CRAFTING TEXTILES IN THE DIGITAL AGE

EDITED BY
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THE INTELLIGENCE OF THE HAND

Monika Auch

Introduction

In this chapter I set out to explore the introduction of digital tools into traditional crafting with a focus on weaving. It is informed by my personal development as an artist with a background in the worlds of both arts and medical science, and by interviews with designer-makers. The worlds of science and arts are each governed by their own rules. Valid scientific research is bound by the rigors of scientific parameters and statistics, whereas arts research thrives through out-of-the-box thinking. In this chapter I discuss the intelligence of the hand, the development of a sensibility for materials, the importance

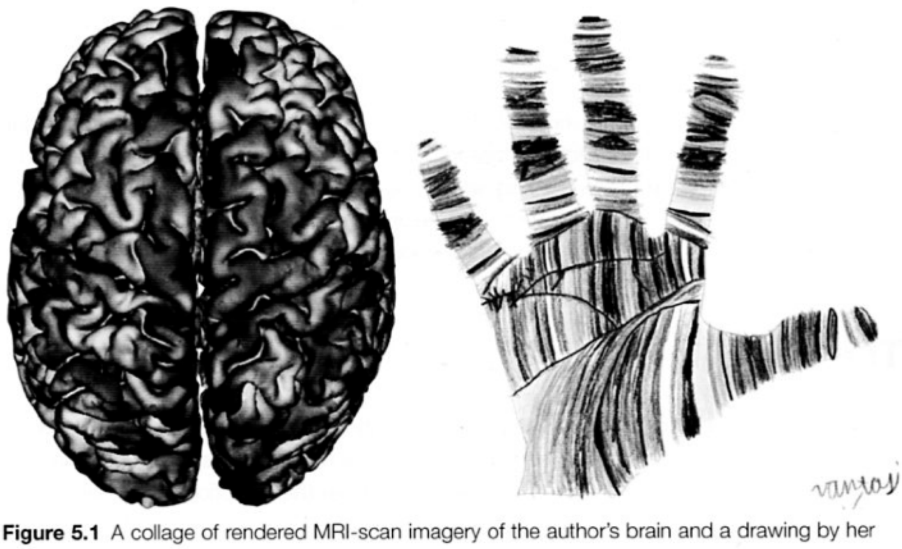

Figure 5.1 A collage of rendered MRI-scan imagery of the author's brain and a drawing by her daughter Nora at the age of five. © Monika Auch.

of cognition, and the use of algorithms, all in relation to the current use of digital tools in weaving and in other disciplines of arts. I conclude by describing my own project, "Stitch_Your_Brain," in order to offer a wider perspective on the use of digital tools in crafting.

Anatomy and weaving

I became a weaver because I studied medicine. During the required five years of theoretical studies I missed working with my hands so badly that I attended private weaving lessons in order to engage in creative making. After learning the basics from a Finnish traditional weaver, I worked in the studio of Margot Rolf, a Dutch weaver and Bauhaus descendant, between the hospital internships.

Combined with the wealth of materials, the mathematical structure of weaving with its endless possibilities appealed to me. However, looking at weaving as a visual artist, I really wanted to explore it as a 3D construction technique. In order to widen my horizons, I attended a course for Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) for weaving soon after such courses became available. Weaving is the oldest binary technique and can be easily translated into computer programs. Working on a computer-controlled loom ever since, I have taken weaving out of its traditional context and used it as a contemporary, autonomous construction technique in order to create woven sculptures. It was critical feedback about the obvious but unintended anatomical qualities of the sculptures that opened my eyes to the analogy between anatomy and weaving in terms of construction, for example, in the microscopic growth patterns and the multilayered embryologic shapes of the 3D woven objects. On another level, practicing as a medical doctor and as an artist needed the same hands-on skills, inquisitiveness, and problem-solving approach. This perception initiated my research about the intelligence of the hand and the fascinating axis between hand and brain in the creative process (Plate 7).

