Anatomical Minutiae and Cannular Self-experimentation

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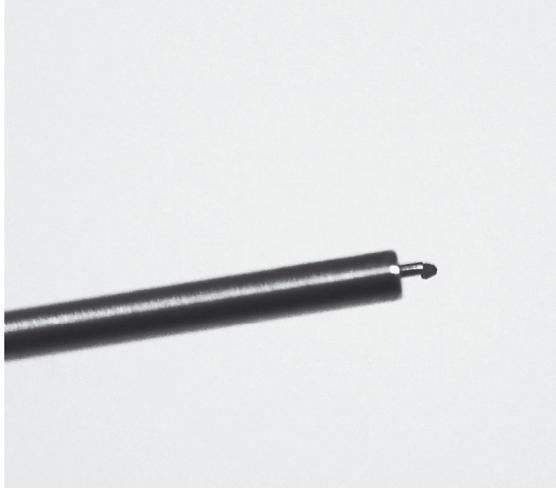
In 'The story of the gauge' (1999), Dutch anaesthesiologist J. S. Pöll accounts for the origins of present-day hypodermic needle measurements. Harkening to European traditions of artisanal wire-drawing, Pöll describes the development of the Birmingham gauge system in regional workshops throughout the United Kingdom up through its increasing prevalence as an international technical reference in the nineteenth century.[1] The principle was simple: gauge size was determined by the number of times a metal line was pulled through progressively smaller perforations on a plate to produce a given external diameter. The finer the wire, the higher the gauge. Wire-drawers only had to count the number of manual draws (or 'G') – a system useful for the rapid production of large volumes of wire, yet that proved impractical to replicate abroad in the absence of incremental metric calculations. At the height of the Industrial Revolution, British metalsmiths used the Birmingham gauge to create wire spools for a wide range of applications, from domestic utensils and precision instruments, to submarine telecommunication cables and electrical power conductors. Despite several attempts at metric standardization, hypodermic needle sizes today are still labelled in 'G' – an idiosyncratic vestige of intensive labour done by hand, now retained in the mechanized fabrication of these medical-grade supplies worldwide.

This article focuses on two operations at the scale of the gauge that I have carried out on my body: first, the sprouting of a plant seed within a tear duct, and second, the autonomous flow of blood through an artificial extracorporeal circuit. In both instances, a mass-manufactured, stainless-steel cannula serves as the primary ready-made tool. Be it the placement of a seed in the interior cavity of a lacrimal plug or channelling the flow of blood within a hollow-bore needle, each of these projects ultimately occurs in a space less than a millimetre in breadth. For ocular germination, a blunt-tip applicator (26G, or 0.4636 mm) was essential for placing the seed within the eye via a silicon punctal plug (fig. 1). Likewise, my attempts at auto-transfusion to date have involved explorations into a variety of bevelled hypodermic needles (fig. 2) such as those used for venepuncture (primarily 21G, 0.8192 mm), including neonatal and paediatric sets (24G, 0.5652 mm).

[1] A highly detailed exposition on the British development of the gauge is provided by Velkar (2012). For an article on the development of the hypodermic needle, see Iserson (1987).



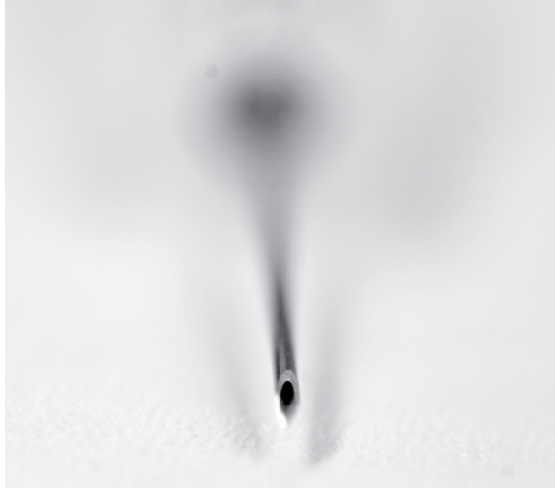


Figure 1. Blunt-tip cannula of a punctal plug applicator with a single seed (Begonia semperflorens) visible at its end.
*(right) F*igure 2. Bevelled edge of a hypodermic venepuncture needle.
Photos courtesy of the author

