OUT OF TOUCH WITH REALITY

A PLEA FOR THE RETURN OF CRAFTSMANSHIP TO ARCHITECTURAL DESIGN AND AGAINST THE (OVER-)USE OF DIGITAL TOOLS

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T. van den Brom

tijsbrom@gmail.com

4063953

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Tutor: A. Radman

“All art forms – such as sculpture, painting, music, cinema and architecture – are specific modes of thinking. They represent ways of sensory and embodied thought characteristic to a particular artistic medium. These modes of thinking are images of the hand and the body, and they exemplify essential existential knowledge. Instead of being mere visual aestheticisation, architecture, for instance, is a mode of existential and metaphysical philosophising through the means of space, structure, matter, gravity and light. Profound architecture does not merely beautify the settings of dwelling: great buildings articulate the experiences of our very existence.”- (Pallasmaa, 2009, p. 19)

PREFACE

In this thesis I want to investigate a subject that is related to myself as an architect. During my studies of architecture I've experienced difficulties with using a computer. Especially during the design process, within the projects I could not find the time and energy to learn to use design programs. It did not feel comfortable to me to design with these programs, and as stubborn as I am with my pencil and crafting supplies, I have always completed my projects with those tools. Developing a project entirely by hand takes a lot more time than doing so with the computer. Because of this, I have always felt that I actually should have focused more on learning how to use design programs.

However, I saw a lecture on the Internet by Erik Scherder, called "Gaat je geheugen kapot, als je teveel voor je computer hangt?" ("Will your memory break if you spend too much time in front of your computer?") (Scherder, 2013). His lecture was about the importance of bodily motion to your memory. As an example he mentioned how students go through their day without undertaking any effort to provide their body with any exercise. Instead they are sitting behind their desk all day, constantly working on a computer.

This made me wonder whether the use of a computer during the design process is actually good for us or that it might affect our work or our learning process. This is an important research, because it could lead to a different attitude against using the computer in the Faculty of Architecture and that's where the foundation for the future of architecture is laid.

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1.INTRODUCTION

At present the computer is an important tool in the faculty of Architecture. Multiple courses are given to learn about different design programs and it is expected that these programs are used during projects as well. Likewise, computer skills are demanded by architects when they want to hire graduated students. That is why it is important to know what the effects are of the use of computers on the creativity of an architect.

A brain is allegedly triggered when a person is making movements. Parts of the brain are stimulated that also encourage the creativity. This means that the creativity is actually decreased when you're sitting behind a computer - and you are only making small movements with your hands - in comparison to taking an excursion to site, or making a real 3D model or even hand drawing.

Activating the brain, is using your senses. By using multiple senses more parts of the brain are stimulated and the information that is stored in your brain is better preserved. This is due to the fact that the memory does not only consist of images, but also of sounds and smells for example. And again, the activated brain stimulates the creativity of a person.

When working on the computer you are seeing what you are doing, but the other senses are shut down. The movements you are making with the mouse and on the keyboard are very small and they do not correspond to what you are actually designing in the computer. When drawing, the movements do correspond to the design, so you are sensing not only with your eyes, but also with your hands. Therefore, by handcrafting and drawing the brain is stimulated more.

Now, at what stage of making a good design is creativity most important? In the beginning of the design process a lot of design choices need to be made and creativity is needed most. At the end of the design process the design is already there, but it needs to be elaborated and presentable. Here, less creativity is needed and the computer could be a great tool to work out the

design. It will give you neat images and you can be more precise. But is this what makes an architect a good architect? Isn't the first part of designing – actually coming up with a design – the foundation of profession of an architect? That is why the Faculty of Architecture should focus more on this part of the design and thus on enhancing the creativity of their students.

This beautifully sums up the point of the argument made in this thesis: creativity is encouraged by using multiple senses. The senses are stimulated more by handcrafting than by using the computer. Being creative is an important part of being an architect. Therefore in the Faculty of Architecture, there should be a lot of emphasis placed upon handcrafting in comparison to design programs. The arguments stated above, are explained extensively in the following chapters.

The next chapter will tell you how creativity exists and where it comes from, by the importance of using your senses. It is told through my own experiences in creating a design and is further explained by the theories of other design philosophers such as Juhani Pallasmaa, Bryan Lawson and Kees Dorst. Chapter 3 gives you a more complete image about the existence of creativity in our brain, by explaining how we process information through different senses. The last chapter will demonstrate the relevance of this topic today and the nearing future and what we should do about it.

2. SENSES AND CREATIVITY

This chapter serves as a short summary of the design process: what happens in your brain when you come to a design, and where does creativity come from? There are not necessarily clear-cut answers to these questions, not yet at least, but I found it to be important to understand the basics of creative thinking, especially how it relates to our senses. After all, what we see and how we remember it constructs our own ideas of beauty, of what the world looks like, and what we feel we can add to it. It is perhaps unique to the architect that he or she sees past the façade more easily, and is able to understand the way something is constructed and to come up with something new.