In contemporary artists' studios, the combination of craft and digital processes has become common practice. In regard to weaving, it takes time to master a technique using CAD/CAM tools that allow a freedom of expression that is not restricted by technical problems. Apart from learning applicable techniques, other indispensable skills are dexterity, hands-on experience with any specific materials and, finally, a good amount of curiosity to solve any problems and nurture innovative developments at the same time.

The hand

The human hand is central to this discussion on crafting in digital times. Frank Wilson, an American neurologist, researched the importance of the hand for musicians, jugglers, and visual artists alike. In his book *The Hand*, he wrote about the evolution of the hand, from the important grasping function of thumbs and fingers to the subtle and mysterious interaction of the hand and the brain during a creative process, be it open heart surgery or the

Figure 5.2 Engraving on paper by Henricus Wilhelmus Couwenberg, 1830–45, shows postures and gestures of the thumb and other fingers. Dimensions: 150 x 108 mm. Photograph: Rijksmuseum, Amsterdam.

making of a sculpture.[1] Wilson describes the work of jewelry maker George McLean, who lost the four fingers of his right hand in an accident but taught himself to work with the remaining grasping function of the right thumb and the intact left hand. McLean explains the sensual pleasure of working with tools and materials:

> When you're filing or hammering there's also the sound. Hammering on a piece of metal is like ringing a bell. A person needs to have feeling for all of those things. You know, tools are very sensual things, and using them can be.[2]

In this quote, he refers to a visual vocabulary, stating how materials have an inherent meaning for him and an emotion attached, which in turn gives his pieces a unique personal stamp. Based on this and other cases in the book, Wilson considers that, through material knowledge and skill, the hand can be transformed into an articulate organ of expression.

Margot Rolf, a former professor of weaving and a Bauhaus descendant, looks at the warp–weft combination in a hand-woven piece with a magnifying glass and can see exactly where the weaver stopped for a break, because the rhythm of the cloth has changed. In weaving by hand, even the slightest, most minimal differences in positioning a weft thread or how the woven thread is pushed into place by the beater changes the expression of the woven piece. A high degree of critical observation and motor skill practice is needed in order to develop such sensibility.

In medical practice, we use our fingertips as eyes to explore and interpret palpable tissue matter and its position when visual information is hidden beneath the skin or inside a body cavity. Is a lump fixed to the surrounding tissue, is it mobile and soft or hard as stone, suggesting either the head of a baby or a tumour? Tactile sensibility and good visuospatial orientation are crucial in medical practice even with available modern image-making techniques such as scans and X-rays.

The sum of these sensitivities could be expressed as a material sense, which appears to be important to weaving and medical practice alike. How does a material sense develop?

Material sense through seeing and touching materials

> Quality, light, color, depth, which are there before us, are there only because they awaken an echo in our bodies and because the body welcomes them.[3]

As soon as we are born, we explore our environment with our mouths and hands. Touching or being touched is an essential sensation. Textiles touch and envelop us from birth to death. Once we consciously make the connection between the different sensations evoked by the haptic and visual perception of different sorts of textiles, we are able to experience textiles as warm but itchy wool, cool linen, soft velvet, caressing silk that feels like water flowing over you, electrostatic synthetic fiber, or clammy nylon. These sensations can be associated with feelings such as security, desire, or revulsion. Sometimes these feelings are so intense that they make the hairs on your arms stand on end or give you the shivers when you just think about a particular material.

When we look at textiles, memories of previous experiences are activated within our brains. This can lead to an automatic reaction like reaching out towards the fabric in front of us to check if our association matches the reality. The well-worn maxim "you look with your eyes and not with your hands" forbids the instinctive urge to touch something that is visually attractive. Meant as a warning for children to neither touch everything they see nor grab what tempts them, the saying implies that touching is less important than looking or, in fact, a second-rate impulse. This is certainly not the case for blind people, who experience the world to a great extent through touch.