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The final form envisioned for both works is the online and print diffusion of instructions, 'how-to guides' that allow a broader audience to directly engage with these works at their discretion – a gesture against their identification as performances or stand-alone works.[2] Instead, these projects represent modes of self-experimentation: a long-standing tradition whereby scientists and physicians, as well as artists and diverse practitioners, carry out embodied investigations on themselves. Self-experimentation involves testing prototypes, procedures and hypotheses on one's body. More relevant than the recognition of authorial execution by an external audience is that these actions can ultimately be replicable by others in equal conditions, if not similar motivations.

The primary objective of this article is to examine ocular germination and autotransfusion as experiences involving anatomical minutiae. In medical terms, minutiae often refer to minor processes or small bodily features, such as the ridges of a fingerprint or ossicle bones. The insertion of a seed or prick of a needle are actions so slight in their physical register they are almost imperceptible. Neither of these self-experiments necessitates high tolerance for physical discomfort or overcoming a threshold of bodily pain. What is required was a period of concentrated waiting: the slow appearance of a plant is as difficult to distinguish as the exit and re-entry of blood once a free-flowing circuit is in place. In these moments, the material reality of the cannula gains far more presence. As mediator of a corporeal intervention, the gauge becomes as much a metrological reference as the marker of individual attention. The narrow confines of the cannula thus emerge as a way to access inconspicuous anatomical realities – the pulse of a beating heart, the welling of basal tears, the blinking of an eyelid – that otherwise tend to recede during everyday life.

ALTERNATE ARRANGEMENTS OF EMBODIMENT

A few words on the self-experiments that ground this article, starting with *Inoculate* (2013–14), or the growth of a plant seed in my right eye. The process was carried out with a silicone punctal plug – an ophthalmological device designed to collect lachrymal fluid for individuals with dry eyes. The plug collects tears, preventing their drainage through the nasolacrimal passage and allowing this moisture to continuously irrigate the surface of the eye. I placed within the hollow cavity of the punctal plug a *Begonia semperflorens* seed, a widespread horticultural species specifically chosen for its capacity to fit the plug's small internal dimensions. Next, I proceeded to introduce the plug holding the seed into my lower right tear duct. Both of these actions were accomplished using the aforementioned applicator designed for this insertion (fig. 1). I proceeded to lay relatively motionless underneath a ceiling-mounted skylight, in order to maximize the capture of sunlight for plant growth. After almost two weeks of staying indoors and for the most part still, a sprout emerged from the edge of my eyelid. Barely visible, its appearance was nevertheless distinct – a tiny stem with a flattened leaf. At this point I had to remove the plug, since the weight of my eyelid when blinking (along with the limited interior space of the plug) would not allow the seedling to grow any further.

The second self-experiment involves the external transfer of blood between different parts of my body. Since 2017, and together with two medical collaborators, I have been developing a simulation of an artery-to-vein cannulation system using solely hypodermic needles, extension tubes and valve fixtures.[3] The goal is to create an artificial extracorporeal circuit in which blood channelled from one of my arteries (for example, the radial artery) can, solely through my own intrinsic blood-pressure, stream back smoothly into a vein. The movement of blood through a configuration of outer synthetic conduits would thus mirror its continuous, uninterrupted flow through the internal vascular architecture held within. If successfully completed, this work-in-progress would unify heterogenous lumina, or tubular structures – a stainless-steel needle, a disposable plastic line, a living blood vessel – without differentiation as to whether these are naturally occurring or of human-made origin. Each iteration of the project to date is provisionally labelled as a new version of *Punctum*, the latest being *Punctum v. 6*.