2.1 LEARNING BY DOING

As Juhani Palasmaa is saying: “Learning a skill is not primarily founded on verbal teaching but rather on the transference of the skill from the muscles of the teacher directly to the muscles of the apprentice through the act of sensory perception and bodily mimesis.”(Pallasmaa, 2009, p. 15). What he means is that it is not enough to be taught the pure theory, but also to practice the profession you want to learn to be more creative. So an architect needs to practice, but how is creativity exercised? Juhani gives a clear answer to this question in *The thinking hand*:

> Gaston Bachelard writes about the imagination of the hand: ’Even the hand has its dreams and assumptions. It helps us to understand the innermost essence of matter. That is why it also helps us imagine (forms of) matter’. […] Creative capacity as well as ethical judgement call for imagination. It is evident, however, that the capacity of imagination does not hide in our brains alone, as our entire bodily constitution has its fantasies, desires and dreams. […] All our senses ‘think’ and structure our relationship with the world […] the sensory and embodied mode of thinking is particularly essential in all artistic phenomena and creative work. (Pallasmaa, 2009, p. 17)

So, Juhani states that to be able to imagine and thus be able to be creative, you can not only use your brains, but you have to use your entire bodily constitution, for example your hands. This is called embodied mode of thinking. Next to a sensory mode this is very important for creativity.

An example of an architect who is using handcrafting to be creative, is Renzo Piano. “Piano explains his craftsmanlike working methods as follows: ‘You start by sketching, then you do a drawing, than you make a model, and then you go to reality - you go to the site - and then you go back to the drawing’.” (Pallasmaa, 2009, p. 66)

Thus, to exercise creativity, it is wise to use your hands by drawing, sketching, modelling, tracing the drawings of others, and relying on as many different senses as possible when working. This should be done elaborately during your education or studies, because you have to do so, to be able to learn.

2.2 PARALLEL LINES OF THOUGHT

2.2.1 My Design Process: Uncertainty in Design

An essay I wrote previously (Brom, 2013) was about the difficulty of not knowing yet what a design will look like, yet at the same time, having to make decisions that shape the eventual design. This paradox, where you need to make the biggest design choices when you know the least, I called the 'uncertainty of designing'. In order to come to a finished design an architect needs to deal with this paradox.

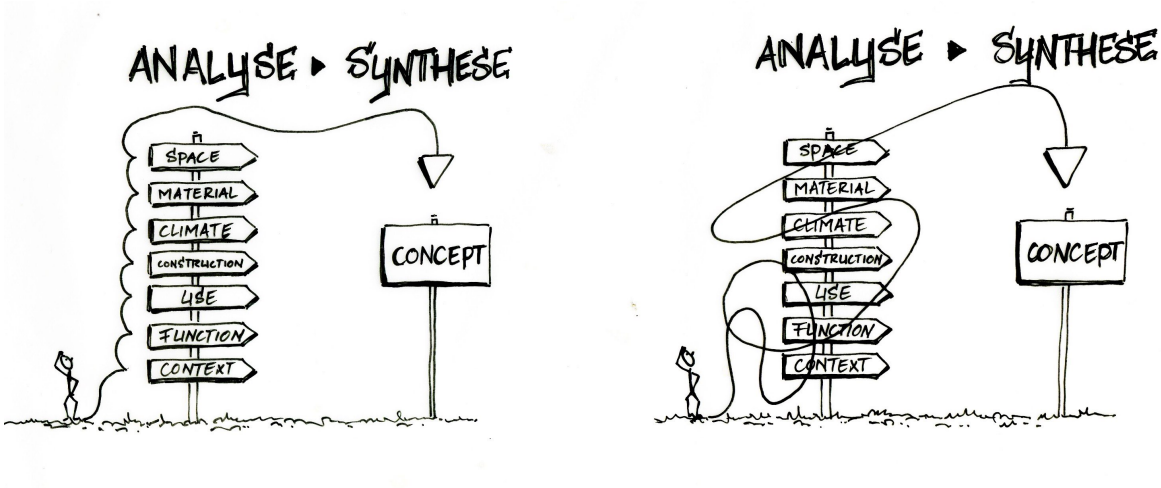

Figure 1: Working methods, own illustration (van den Brom, 2013)

When you are a student of architecture, you are looking for the ideal way to do this. That involves teaching yourself how to design best, how to put your process in perspective and how to communicate your idea to others. After doing some projects you'll start to recognise your way of dealing with all the requirements of the assignment and delivering a final design. In figure 1 the design process is drawn up. On the left you see how I wanted to under-

take one of my bachelor projects, ‘BK6004 Rmit’. On the right is shown what really happened during this project.