In Denis Diderot's famous "Letter on the blind" from 1749, a blind man answers the question whether he would like to see:

> I would just as soon have long arms: it seems to me my hands would tell me more of what happens in the moon than your eyes and your telescopes; and besides, eyes cease to see sooner than hands to touch. I would be as well off if I perfected the organ I possess, as if I obtained the organ which I am deprived of.[4]

This man, blind from birth, concludes the sense of touch to be a more reliable source of understanding and states that seeing with the eyes is equal to feeling with the hands. Ultimately, it is proof of the intelligence of our hands. In conjunction with tactile memory, our hands allow us to experience the softness of velvet, the animal sturdiness of horsehair, the warmth of wool, the fluidity of silk, the roughness of jute, and the artificiality of Tyvek, by just looking at such materials. We do, indeed, see with our hands and instantaneously feel—even if we do not touch. Experiences and memories we have collected through our hands provide us with an understanding of materials.

Knowing and valuing the behavior, properties, and emotional meaning of materials can only be acquired by touching them and, in weaving, by using yarns in unusual ways. However, will computers, laser machines, 3D printers, and other innovative tools place a barrier between us and the material world, and limit us to touching a screen or mouse pad? Or does this limitation in turn cause a craving for touching materials in order to establish a physical link with the world?

Hand and cognition

Bearing these questions in mind, the important cognitive steps of seeing, understanding, and representing an object visually through drawing by hand or by computer needs to be discussed. Drawing is still one of the basic skills taught in art school programs. It is of particular importance to artists working with digital methods in order to implement a "natural" touch into computer-generated designs. Since 1999, renowned jewelry artist

Ted Noten has been working with 3D printing. The first task for interns in his studio is to draw an apple. Competent in computer skills, the interns usually work with an image from the internet. Noten sends them to the greengrocers to buy an apple and to draw by hand the shape of the fruit, complete with texture and light reflection. By executing this elemental cognitive step they learn how to add tactile qualities to software designs, like Noten does for his 3D printed jewelry pieces.

In medicine, drawing has a long tradition going back to Leonardo da Vinci, but it has sadly been struck off the curriculum in medical faculties. Before technical means like photography and scans were available to visualize anatomy, drawing was a basic skill for a career in science.

Jan Swammerdam (1637–80), a famous Dutch anatomist, was an astute observer, taxidermist, and skilled draughtsman. He fully understood the cognitive steps of observing, understanding what he saw, and reproducing it as realistically as possible on paper, in order to communicate the findings to a greater audience and lay personal claims to any profound discoveries. Through the powerful single-lens microscope of his fellow countryman Antonie van Leeuwenhoek, Swammerdam observed and documented virtually unexplored territory using specimens of frogs and lice to see structures whose functions he could only guess at because nobody had ever looked at them before. In his work, he fused the scientific with the artistic view, and even described his findings in terms borrowed from the arts, thus reflecting also the rich art world of his times. "Repeatedly he spoke of the astonishing 'handiwork' or 'embroidery' of the tiniest creatures."[5]

Material making and time

The current idea that the use of digital tools will speed up any time-consuming learning and making processes begs critical consideration. In interviews with designer-makers, it is obvious that the time factor has to be regarded in relation to the quality of work. Ted Noten, for example, made hundreds of material samples before he reached the exquisite balance between materials, form, and content in his 3D printed pieces. In weaving, making samples is essential preparatory work in order to explore the qualities of weft–warp tension, the special qualities of materials, and structure of any cloth or sculpture. There are no shortcuts or time-saving procedures in this necessary step. CAD/CAM machines do not speed up the process but, quite contrarily, can slow it down because of the increased number of possibilities in designing and manufacturing.

During their residency period at the European Ceramic Working Centre in the Netherlands, the design duo Minale and Maeda were creating a porcelain dining set and using a 3D printing machine for the arduous production of molds. Unexpectedly, the water-attracting qualities of the printing material defeated their attempts to produce an evenly surfaced mold and a smooth, industrial-looking product. The cast porcelain showed random irregularities, and numerous test runs with different materials were necessary until a satisfactory flawless result had been achieved. The designers stated that digital techniques like rapid prototyping are, in fact, a new time-consuming craft with its own rules that can only be applied creatively after mastering them.[6]

