treatises of the epoch exhibit a specific common type: the *nascituri*, the child ready to be born is never a pre-infantile nor even an embryonic form (Fig. 2). These illustrations represent the fetus as a type symbolizing the future life as «a tiny *homunculus* lost in the vast expanse of the uterus, connected to an umbilical cord reminiscent of the mythological Ariadne's labyrinthine thread» (*ibidem*: 33).

FIG. 2. Wax models from the Obstetric Museum of the University of Bologna, 17th Century. Source: Museo di Palazzo Poggi.

Let now consider a few examples from the period: the Danish anatomist Thomas Bartholin (1616-1680), in his work *Anatome ex omnium veterum recentiorumque observationibus* [Anatomy based on the observations of all the ancients and moderns] (1673), presents two tables significant for contemplating the representation of this *nascituri* type. Table 47 and Table 54 depict the fetuses around their placentas (Fig. 3). These portrayals showcase formed human figures characterized by precise facial features, including designed hairs and adult-like expressions. The figures stand resolutely, supported by their umbilical cords. Furthermore, within Bartholin's work, the depiction of the intrauterine also embodies a distinctive gendered discourse: a form that, drawing on classical and mythological discourses, transforms the pregnant figure into a cut body organized with layers resembling petals and purely ornamental vasculature that frames the child-type in a blissful torpor, as in the case of Table 52.

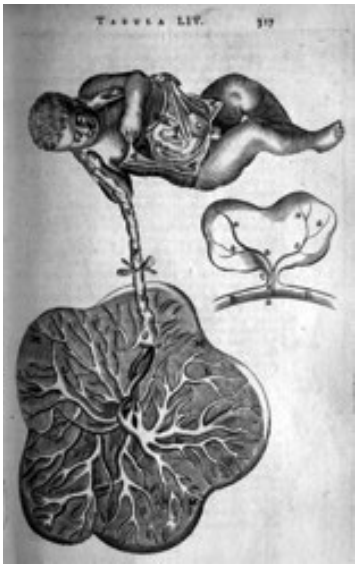

FIG. 3. Thomas Bartholin's *Anatome ex omnium veterum recentiorumque observationibus*, 1673. Source: Claude Moore Health Sciences Library, University of Virginia.

Another example showing the spread of the *nascituri*-type is an earlier table from Hieronymus Fabricius's, the Paduan anatomist and surgeon, and author of the *De Formato Foetu* [On the Formation of the Fetus] (1600). The father of embryology, as he was known at his time, sketches the embryonic state of different human and non-human animals. However, while embryonic forms of non-human animals were meticulously depicted with accuracy and verisimilitude when unveiling the contents of women's uteri, Fabricius portrays a pudgy, child-like figure within its dark, rounded uterine receptacle. This depiction shows the figure floating in a cradle, firmly anchored in maternal tissue by a thick umbilical cord. This plate does not represent what we today call a fetus in the same way as the representation of the non-human animal fetal stage. Instead, we witness the illustration of a discourse asserted within its context, to a depiction that creates a correspondence between the visual artifact and the scientific factum (Fig. 4). Even regarding the facial features, the author opts for a design solution that allows him to elude the quintessential surface of identification, leaving the face of the fetus barely visible.

Fig. 4. Hieronymus Fabricius's *De formato foetu. [De brutorum loquela. De venarum ostiolis. De locutione et eius instrumentis liber / a J. Ursino editus]*. Public Domain Mark. Source: Wellcome Collection.

Through these illustrations, the internal environment of the gestating body was exposed to the public, inviting both medical and social scrutiny. This exposure has accentuated a process of expropriation and a gradual disembodiment of pregnancy[6], both ideologically and culturally. Bound by legal, educational, and ethical standards that confined them to the domestic sphere, scientific methods transformed uteruses into public spaces. This shift instilled a collective perception of pregnancy intricately connected to viewing uteruses as sites for the intricate biological journey of singularity. At the end of the 18th century, a novel pattern was introduced. The turning point in anatomical treatises occurred in 1799 when the German physician and anatomist Samuel Thomas Soemmerring published a folio titled *Icones Embryonum Humanorum* [Images of Human Embryos]. Two plates represent a series of male and female embryos and fetuses, arranged by age and size. In his preface, the anatomist critically assesses the earlier depictions and presents a state-of-the-art: prior to his publication, there existed no illustrations of embryos that captured the sequential and systematic aspects in accordance with the temporal metrics of growth. The deficiency lays in the absence of portraying human somatic meta-

morphosis from the third-week post-conception to the sixth month. In addressing this void, the folio endeavors to introduce an innovative biological progression into the visual design employed for embodying the fetus.