I can conclude that my methodology is quite chaotic. I worked on all different aspects of the assignment at once: reading literature, making drawings, and models, listening to different people with something to say about my assignment, and so on. By doing all of this together I tried to connect all of the different aspects of the assignment. Although on paper this seems very chaotic, it is really hard to make a well-functioning design using the method on the left of figure 1.

Elise van Dooren is a teacher at the Faculty of Architecture. In a lecture she explains this as follows: An assignment can be very complex, to the point where it becomes difficult to make your way through; a large variety of factors need to be taken into consideration, including but not limited to because you have to take into account: space, form, composition, material, climate, construction, use, function, context, routing et cetera (van Dooren, 2012). And if you change one aspect, like for example the use case for your design, aspects such as indoor climate or routing will change as well. So to be able to use the organized path on the left of figure 1 is unlikely.

In my research I found a description of Brian Lawson, psychologist, architect and design researcher, about on how to design. He called working on different aspects or domains at the same time ‘Parallel lines of thought’. He said: “The more experience you have, the more parallel lines of thought you can handle” (Lawson & Dorst, 2009, p. 60). This is visualised in figure 2. The coloured lines illustrate the parallel lines of thought and how they eventually lead to a solution for all the aspects.

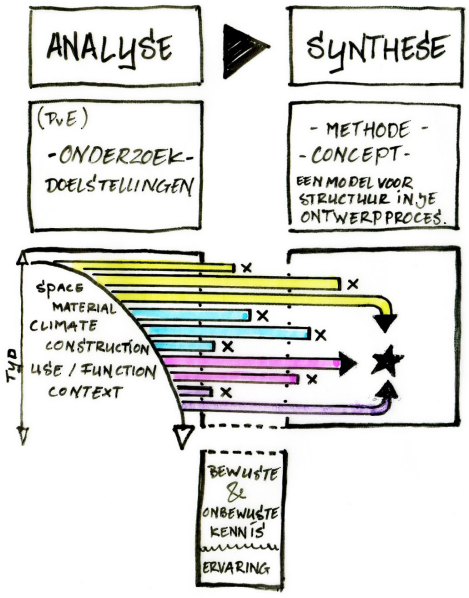

Figure 2: Parallel lines of thought, own illustration (van den Brom, 2013)

Parallel lines of thought exist by overseeing all the domains and seeing connections between the different aspects. These connections are easily seen when you draw a line on your paper or fold a piece of carton in a certain form. Because drawing the line is evoking all the experiences in your brain that relate to this line. So you are activating your brain on every domain you have worked on and parallel lines of thought are created.

2.2.2 Design Sketching Activity

In '*Design Expertise'* by Bryan Lawson and Kees Dorst they call this way of working, using sketching and making models to be more creative, the 'Idea-Sketching-Activity' where: "The designer fluently moves from making a proposal towards stepping back and reflecting upon it, and deciding on a modification, all in one flow. This can happen on a split second timescale."(Lawson & Dorst, 2009, p. 58) So it is much easier to reflect on yourself when you are making a sketch, going back and forth between new proposals - adding lines to your sketch - and reflection. Reflection is very important for creating parallel lines of thought: "Reflecting on your self is good for understanding the problem you are working on because you are judging your sketch through every domain you have already thought. Judging when to drop some of the ideas or resolve the conflicts between them seems to be one of the key skills required for creative design."(Lawson & Dorst, 2009, p. 59) This brings us to the main conclusion of this part: parallel lines of thought are leading to a more creative design.

"Travel and sketching, long a mainstay of architectural training, remains the quintessential way to see and feel firsthand what it means to understand architecture in a material and structural sense." (Mallgrave, 2011, p. 217) So, by seeing your design from different point of views, by sketching, modelling, hearing, watching and so on, you can solve the problem one piece at a time. By constantly trying to reflect the design on every aspect, one can better understand how the design can be better for all aspects.

In conclusion, the best ways to create as many parallel thoughts as possible is to revive all your experiences and knowledge. The best way to recall these experiences is through the idea-sketching activity. Now you are able

to make connections between domains or aspects. Working on a design in many different ways will give you a more comprehensive view on what you are doing, which will inevitably lead to a better design.

2.3 BERLAGE & THE MULTI-SENSORY EXPERIENCE

2.3.1 BERLAGE'S JOURNEY

The use of multiple senses is described well in the book *'Reisherinneringen van Berlage'* written by Herman Bergeijk, about Berlage's journey to Italy. When Berlage was 24 years old, he was going on a study trip to Italy. Once there, he tries to capture how the people lived in their own environment. He accomplished this by first observing the people very carefully, simply by looking at them. He wrote down in text what he experienced and also made sketches and impressions.

The study did not only describe what the city looked like and how the people were moving through town, but it also included the way the city smelled, the noises he could hear and the textures of the different materials he encountered. Berlage's descriptions are very comprehensive with a great eye for detail. By adding all the other senses and not just relying on sight, the reader has the feeling to be actually present in Italy themselves. By using all his senses, Berlage was trying to capture the best image of what it is like for a person who lived there. This provides complete context of what is important in a certain environment for certain users.