Freedom in algorithms

In an interview, Swiss architect Michael Hansmeyer points out that computers and software are tools to realize what would not otherwise be possible. Hansmeyer creates columns with an amazing aesthetic appeal by using a computational method and laser technology for designing and manufacturing the pieces. He says: "Modern software simplifies the drawing of very complicated forms. There are hardly any limits for complexity in design and production processes."[7] He uses a computational method whereby information is fed into the software which then draws a design autonomously in a repetitive loop with playful variations. A relatively simple input results in complex forms. The process is not totally controlled, but has a calculated freedom of expression—a moment of surprise. This is comparable to the human or natural touch that other designer-makers introduce in their 3D printed or CAD/CAM engineered work. The maker defines the variable parameters and conditions, not the design of the final object itself.

In the weaving process, I develop my work using a collage of materials, with the blueprint of the multilayered embryonic growth in the back of my mind. My working method of alternating slow manual weaving with planning the next step on the computer interface leaves room for playfulness and serendipity. The physical contact with the material and loom is crucial for the process. The final shape of the woven sculptures depends on the barely controllable interaction of the materials and is only revealed

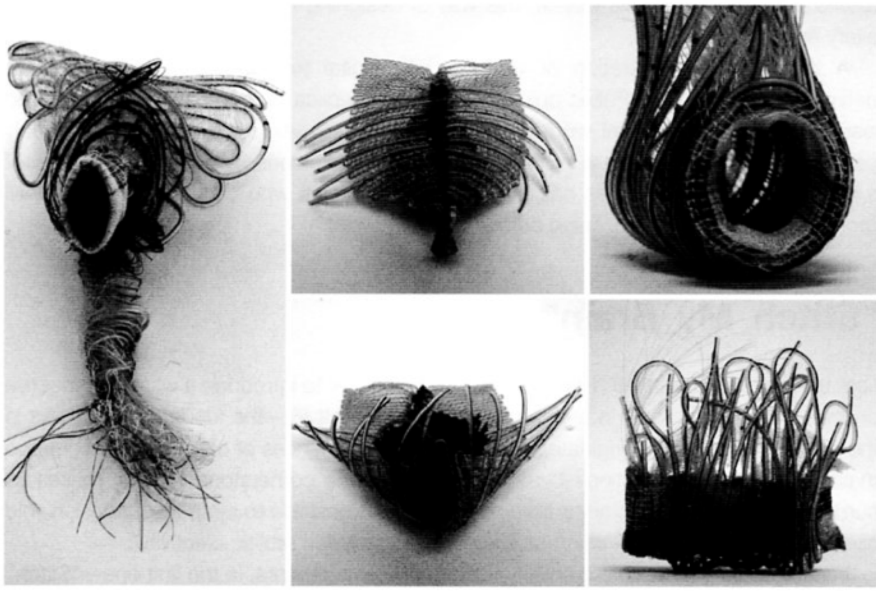

Figure 5.3 Morphology studies, three objects from the "Ludens" series, 2011. Left: "Incompleta." Middle: "Spina Aperta." Right: "Spina Occlusive." Materials: plastic yarn, surgical drains, horsehair, paper yarn, and heat-reactive yarn. Dimensions: approximately 13 x 5 cm each. Photograph: Ilse Schrama. © Monika Auch.

when the tension of the warp is released. The unfolding of the 3D form happens at that very moment which I documented in the video "Weaving Proxyclones."[8] In contrast to weaving with industrial CAD/CAM machines that require control of all parameters, the manual interweaving of materials on a computer-controlled loom offers creative freedom during the construction process. In this "laboratory" of forms, I create series of objects that are not intended to be true-to-life copies of existing forms, but rather additions to what nature had not yet thought of, even with construction defects, such as mutations and aberrations. All woven objects in a series are of equal value. There are no failures as such, only new and unexpected forms. The freedom in creating with a unique and highly personal technique is the basis for my artistic grammar—a morphology of woven forms.

Digital technology has been with us now for some time and it has been followed by a renaissance in crafting. The contradiction that seemed to sit between craft and digital technology has been resolved. Parallel to the discovery and implementation of digital technologies, a reevaluation of craft and making by hand is taking place. The transfer of the sensibility of the hand into digital tools is a logical and often-applied step in the process. A combination of traditional, time-consuming methods and contemporary, instantaneous technology, i.e. a visible clash of digital and tactile methods, can strengthen the material impact of the viewing experience.