Soemmerring challenges the interpretative biases of earlier anatomists in their representations of the embryonic form, as he writes in the same folio: «Seduced by old wives' tales, not only laypeople who are ignorant in physiology but also artists […] depict the human embryo as repulsive, nay disgusting or monstrous». Through these critiques, he introduces a novel morphological pattern: recognizing the fetal state as a unique entity that, owing to its form based on serial proportions, enables the appreciation of singular progressive development. Guided by a temporally and sequentially developed aesthetic, his anatomical tables portray the fetus in a manner that reflects a point of linear evolution. This conceptualization establishes an embryonic ideal morphology, leaving no space for deformations under any circumstances. In this regard, in the case of rendering the facial surface, we observe how the features are subjected to the same mechanism of objectification, making the evolution of the face a useful component in singularization.

To attain this, he resorted to aborted fetuses, preserved in jars of alcoholic solutions (Tripaldi 2023), with the intention of eliminating subjective influence in the designing process through an approach rooted in the conviction regarding the efficacy of graphic outcomes. The instrument employed for designing the plans represented in the *Folio* was the dioptra, an optical device used for plotting isometric projections with the aim of aligning surfaces and generating a topography. Through this apparatus, the fetus can be portrayed with newfound objectivity as it is projected without a direct connection to the observer's eye or point of view. Soemmerring utilized this technology to render a visible fetal icon, an artifact augmenting the capabilities of those engaging with it. With the diopter, fetuses are projected into a virtual void, owing to their singular nature. By doing this, he designed the ontogenesis of fetal singularity through an imaginary linear evolution of human development, starting from its embryonic state, and achieved through the abstraction and the separation, but perhaps we can speak in terms of ex-traction, from the maternal environment. He devises a visualization that establishes the fetus as the icon of singularity, decontextualized and devoid of any intra-action with the intrauterine.

THE ICONS OF SINGULARITY IN AI DATASETS

In the latter half of the 20th century, concurrent with the progressive technologization of human experience, a notable transformation occurred in the perception of pregnancy, thrusting the fetus into the public domain. Within our present digital milieu, characterized by the processes of datification that seamlessly integrate information and communication technologies, novel habits are surfacing.

The march of digitization has ushered in the widespread proliferation and triumphant assimilation of artificial intelligence systems into diverse facets of contemporary life. The pervasive influence of digital technologies in scientific advancements, socio-cultural practices, products, and services is underscored by their intrinsic capability to deconstruct and reconstruct the fabric of reality, signifying a progressive re-ontologization (Floridi 2022). It is not merely a re-engineering of the world, a novel or unprecedented restructuring, or a simple recombination, but rather a radical modification of its intrinsic nature, its ontology. The transition to this new ontological status inherently demands a re-epistemologization of modernity, reflecting a direct reconfiguration influenced by the digital in daily practices, dismantling previously established and considered stable knowledge and ideas.

The transformative reconfiguration wrought by these digital innovations is evident in their profound capacity to redefine perceptual frameworks and alter modes of intra-action with the world. This recalibration necessitates a fundamental reassessment of established norms and a reconfiguration of traditional paradigms inherited from the Modern Era. The impact is extensive, heralding a paradigm shift that not only challenges pre-existing conventions but also unveils novel avenues for understanding, navigating, and participating in the rapidly evolving digital landscape. In this context, artificial intelligence introduces innovative patterns ingrained in computational and algorithmic models. Consequently, today, fetal images transcend human entities alone and find application in humane-machine interaction. Following this trajectory prompts contemplation on the implications of the shift from the *hortus conclusus* to the disembodied womb in the era of its digitalization.