> H.P. Berlage. Reisschetsen Italië. Bij Pisa, 1880. Collectie NAi / BERL 289

Figure 3: Sketch of Berlage (van Bergeijk, 2010)

> H.P. Berlage. Reisschetsen Italië. Kinderen bij de Concordia tempel, Agrigento, 1881. Collectie NAi / BERL 289

Figure 4: Another sketch from Berlage (van Bergeijk, 2010)

As is mentioned on the page before, Berlage came back, not only with an elaborate story, but also with a bundle of sketches. So not only has he tried to understand his environment by using multiple senses, he also tried to capture this by using more than one way to communicate the information. The essence of his surroundings is not only written down, but also captured in images. It provides a complete impression of the places Berlage occupied (van Bergeijk, 2010).

2.3.2 Sensing Experience

Doing a study trip as Berlage is an example of using all the senses you have. You see the people, the buildings and their context. You hear the people moving around, you touch the food, and you taste how good it is.

Harry Francis Mallgrave, a professor of Architectural History and Theory at the Illinois Institute of Technology, is elaborately describing the effects of using your senses in the book *The Architect's Brain: Neuroscience, Creativity and Architecture*. He states:

> In a purely tactile sense, we experience architecture in numerous ways, as many writers have discussed. In walking across a tiled floor or the gravel of a garden, our feet experience the texture and relative character of the material we engage […]. Tactile sensations stimulate areas of the visual cortex associated with visual imagery. […] Among them light and shadow, color, texture, grain, repetition, contrast, coherence, transparency, temperature, sound, scent and sight. (Mallgrave, 2011, p. 203)

It is mentioned here that our brain actually works better when using multiple senses, but this is discussed later in the thesis. The point is that architecture is not experienced by our eyes only, multiple senses contribute to the total experience of a building.

So when you are combining all your senses, you use them to create an extensive multi-dimensional memory that includes all the different elements of a space. Whereas, if you were to look only at a picture of a city, only your eyes are stimulated, resulting in a more one-dimensional memory,

because it does not include any of the other senses. This results in memories that are less distinct. When more senses are used, more parts of the brain are activated and a memory is better imbedded in the brain. During the design process, these multi-dimensional memories can be very convenient. When you have visited the site, instead of only looking at pictures, you will be much more capable of remembering what it is like. However, also reference projects or old designs will be much easier to use, when the memories of it are more intense.

When drawing a line or making a model, you are using more than one sense. You can see your design in front of you, feel the texture of the paper or model and you sense the movements that are needed to finish the drawing or model. These drawings and models will be better embedded in your brain, because they are stored with the use of different senses. When you are further along in the process, all your design steps will be clearer to you; you will remember them more easily. This will eventually lead to a better design.

Mallgrave also says:

> The skin, and its sense of touch, is the site of our most intimate communication with the world and is, at any age, the essence of our emotional well-being. […] We often need to hold and feel an object in order to understand it. We can do so, because of the incredible discrimination of our tactile senses and their capacity of evaluate weight, pressure, texture, temperature, hardness and softness. (Mallgrave, 2011, p. 202)

So instead of our eyes, he says, the skin is the most important sense we have, considering an emotional perspective. Compare the difference between making a 3D model in the computer, where you cannot touch it, and making a 3D model by hand, where you can feel the design that was in your head. From an emotional point of view one could design better in the second case. Even when sketching a 2D image of a design, you can still feel

the movements of your arm that can tell you something about the shape for example.

To continue, this paragraph explains the importance of one's senses in the storage of memories. When multiple senses are used, a multi-dimensional memory is created that is much better embedded in your brain and the memories are more comprehensive. These memories can be very handy in the creative process of a new design. You use your senses much more when you are sketching or modelling than when you are working with a computer. Emphasising this even further, the senses - especially the skin - are helping creativity as well. By using your senses, more parts of the brain are stimulated and more connections can be made between different memories. This can be used to have more 'multiple lines of thoughts'.

3. NEUROSCIENCE AND CREATIVITY

Now we know that creativity cannot arise without the use of bodily movements and sensing experiences. So how does this phenomenon work and what is happening inside your head? Thanks to new technology, where we are able to make scans of the human brain, we can do experiments and we can actually measure the neurological activity. In the following section you will be taken on a journey through the neurological path of the human brain, to understand how information is processed. This chapter consists of the more technical detail behind chapter 2. Here, neuroscience is used to show that creativity is enhanced by using handcrafting methods.

3.1 CREATIVITY AND THE HUMAN BRAIN: AN INTRODUCTION

The moment when one sees a connection between different lines of thought is a moment of a creative peak; call it the ‘Eureka’ or ‘Ah-ha!’ moment. But where does this actually come from? To understand how these connections come together, it is a matter of looking at the activity of the brain, and to understand how different parts of the brain communicate with each other.