Ann Marie Shillito's book *Digital Crafts: Industrial Technologies for Applied Artists and Designer Makers* (2013), about the use of industrial technologies for applied artists and designers, fuses a craft-minded approach with 2D and 3D digital technologies.[9] In Shillito's design of a haptic device, this way of designing has come within the reach of every artist and designer.

A theoretical consideration of working with digital technology must address the definition of authenticity. Public opinion regards the replica of an artwork as possessing less value than the original work. In digitally produced work, however, there are only perfect replicas—or to use a more appropriate word, clones. A copy in the sense of a less valuable product does not exist any longer. Artists who create using CAD/CAM production are, in fact, redefining authenticity.

"Stitch_My_Brain"

I set up the project entitled "Stitch_Your_Brain" in order to introduce a wider perspective on the use of digital tools in crafting. Where does creativity—the fundamental aspect in the process of making—originate, and what are the influences of digital tools on creative making by hand, i.e. crafting? Creativity is after all the cornerstone of what makes us human. Can creativity be traced and measured? Is it possible to jump the Cartesian void dividing mind and hand by using science in order to trace artistic creativity?

In an attempt to measure creativity I set up two experiments. In the first one—"Stitch_My_Brain"—I measured my own brain activity during a defined creative action with the help of innovative brain technology. The second on-going experiment—"Stitch_Your_Brain"—is open to the public and documents the engagement of participants in a crafting task and their reflections on it in a questionnaire.

Figure 5.4 The author is wired up while knitting at the Netherlands Institute for Neuroscience for EEG registrations, mapping dexterity through scientific data. Photograph: Jennifer Ramautar. © Monika Auch.

In the "Stitch_My_Brain" project, creativity is defined as the interruption of a repetitive automatic movement (i.e. knitting) by making a mistake (i.e. dropping a stitch) which initiates the learning of a new action in the brain. This definition of creativity is based on the observation that innovation very often occurs in studio practice as a happy accident—a moment of serendipity or a "Eureka" moment. This happens when a maker incidentally changes the usual placement of a tool in the hand, or when a skilled hand fumbles, or when a material behaves differently. At the Netherlands Institute of Neuroscience in Amsterdam, I registered the execution of a new motor skill action with medical technology using functional Magnetic Resonance Imaging (fMRI)[10] scanning and Electroencephalographic (EEG)[11] registrations. The registrations yielded slight, expected variations in brain patterns, mapping the change from the automatic to non-automatic movement, but gave no clue as to the origins of creativity.

In framing the origins of creativity in combination with the influence of digital tools, the net has to be cast wider, involving a larger and more varied group of people and different research methods. Why, after all, do humans enjoy and even crave creative making? What motivates them to put so much effort into learning a skill in order to make objects? And—returning to the original question—how does digital technology influence crafting?

"Stitch_Your_Brain"

The "Stitch_Your_Brain" (SYB) project and website were launched at the Impact International Printmaking Conference in Dundee, Scotland.[12] SYB is a textile-related project which consists of an embroidery kit with the schematic representation of a brain to embellish. The project aims to engage participants in making work by hand, while at the same time reflecting on a visual representation of their brain (Plates 8 and 9). Participants are asked to send an image of their stitched brain for the SYB website. Additionally, they are asked to complete a questionnaire with twenty questions covering the developmental and cognitive aspects of individual creativity and dexterity, such as social environment, education, the use of digital tools in everyday life, emotions during crafting, and peer group-related goals. They are asked about their experience of crafting and to comment freely on the subject. With the involvement of international participants of all ages and their different ways of approaching the task, the project is expected to give answers to queries about possible changes in manual skills and generally about the changed experience of crafting since the arrival of digital tools. Once a representative number of submissions have been received, the stitched brains and questionnaires will be analyzed.