This concluding section endeavors to delve deeper into the genealogical perspective previously established, focusing on the contemporary manifestations in fetal imagery facilitated by Artificial Intelligence systems. Situated within the realm of medical imaging, these

digital artifacts primarily revolve around computational entanglement, aspiring to seamlessly integrate our surrounding environment with the capabilities of algorithmic models. Central to this integration is the development of datasets, extensive collections of data designed for testing, training, and evaluating algorithmic performance, with a specific emphasis on computer vision algorithms.

Referring to this contemporary artifact, the scholars and artists Kate Crawford and Trevor Paglen aptly stated that «datasets aren't simply raw materials to feed algorithms, but are political interventions» (Crawford, Paglen 2019 w/p). Within the context of these pages, I am interested in how the collection of data pertaining to fetal images carries implications, fundamentally shaping the perception of human reproducibility. The entire process of collecting, categorizing, and labeling images is inherently both epistemic and political, raising critical questions about the legitimacy of those who determine the meaning of images and the societal impact carried out by these artifacts. In line with the genealogical perspective articulated in these pages, it can be asserted that fetal imagery always operates along the dual axis of visual replicability and biological reproduction.

In the landscape of contemporary fetal imagery, extensive datasets of ultrasound planes are gathered and utilized, particularly in the domain of AI-assisted ultrasound imagery. The designing of this dataset takes a leading role in various diagnostic practices, also contributing to the creation of systems for automated fetal facial analyses (He *et al.* 2021, Miyiagi *et al.* 2021, Xiao *et al.* 2023). These novel artifacts employed for visualizing pregnancy represent a significant stage, marking the culmination of the iconicity of the fetus beyond singularity and progressing towards a precise identification. The datasets not only replicate the iconic dimension of singularity but also render the fetus not only visible, measurable, and reproducible but also predictable.

The incremental process of iconizing fetal singularity raises a crucial inquiry regarding the implications that emanate from the haptic recognition of quickening, permeating through the prenatal depiction and visualization of the fetal stage and culminating in the facilitation of singularization, allowing for predictions of the fetal ratio. The enacted iconicity in this transformative journey turns the fetus into a visual representation that can be designed through a dataset, effectively stabilizing and consolidating it into a singularized entity. Iconicity, within the realm of AI-assisted fetal imagery, assumes a dual role by not only

legitimizing the stabilization of fetal patterns as a form of figuration but also by endowing the image with the capacity to generate distinct identities. In alignment with the expectations of interpreters who integrate these images into an encyclopedic system of interpretations, thereby imparting a symbolic dimension to the discourse, the fetus is attributed with personal identity.

It thus becomes imperative to investigate the potential trajectories of fetal image development in an environment where AI-assisted imagery will increasingly have the capability to shape our world and its inhabitants. On the one hand, the success of the chain of transformations that has given rise to distinct visualizations of the fetus not only ensures a historical record of production through rootedness and indexicality but also establishes a robust mechanism for reciprocal control between various technical phases and transformations. On the other hand, the commensurability inherent in the result of this transformative sequence, the iconicity of the fetus both as figuration and as an image of identity, must guarantee avenues for further developments, extending its symbolic implications to the benefit of human-machine interaction. This interplay between iconicity, indexicality, and symbolicity underscores the multifaceted significance of fetal image stabilization and its subsequent contributions to diverse realms of research and interpretation. It should not surprise us, then, that the major cognitive and economic efforts today are directed towards the development of artificial intelligence systems capable of detecting, identifying, and recognizing facial expressions. Making the fetal emotional simulation public signs the final stage in the process of disembodying women from their pregnancies. From this perspective, fetal images can be thoughtfully conceived as delegates – icons that enable the expansion of the uterine environment into the interpersonal visual space. They function as proxies[7] for the amplification of the individualization of humanity and for providing feedback on the sense of singularity that we, as human beings, encounter.