There has been so much written in the past about what creativity means, where it originates from and how it works exactly. All these theories are based on experiences and opinions. Never has there been a comprehensive scientific explanation about what creativity really is and where it comes from, because people have not been able to properly observe brain process activity - until now. Thanks to the marvels of technology we now have the capability to scan our brain in high-resolution 3D images when the activity of a ‘Eureka’ moment happens. (Mallgrave, 2011, p. 171)

3.2 RECEIVING VISUAL DATA

How the brain works when receiving a creative idea is very complicated to explain. An experiment on this matter has been conducted in 2006 by a team of neuroscientists of three universities, led by John Kounios and Mark Jung Beeman. Multiple subjects were given a series of word problems that demanded a series of semantic association; meanwhile the neural activity was followed with scans. At first, the scans showed activity in multiple areas in the left hemisphere, these areas focus for example on keeping attention and processing language. But when a word problem could not be solved with the use of the left hemisphere only, also parts of the right hemisphere became active. That is when the Eureka moment takes place and the word problem is solved by the subjects. So, the right part of the brain is able to solve a problem, when the left part is failing. What is the difference in the working of these two hemispheres? The right hemisphere has the ability to

generate larger associative patterns or recognize new connections across existing knowledge, so it is able to come up with a more creative solution. (Mallgrave, 2011, pp. 171-172)

Thus, for creativity we should look to the right part of the brain. This thesis focusses on the idea that the use of multiple senses will increase creativity (and therefore the use of handcrafting methods). This part explains what happens with the signals that are coming from the different senses, how they are stored and how the brain is using its right hemisphere to come up with more creative solutions.

Let us start by showing what happens with the visual data that comes from one sense only, the eyes. Below the neural path is explained where visual data is processed, which leads from the eyes to different parts of the brain.

3.2.1. Processing Visual Data

The way by which the brain processes visual data is on itself a complex and impressive process. As an example, there's actually a difference in seeing pictures on the screen and seeing actual real life, simply because our brains are advanced enough to distinguish between reality and a reproduction of reality.

So, what actually happens when we see something? The process is summed up by Mallgrave as follows:

> Seeing an object, light will be reflected of the object through the lens of your eyes stimulating the retina nerves of the eye. These optic nerve cells are the messengers of this visual information and are further transmitted to the area at the back of the brain, known as the visual cortex. Nerve cells are unevenly distributed along the surface of the retina and thus selectively favour or distort the information. (Mallgrave, 2011, p. 139)

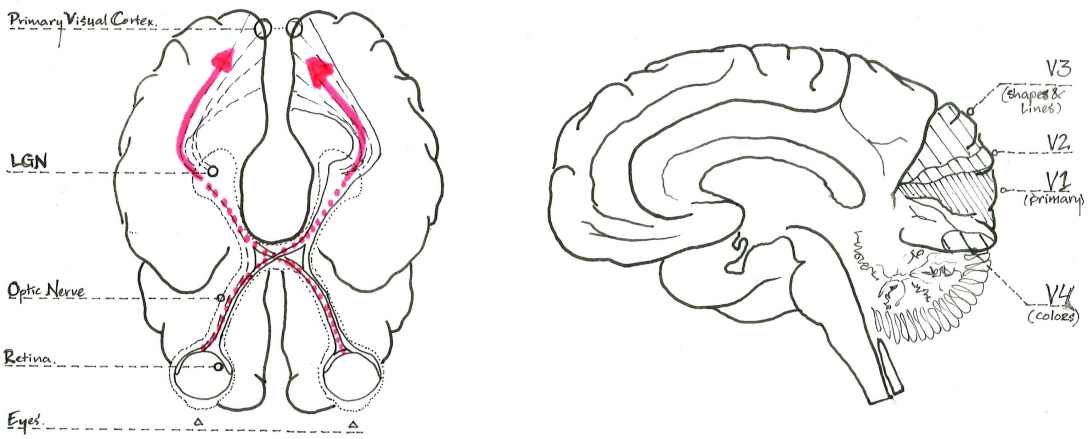

Figure 5: Own illustration, Cross Section of the Brain, (van den Brom, 2015)

The visual data that is gathered by the eyes is sent to the back of the brain first, where the information is processed in multiple small parts of the brain, denoted by V1 to V5 in figure 5.

When visual data reaches the visual cortex, the data will be reorganised in both hemispheres of the brain in a highly selective way. The area that will do this organisation is the V1 area. It arranges the information/data impulses by type and then transmits it further to the adjoining area V2. V2 collects the visual data from both hemispheres and continues processing the data into different characteristics, as in contrast, edges, depth and shape, showed in figure 6. Area V3 processes the shapes and the orientation of lines in motion, where V4 is busy with organising color, curved lines and some angled lines. Area V5 is specialised in the stimuli process of motion and an even greater part of this area is specialised in facial recognition. V1 - V5, showed in figure 5, are the early stage of your visual perception. After this stage, the data will be sent to other adjoining and geographically distinct areas of the brain, like the temporal or parental lobe, where further selective processing will take place. (Mallgrave, 2011, pp. 142-143)

To conclude, in V1-V5 different parts of the visual data can be found in the different areas and this information is stored there as well. This is shown in figure 6. Visual data concerning color is stored in one area, shapes are stored in another part, etc. Now the sorted visual data is ready to be processed in other parts of the brain.