A surprising new angle on crafting has appeared in discussions as to its contribution to the improvement of health and well-being. Artists and healthcare workers have discovered the positive effects of crafting on mental health. Physiotherapist Betsan Corkhill established the stress-reducing effects of knitting in her study involving more than 3,500 participants. This has gained the interest of healthcare workers and medical specialists alike.[13] Corkhill's findings and the statement of many women that a knitting, crochet, quilting, or other craft project has kept them in a stable mental state in times of crisis can be used as a concept towards the prevention of rising healthcare costs. It also strengthens the point that creative making is a fundamental and necessary human activity. The idea that crafting can actually contribute to well-being is supported by healthcare institutions and funded Arts projects in Great Britain.[14] It is an interesting theme to be discussed at another place and in the context of healthcare policies.

Conclusion

The conclusion of this discussion about the influence of digital tools on crafting and its parameters, i.e. the hand, cognition, and creativity with a focus on embroidery and weaving, is an interpretation of the early results of the SYB project, interviews with designers/makers, and my studio practice of weaving on a digital loom. A preliminary analysis of about forty admitted works of the SYB project shows that participants under the age of fifty who regularly work with digital tools, i.e. a computer, and are not professional designer-makers have a very different approach to crafting in general and less detailed skills in performing a manual creative task than the fifty+ generation. It is necessary to continue the study in order to gain more data before further conclusions can be made. Interviews with designer-makers show that digital tools have become yet another skill that has to be mastered—a new craft. By now designer-makers working at the cutting edge of innovative technology have implemented digital tools in their work and adapted them, fitting their individual signature and style. Weaving has been the ideal playground for experimenting with software and CAD/CAM technology, because it is the ultimate and original binary technique. The technical aspects are easily learned. The challenge is to combine new materials in a meaningful way with the infinite possibilities of the CAD/CAM loom. Groundbreaking discoveries in smart materials will add more possibilities for constructing woven artwork or applied woven structures, e.g. body prostheses, in the field of medicine. There has never been a more exciting time for weavers than now.

The developments of working with digital tools in crafting and especially weaving can be summarized by Tim Ingold's observations on livelihood, dwelling, and weaving as a dynamic process:

> First, the practitioner operates within a field of forces set up through his or her engagement with the material; secondly, the work does not merely involve the mechanical application of external forces but calls for care, judgement and dexterity;

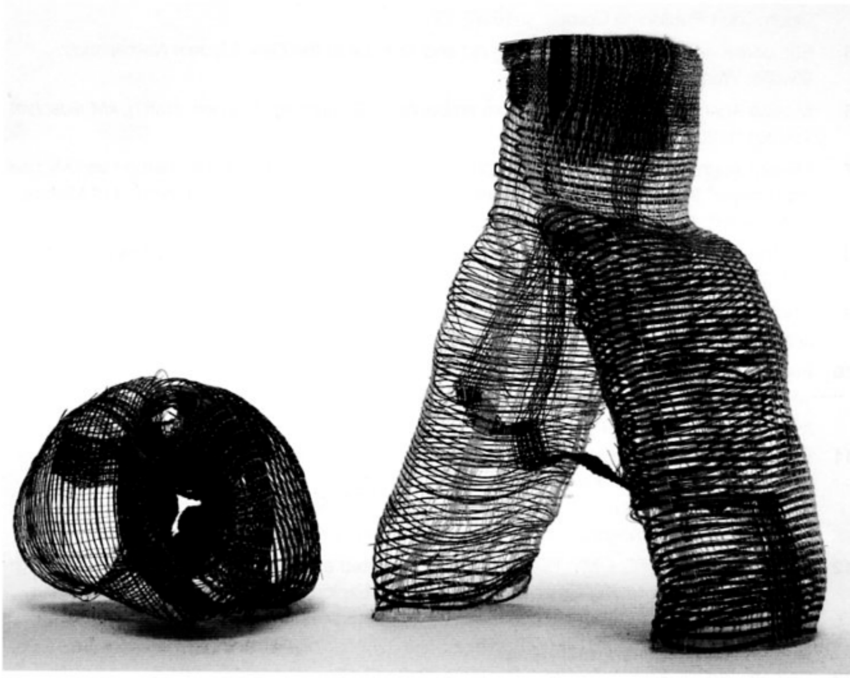

Figure 5.5 Two objects of the morphology series, "Neurotubes." Dimensions: approximately 20 x 25 x 10 cm each. Materials: fishing line, horse hair, and heat-reactive yarn. Technique: 3D weaving on a computerized loom. Photograph: Ilse Schrama. © Monika Auch.