[2] The following are the future websites for *Inoculate* and *Punctum*: http://manual.vision http://vascular.systems

[3] All versions of *Punctum* were made possible through ongoing collaboration with Jelle de Wit, medical resident at the Academisch Medisch Centrum (Academic Medical Centre) in Amsterdam, and benefited from the professional advice of Dr H. H. F. (Bert) Derkx.

To the best of my knowledge, voluntary ocular germination or auto-transfusion propelled by arterial pressure alone are procedures that have not been previously executed. Artists such as Petr Štembera (*Grafting*, 1975) and Yang Zhichao (*Planting Grass*, 2000) have performed works that entail short-term surgical implantation of plant specimens into their bodies. The video *Oasis* (1999) by Ene-Liis Semper and Kiwa also comprises the insertion and watering of a horticultural plant in both of the artists' mouths, which have been previously filled with soil. Through *Inoculate* I attempt to take such strategies further, pursuing actual plant growth from a seed within a human body. The only documented event of ocular germination I have found is Julian Fabricius, a young South African boy who in 1979 had a stray plant seed sprout inside an undetected corneal lesion within his iris. Fabricius is an example of a naturally occurring self-experiment, which nevertheless merits recognition as a first patient case study.[4]

In contrast, autologous transfusion, or the use of one's own sourced blood, is an established medical practice done through shunting procedures, haemodialysis machines, coronary artery bypass surgery and intraoperative blood salvage devices. What I attempt to innovate with my project is the proposed simplicity of creating this circulatory cycle using basic venepuncture instruments and arterial pressure alone. It is worth noting, however, that the development of blood transfusion in the history of medicine has always relied on inventive and often unorthodox forms of self-experimentation. Two notable figures from the early twentieth century are Alexander Bogdanov and Werner Forssman, Soviet and German physicians respectively who carried out ground-breaking forms of blood transfusion or vascular intervention.[5] An example from contemporary art featuring transfusion methods is Paul Wong's video *60 Unit; Bruise* (1975), in which a man sitting next to Wong draws his blood with a syringe only to immediately inject its contents into the artist's outstretched arm. Another artistic transfusion pairing are Sun Yuan and Peng Yu: in their work *Body Link* (2000), they each infused 100 cubic centimetres of their blood into the corpse of conjoined infant twins. Finally, the artist duo Art Orienté Objet and their work *May the Horse Live in Me* (2011) involves the xenotransfusion of horse immunoglobins into Marion Laval-Jeantet – a process that culminated in a performance with her partner Benoît Mangin, where she walked on stilts resembling equine limbs next to the donor horse itself. Although somewhat further afield, the interspecies and haematological proximity of this work holds similarities with the forms of self-experimentation described above.[6]

PUNCTUM – PUNCTAL – PUNCTURE

A critical component of ocular germination and auto-transfusion is the insertion of the cannula and the forms of connection this precipitates. *Punctum*, the name I have chosen to describe each new circulatory model, translates into Latin as 'point' or 'period'.[7] More broadly, punctum is used in a variety of existing anatomical, biological or scientific terminology relevant to both of the aforementioned projects, offering a guiding conceptual framework for my understanding of minutiae. Examples of these puncta include:

- *punctum vegetationis*: the node for new botanical growth, such as the first leaf on a stem,
- *punctum lacrimalis*: the orifice through which tears drain out from the eye, and
- *punctum acus*: the tip of a needle, such as that used in puncturing the skin to draw blood.

In functional terms, punctum stands here as a spatial position, a discrete unit or location. Yet these puncta bring about the formation of *punctum saliens*: a biological and figurative term that denotes a starting point or a point of origin. The puncta listed above, non-descript when considered in isolation, become generative when made into sites of activation, be it of plant germination or blood flow. At once unexceptional and commonplace, minutiae are upraised in their ability to beget.