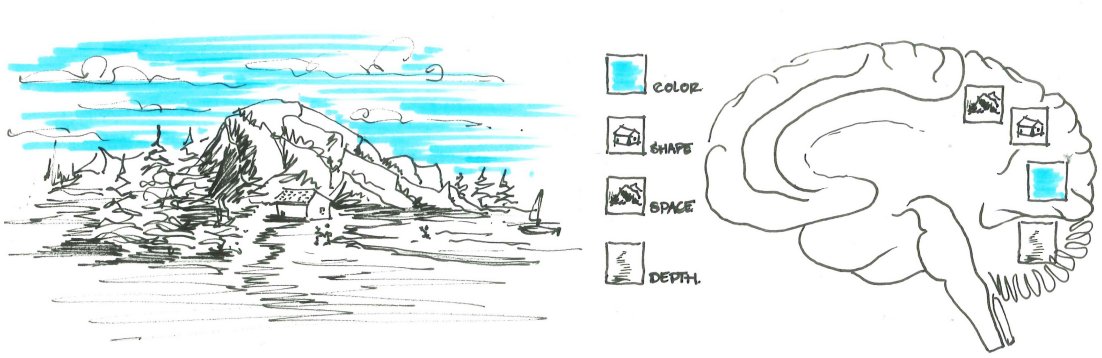

Figure 6: Own illustration, Visualizing Process in the Brain, (van den Brom, 2015)

3.2.2. Linking Visual Data to Other Senses

The other senses are processed in a similar way, and also their information is sorted, in a way that it can be processed in other parts of the brain. The parts of the brain that are processing the sorted information of one sense are actually also the parts of the brain that are processing the information of another sense. Below a few areas are mentioned that gather visual information.

The temporal lobes;	This area gathers information about form, color and recognition of objects.
Parietal lobes;	This area stores the data about space, motion and depth.

These areas also gather information that comes from other senses.

The temporal lobes	This part obtains data about language comprehension, emotion associations, high-level auditory procession and visual memories.
Parietal lobes	This area gather data on touch on skin, touch localisation and language processing.

(Wikipedia, 2015)

So the temporal lobes gathers certain visual and auditorial data and the parietal lobes gathers visual, auditorial and tactile data. For information on emotion associations all the senses can deliver certain data. So now we have

information from multiple senses in one part of the brain and this will come in very handy when we want to make well-embedded memories. Because by making memories you link the information together by creating new neural pathways. When you repeat this process, these neural pathways are forming a pattern or neural circuits, which you can understand as forming memory of the object. When information is stored close together, these neural pathways are short and easily made. During this process, more pathways are created and the memories will be better stored. And because the information that is close together is coming from different senses, the memory that is created contains much more different types of information. Now, even more pathways are created, because this information can be linked to other stored information in the brains as well. (Mallgrave, 2011, pp. 202-206)

Remember the first part about the experiment with word problems, where the right hemisphere seemed to be the creative part of the brain. Mallgrave explains this as follows:

> The fact that a word problem is solved not in the language area of the left hemisphere but rather in the right hemisphere is significant in itself, but so too is the researches conjecture that the ACC, aware of the failure of the language to solve the problem, turns the matter over to the right hemisphere of the brain, were a "coarser semantic coding" (the ability of the brain to generate larger associative patterns or recognize new connections across existing knowledge) allows a more creative solution. (Mallgrave, 2011, p. 172)

Here is stated that the right brain is capable of recognizing new connections between existing knowledge, so it is creating more neural pathways itself. When already so many neural pathways are formed as possible, it is easier for the brain to create new neural pathways. Therefore, creativity is enhanced when memories are created using many neural pathways. As described above, this is done best when using multiple senses.

3.3 TOUCH VS. VISION

The level of complexity required for processing visual data in your brain holds true for other senses as well. Touch, for instance, is a well-defined process, where a part of your cortex receives signals from the fingers. Recognising touch on the skin takes place in your Parietal Lobe. The processing path from your fingers to your Parietal lobe is a much larger processing area, but works even quicker than processing visual data. (Mallgrave, 2011, pp. 142-143)

So, if you both look at and touch an object, the tactile part of the object is perceived in your brain before its color, which in turn is perceived before form, motion and orientation.