and thirdly, the action has a narrative quality, in the sense that every movement, like every line in a story, grows rhythmically out of the one before and lays the groundwork for the next.[15]

Where making (like building) comes to an end with the completion of a work in its final form, weaving (like dwelling) continues for as long as life goes on—punctuated but not terminated by the appearance of the pieces that it successively brings into being. Dwelling in the world, in short, is tantamount to the ongoing, temporal interweaving of our lives with one another and with the manifold constituents of our environment.[16]

Notes

1 Frank R. Wilson, *The Hand* (New York: Pantheon Books, 1998).

2 Wilson, *The Hand*, 142.

3 Maurice Merleau-Ponty, "Eye and Mind," in *The Merleau-Ponty Aesthetics Reader: Philosophy and Painting*, ed. Galen A. Johnson, trans. Michael B. Smith (Evanston, IL: Northwestern University Press, 1993), 125.

4 Margaret Jourdain (ed.), *Diderot's Early Philosophical Works* (Chicago and London: The Open Court Publishing Company, 1916), 77.

5 Eric Jorink and Bart Ramakers (eds), *Art and Science in the Early Modern Netherlands* (Zwolle: Waanders, 2011), 169.

6 Monika Auch, "3D printen: het nieuwe ambacht?" [3D printing: The new craft?], *kM tijdschrift* 79 (2011): 20–3.

7 Monika Auch, "Antieke pilaren en algoritmische zuilen, de computational method van Michael Hansmeyer" [Antique pillars and algorithmic columns, the computational method of Michael Hansmeyer], *kM tijdschrift* 85 (2013): 16–9.

8 For the video "Weaving Proxyclones." http://www.monikaauch.nl/agenda [accessed June 22, 2015].

9 Ann Marie Shillito, *Digital Crafts: Industrial Technologies for Applied Artists and Designer Makers* (London: Bloomsbury, 2013).

10 Functional MRI (fMRI) is "a non-invasive tool for studying brain function, both in healthy volunteers and clinical patients." http://www.ed.ac.uk/clinical-sciences/neuroimaging-sciences/about-us/imaging-techniques/functional-mri [accessed November 17, 2015].

11 Electroencephalography (EEG) is "the recording of electrical activity along the scalp." It "measures voltage fluctuations resulting from ionic current flows within the neurons of the brain." http://www.ed.ac.uk/clinical-sciences/neuroimaging-sciences/about-us/imaging-techniques/electroencephalography [accessed November 17, 2015].

12 Monika Auch, "STITCH_MY_BRAIN," paper presented at Impact 8 International Printmaking Conference "Borders and Crossings: The Artist as Explorer," University of Dundee, August 28–30, 2013. http://www.conf.dundee.ac.uk/impact8/people/biographies-2/monika-auch/ [accessed February 7, 2015].

13 Betsan Corkhill, *Knit for Health & Wellness* (Bath: FlatBear Publishing, 2014).

14 Monika Auch, "The Intelligent Hand," keynote presented at symposium "Beyond the Toolkit: Understanding and Evaluating Crafts Practice for Health and Wellbeing," Falmouth University and Arts for Health Cornwall, February 19, 2014. http://www.falmouth.ac.uk/content/beyond-toolkit-keynote-speakers [accessed June 21, 2015]

15 Tim Ingold, *The Perception of the Environment: Essays in Livelihood, Dwelling and Skill* (Oxon: Routledge, 2000), 347.

16 Ingold, *The Perception of the Environment*, 348.

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Plate 7 An Installation at the Museum Vrolik for Anatomy and Embryology in Amsterdam in 2011. It shows a 3D woven object of the embryologic series together with a fetus in the museum's collection. Photograph: Monika Auch.