The sustained interaction between heterogenous elements – tear–plug–seed, blood–needle–conduit – constitutes what French philosopher and inventor Gilbert Simondon[8] refers to as 'techno-geographic environments', or associated milieus formed by specific 'technical objects' (Simondon 2017 [1958]: 58). In his 1958 book, *On the Mode of Existence of Technical Objects*

[4] Additional details on Julian Fabricius and the aforementioned artists are included in Gómez López (2019).

[5] For further information on Alexander Bogdanov, see Krementsov (2011) and Voehringer (2007). See also Forssman (1974).

[6] Although not a cannular self-experiment involving her circulatory system, Marianna Simnett's *The Needle and the Larynx* (2016) also bears mention. This video shows the artist receiving a Botox injection to her cricothyroid muscle in order to lower her vocal pitch to a traditionally masculine range.

[7] Allusions to the term likely evoke Roland Barthes's study of punctum and studium in his book *Camera Lucida (1981 [1980])* or Walter Benjamin's *Little History of Photography* (1999 [1931]).

[8] Simondon was not solely a theorist but a hands-on tinkerer. He built a television receptor while teaching at a French lycée and drew up applied experiments in the Laboratory for General Psychology and Technology at the Université Paris V – René Descartes, which he ran from 1963 to 1983. See Simondon (n.d.).

(Du mode d'existence des objets techniques), the first example Simondon provides of an associated milieu is a Guimbal turbine used for hydroelectric production. This tidal power plant is one of many industrial objects Simondon illustrates throughout the text or in its accompanying image plates, such as cathode-ray tubes, automobile engines and rotary-dial telephones. He communicates in detail how oil transfers heat within the turbine's generator while providing concomitant lubrication and insulation (Simondon 2017 [1958]: 59), submerged operations that also '[assign] to saltwater (the natural element) a triple technical function: to furnish energy, to cool the structure of the turbine, and to catalyse the water-proofing of the stages' (Stiegler 2010: 83). For Simondon, the technical invention of this power source is when oil and water connect, '[coming] into existence at the very instant their disparate fields clicked together into automatic relation', an instantiation made possible as 'an action of the future in the present' (Massumi *et al.* 2012: 25–6).

I access Simondon primarily from the position of an artist practitioner for whom this 'futural function' of a technical object – one in which only 'foresight and creative imagination can accomplish such a reverse conditioning in time' (Simondon 2017 [1958]: 60) – reads as grounded reassurance. My own guiding principle for self-experimentation is two-fold: first, to repurpose single-use medical devices in order to extend, mediate or otherwise reconfigure physiological functions; and second, to merge organic and synthetic elements as a means to question the physical limits of a human body in relation to its surroundings. I interpret my corporeal interventions as techno-geographic environments around specific technical objects, histological, iatric or otherwise, a view that corresponds with Simondon's brief mention of blood and conjunctive tissue as examples of associated milieu (62). These miniscule spaces for mechanical and physiological interaction are created by ocular germination and autotransfusion through a technical object, namely a stainless-steel cannula. This device allows puncta to remain 'open to functions of convergence' (170), altering design and physiological priorities both for the cannula itself, bodily fluids, and the surrounding physical frame in which these co-exist.

It is Simondon's formulation of an aesthetic object as 'an outstanding point in the universe' (199) with which this ensemble of intersecting puncta most closely aligns. In another section of *On the Mode of Existence of Technical Objects*, he states that 'the aesthetic work makes the universe bud, extending it by establishing a network of works, in other words by establishing radiating realities of exception, key-points of a universe that is at once human and natural' (196). This burgeoning quality of the aesthetic object, as well as its potential for linkage, resonate keenly with *Inoculate* and *Punctum*. At their most basic, these projects consist of puncta with the ability to transform pre-existing points that together constitute the 'reticular structure of the real' (210). In reviewing Simondon's aesthetics, Yves Michaud further underscores this self-reflexive appreciation by stating the following:

> What defines the aesthetic object is therefore its insertion … What characterizes art is its pregnancy and its salience, its manner of generating places, points, moments and exceptional instants. Simondon thereby defends an aesthetics of the local and the in situ, an aesthetics of sensitivity to places and moments, an aesthetics of structures grafted on to reality to give it form and signification; the aesthetic object depends on the gesture of placing, inscribing, inserting a mark in the natural or technical or religious world. (Michaud 2012: 125)

THE POTENTIAL OF MISCALCULATION

Historians of science remind us that precision and accuracy in standardized measurements are more often exercises in convention than exacting universals or absolutes (see Wise 1995). The gauge, as discussed above, poses one such example. Institutionalized with only slight variation as an official standard by the British Board of Trade in 1884, the Birmingham gauge stands in-between an empirical and a geometric reference, one that still today is not calculated by fractions of an inch or metric decimal measurements.

Beyond tradition and expediency, the reasons why the gauge remains a leading form for sizing stainless-steel cannula may be more readily at hand. Its form represents the functional merging of manual labour and tactile sensibility at a human scale – one that connects early experimental manufacture of wire with precision-gripping and

finger dexterity in the manipulation of a scientific instrument (see Ingold 2013; Markze and Markze 2000). A compelling direction to consider is the cannular gauge not strictly in relation to engineering or industrial applications, but to the individualized morphology of biological bodies – primarily human and non-human vertebrates – for whom vasculatures are never uniform or identical. There are no two individuals who have the same layout of veins and arteries mapped onto their bodies. Equally, there is no regularity in the internal diameter of these vessels, much like with the size of tear ducts. These minutiae, again, do not generally affect activities in medical and laboratory contexts; there are approximation tables and best-practice guidelines for matching cannula gauges to different parts of the body, based on age group or volume requirements. Yet undoubtedly, the primary quality of the gauge is one of elasticity in its latitude to manoeuvre, a usability trait that may well reflect the hand-intensive occupation of its origins.

In his unpublished manuscript On Techno-aesthetics (Sur la techno-esthétique) [2012 (1969)], Simondon highlights the manual sensorial range exhibited by an artist – the fingering of piano keys, the tensing and release of a harp's strings, the unctuous texture of paint (3). These forms of contact between the artist and 'the material in process of becoming a work' bring together the aesthetic with the technical. This manual affect is not exclusive to art making, as Simondon identifies its presence in experiences such as 'soldering or driving in a long screw' (3). Such an observation parallels his views on technical objects as retaining human gesture or actions made by the hand (Simondon 2017 [1958]: 18; Lindberg 2019: 303). Simondon goes so far as to say that a machine is 'a deposited fixed human gesture that has become a stereotypy and the power to restart' (Simondon 2017 [1958]: 151): an understanding that encompasses the repetitive, industrialized production of hand-drawn wire. In uniting the aesthetic enterprise with the technical, Simondon furthered his ideas on the aesthetic object as fluctuating freely and horizontally between the hand-made and other forms of thought, crafting itself in 'finding modes without going outside a mode, only by dilating it, reworking it, and perfecting it' (209).

To repurpose a stainless-steel cannula implies finding the techno-aesthetic in subtle intrabody distinctions – the opening and distension of diminutive flesh orifices, the containment and dispersal of bodily fluids. Upon reflection on the aesthetic object, Yves Michaud discusses Simondon's formulation as 'an aesthetics of the banal, the slim, the light, the fugitive', an acknowledgement of art that engages in that which is 'in passing' (2012: 129). Gauge-scale operations represent such forms of fleeting passage. These are sinuous and transient, moving from instruments to the body, then through it and back. The minutiae involved in ocular germination and auto-transfusion – teardrop, plant bud, needle prick – are each simultaneously transient phenomena and palpable loci of creation. Even when aesthetically substantive, these puncta are quotidian first and foremost: ephemeral occurrences, equal in their accessibility as shared aspects from ordinary life. And as embedded and embodied processes alike, their influence both inside and out lies in the re-evaluation of what is ultimately significant – a personal discernment that eschews easy measure altogether.

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