An interesting theory by Juhani Pallasmaa, is that as we see with our eyes, we are unconsciously experiencing with touch as well. When we look at something, he writes:

> […] in our minds we touch it before we ever actually do; before we really look at the object, we have already touched it, judged its weight, temperature and surface texture. Both our eyes and hands are constantly working together. Like when you are drawing, your eyes are carrying your hand to the right place on the paper, and the hand informs the eyes at an intimate scale. You can say touch is the unconsciousness of our vision. And this hidden tactile experience determines the sensuous quality of the perceived object. (Pallasmaa, 2009, p. 102)

Pallasmaa thinks that tactile judgement is used when we are looking at something, remembering for example the texture that you have already felt in the past. Tactile judgement is done even before we have looked well at what we see. Tactile information is important for our vision. When the tactile sense is activated - instead of using only your memory to create a tactile judgement on something you see - tactile judgement will be more reliable and accurate.

On this subject, Pallasmaa continues “The sense of touch mediates messages of invitations or rejection, nearness or distance, pleasure or repulsion. The unconscious dimension of touch envision is ‘disastrously neglected’ in today’s visually minded Architecture and Design studies.” (Pallasmaa, 2009, p. 102)

To continue, using the above stated information, what can drawing by hand give us in comparison to modelling in the computer? When drawing, the tactile sense as well as the visual sense is activated, therefore more comprehensive information will be available for the brain. Next to this, hand gestures and touch follow a quicker neural path than vision. Which means that when you start making a design by drawing a line on paper, that line will be processed a split second before you can visualize it. With a lot of experience in sketching by hand, the idea of sketching activity is that your hands can think for you, this was also explained in chapter 2. Also tactile judgement is an important part of creating a vision in our brain, the best way to create an accurate judgement is by activating the tactile sense. So visualizing a new creative idea is done better and faster by using your hands.

3.4 PERCEPTION, MEMORY AND THEIR APPLICATION

But what do we use all of this information for, exactly? According to Darwin’s Theory of Evolution (Darwin, September 2003) we use the visual apparatus of the brain to acquire knowledge about the world in order to insure survival. Basically, we learn what in our environment threatens our survival quickly and early in life, because it helps us stay alive. It does this by selecting the essential properties of an object we need for survival. At first we discount all the information that lacks relevance. We then compare the selected information to our past experiences. Comparing this information is the same as recognising the pattern in our neural pathways. We approach every act of visual perception with stored visual records of forms and

colours, which we develop in our lifetime. What this also means is that the patterns we have developed will affect our future perception and new images we acquire.

Semir Zeki, a British neurobiologist who has specialized in studying the primate visual brain and more recently the neural correlates of affective states, tells us that “the brain is only interested in obtaining knowledge about those permanent, essential, or characteristic properties of objects and surfaces that allow it to categorise them.” (Mallgrave, 2011, pp. 142-144)

Memory comes through understanding all forms of learning, resulting in synaptic changes, and the communications between our nerve cells. Memory has no specialised area to call its own in our brain, a theory based on the research of Donald Webb. He tells that the memory is scattered throughout the brain, within its neural circuits, made up of different elements of perception. (Mallgrave, 2011, p. 161)

Imagine you are on a journey, just as Berlage in Italy, and you have visited a number of temples. When you got back home and think back to these temples, your perception of these experiences is myriad. You have seen the pattern of horizontal and vertical lines, the color of the materials that were used, the reflect of sunlight on its surface, the scale of the build elements, the formation of silhouettes and ornamental reliefs. You touched and experienced the heat of the Mediterranean while you climbed the stairs. All these stimuli through different senses are processed in different areas of the brain, but together they form your memory of a place.

After the first temple you have visited, the next temple you will experience will offer some recognition because of your first experience. Imagine you have visited the temple of Venus, in the center of Rome, and you are now standing in front of the Temple of Portanus. The smaller scale of the Portanus will give you a better appreciation of the Temple of Venus. And after seeing the Parthenon you are better allowed to imagine its former glory.

Experiencing and processing all of this multi-sensory input has led to you creating a pattern of neural circuits. This means that you have linked these experiences together as a whole. The pattern of neural circuits is the memory you have created. With the new scanning technologies we are now able to see what happens in the brain if we think back to this memory, and as it turns out, the scans show the same activation of this created neural circuit as when you first experienced it. In short: a multi-sensory experience creates a more comprehensive pattern of memory, and research shows that remembering something is very similar to actually living that moment. Also, the more disparate elements you remember of a place or thing, the more comprehensive your memory of it is, and the more it will inform your future memories. After all:

> The ability of the brain to recognise large association patterns across existing knowledge allows you to achieve a more creative solution. (Mallgrave, 2011, p. 172)

So the more we have experienced, the more patterns we have created. The better we have experienced information through different senses, the better the patterns are embedded, creating a memory. This allows us to handle more parallel lines of thought and thus to be more creative.