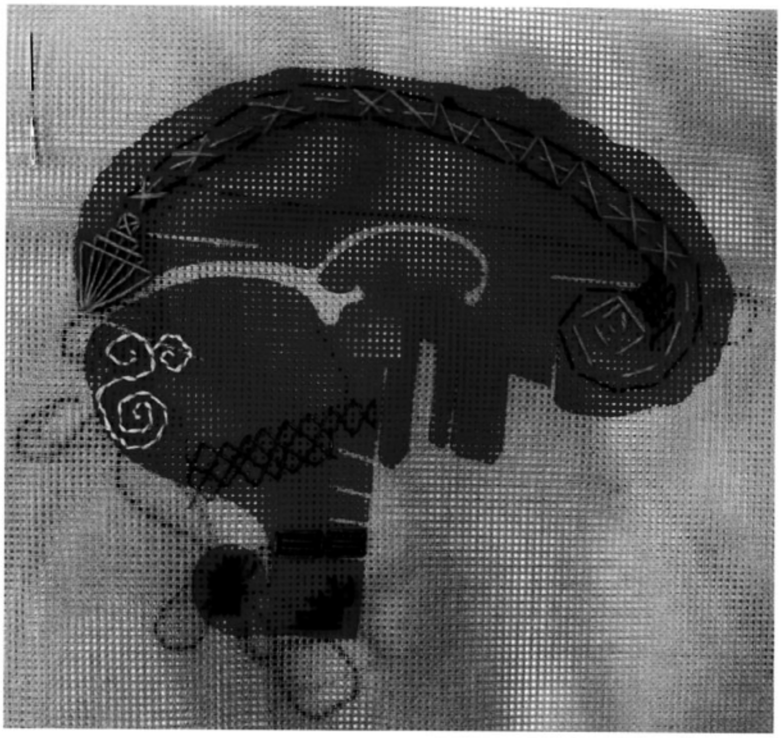

Plate 9 Stitched brain. The interpretation of a brain by a Dutch high school student during a workshop. Photograph: Monika Auch.

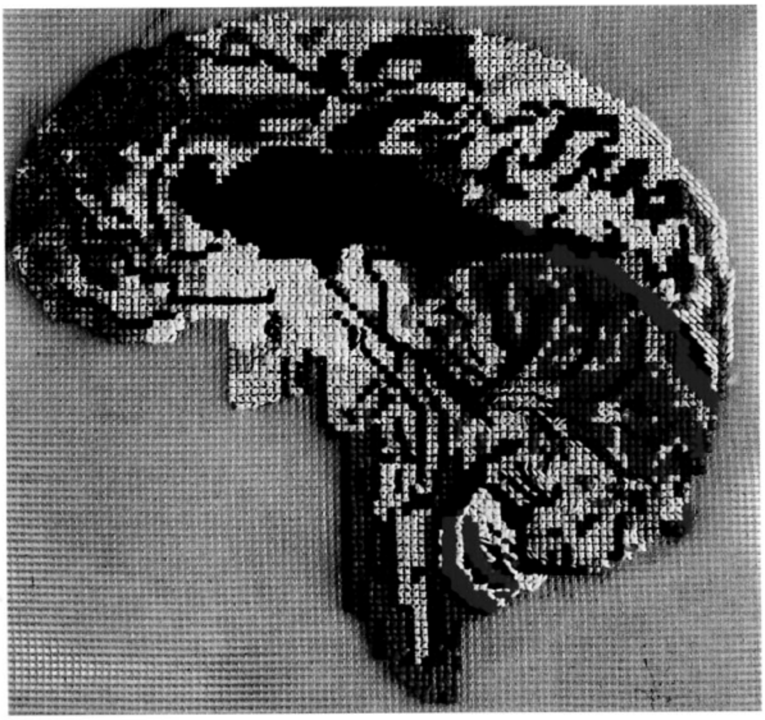

Plate 8 Stitched brain. The needlework of printmaker Jo Ganter from Glasgow, reflecting her very subtle graphic work. Photograph: Monika Auch.