TOWARDS CONCLUSIONS

This paper has explored the role of material images in visualizing the fetal stage, with a particular focus on the intricate process whereby images not only capture the material essence but also imbue it with

nuanced meaning. It has started from the recognition of a fact: the pervasiveness of fetal images that permeates our media sphere today is a relatively recent phenomenon, just over fifty years, but one that has been strongly driven by the technological acceleration of our times. Within this framework, the primary objective was to investigate the conditions under which fetal imagery contributes to shaping values related to human reproductive habits, endowing fetal visualization with a sense of singularity. The central inquiry revolved around understanding how fetal depictions and visualizations participate in our cognition of the surrounding environment, particularly within the complex dynamics of reproductivity and pregnancy.

To accomplish this objective, this study explored the inherent feedback loop in our interaction with fetal images. It posits that these images not only expand and intra-act within our understanding of the environment but also predispose habits, including reproductive ones. Consequently, the research sought to unravel how the category of fetal features that encompass facial characteristics, initiates a mutual reinforcement in understanding the fetus as an icon of human personhood. Given that facial perception inherently instills a profound sense of singularity at a cognitive level, this process is further heightened when the face in question relates to the fetal stage. Fetal images can be considered as proxies that expand singularization towards a recognition of an identity.

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ENDNOTES

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[2] In the Roman Catholic Church, it is possible to remember the Instructio de observantia erga vitam humanam nascentem deque procreationis dignitate tuenda. Responsiones ad quasdam quaestiones nostris temporibus agitatas [Instruction on Respect for Human Life in its Origins and on the Dignity of Procreation: Replies to Certain Questions of the Day] by – at that time – Cardinal Joseph Aloisius Ratzinger released during the Feast of the Chair of Saint Peter in 1987. In the text, where the «ethical relevance, in order to designate the result (whether visible or not) of human generation, from the first moment of its existence until birth» is considered, the scientific fact leads to the recognition of a human presence. We read: «Certainly no experimental datum can be in itself sufficient to bring us to the recognition of a spiritual soul; nevertheless, the conclusions of science regarding the human embryo provide a valuable indication for discerning by the use of reason a personal presence at the moment of this first appearance of a human life: how could a human individual not be a human person?» (1987: 1, 25, in https://www.vatican.va/, last access 07/11/2023, also quoted in Duden 1993).

[3] Originating from Latin as «closed garden», this phrase finds its roots in the biblical text, specifically the Song of Songs (IV, 12: «Hortus conclusus soror mea, sponsa, hortus conclusus, fons signatus»), where it is employed as a commendation from the bridegroom to the bride. Frequently interpreted as a sacred space, it symbolizes a fertile and maternal womb.

[4] The term, first introduced by Alvin Toffler in 1964, is a compound formed by the English words «producer» and «consumer» and refers to an individual who is simultaneously a consumer and producer of a good or service. At the core of the prosumer concept is the community's decision to transform the exchange value of information into a use value, entrusting it to the community's free management: neither to the State, which limits itself to providing infrastructure, nor to the market. The most intriguing aspect of this transformation lies not only in enabling the unrestricted use of information contained on the network but also in promoting the most innovative aspect of the Internet: the active participation of users in information development.

[5] The homunculus is the name given by alchemists to a fictional being endowed with supernatural power, which they claimed to be able to create through alchemy.

[6] Historian Silvia Federici, in her work Caliban and the Witch: Women, the Body, and Primitive Accumulation (2004), and theologian and anthropologist Mary Condren, in The Serpent and the Goddess: Women, Religion, and Power in Celtic Ireland (1989), assert that the witch-hunt was part of a protracted historical process in which Christianity delegitimized the priestesses of the older religion. Initially, this displacement involved asserting that these women wielded their powers for malevolent purposes, followed by a denial of their knowledges, including those related to reproduction. A particularly compelling assertion made by Condren pertains to the link between the persecution of witches and the Christian priests' endeavor to appropriate women's reproductive powers. Condren illustrates how priests engaged in a true competition with the «wise women», showcasing their abilities in performing reproductive practices, inducing fertility in barren women, altering the sex of infants, and conducting abortions (Condren 1989: 84-85).

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