4. DRAWING BY HAND VS. DIGITAL DESIGN

The strides that have been made in understanding and analysing the way creativity, perception and the human brain function have laid bare an interesting contradiction, though: Over the last decade or two, the increase in computational technology has touched almost all aspects of daily life, naturally including doing research and production in a design-oriented sense. The architectural practice has been changed, almost to the point of being unrecognisable. Sure, there are a lot of benefits from the digitalisation of our society, which is undeniable and irreversible. Use of the computer and other digital related technologies support most aspects of architectural production with no doubt. “It is a tool of precise working, efficient with time and rapid drawing. It is good for doing analyses, testing and virtual prototyping. Working with the computer is the answer to rapid working, easy communication and structural calculating.” (Pallasmaa, 2009, p. 95)

However, keeping in mind the way that complex memories originate by incorporating multiple sensory inputs, a problem arises.

“The hand with charcoal, pencil or pen creates a direct haptic connection between the object.” Juhani Pallasmaa (Pallasmaa, 2009, p. 96) So you are creating a deeper connection with the object you are designing by using hand tools.

The computer is a whole different tool than we are traditionally used to. By traditional I mean sketching, drawing and other crafting methods. The difference between the old school methods and the new ones is that the old methods show the passion of the designer where they express his or her assurance, hesitation, boredom, excitement, affection, repulsion and their own judgment in their work through labor. Every move he or she makes or how the line is drawn carries a meaning or thought. (Pallasmaa, 2009, p. 100)

When drawing a line on paper you can think a step ahead in a split second. Compare that to working with a computer, where a button has to be clicked

to make a line appear, which is then moved with the mouse to get a bending curve, and later moved again to the right coordinates. With more difficult shapes, this process can become quite convoluted, so thinking ahead becomes progressively more difficult. Moreover, seeing connections between the line you have drawn to other domains is far more difficult, because you are limited by the possibilities of your design skills with the computer when you want to create something new, rather than designing purely with the mind and a simple tool like a pencil, where every design ranging from the really simple to the impossibly complex is achievable with the same toolset. When working with a pencil and a piece of paper, the tactile sensation allows you to relive every memory of a similar situation in that moment - after saving information you have experienced before in your memory, you are unconsciously making comparisons using these experiences when drawing new lines. In short, working by hand gives you the feeling that anything is possible.

> While working on a drawing you concretely touch all the edges and surfaces of the designed object with the tip of your pencil that has become an extension of your fingertips. The hand-eye-mind connection in drawing is natural and fluent, as if the pencil were a bridge that mediates between two realities, and the focus can constantly be shifted between the physical drawing and the non-existent object in the mental space that the drawing depicts. (Pallasmaa, 2009, p. 60)

It’s not just a matter of digital design having less physicality to it or how it relates to memory - there is also a more direct consequence to a focus on digital design. That is, the digital design process can be very convoluted and the relationship to what you are designing and how you have to make it in the design program can be vague.

4.1 THE FACULTY OF ARCHITECTURE, TU DELFT

On the TU Delft Architecture, the student experiences high work pressure, especially when working on a project. Often times students encounter the problem that on one hand they have little time to finish their projects, because there is a time limit to every project, while on the other hand they are made aware of the fact that a design is never actually finished and it can always be optimised. At a certain point a student needs to make decisions and start elaborating on the design that is present at that time, so it can be made into a finished and polished presentation. Due to the lack of time, students tend to stop designing and start drawing up the design rather quickly in the course of the project.

At the end of their studies, a student is expected to have gained knowledge about several different digital design programs, for example Rhinocerus, Grasshopper, Revit, Maya, Autocad (3D) and SketchUp. Architectural firms require their new employees to be able to work with all of these programs. During the study of Architecture only a small amount of time is reserved for getting to know these programs and the student is expected to do the rest with a lot of self-studying. Most of the time, this is required to be done during the projects, because the programs are needed to create the polished drawings for the end presentation. This means that a student will not only focus on the design process and design skills, but also on learning to work with a lot of computer programs.

This leads to the situation where students are already tempted to stop designing as soon as possible, so that they can focus on a polished end result. The focus is moved from having a properly contemplated design to making a well-displayed design. Therefore, students have less time for designing, and by learning a skill-set specifically because it is required of them by their future employer they lose time on the actual design process.

Naturally, the advantages of working with a computer for part of the process cannot be denied. They are more precise and capable of optimising and cal-

culating the specifics of a design better than people can. However, they remain useless at the start of the design phase, at the point when creativity is most important. People should rely on their own creativity and make the most of their creative capabilities, bettering them in the process. The focus of (the study of) architecture should shift from making a good-looking end result to a creative design process, using the old handcrafting methods as a tool both for the work itself and the inherent processes at the core of it.

4.2 DIGITAL DESIGN (IM)POSSIBILITIES

Designing with a computer program is a whole different type of thinking. The biggest difference is that the process of putting a line on paper with a computer takes a lot more steps than by using just a pen. When using a pen, the hand movement itself has a physicality to it, and the distance between thought and result is very short, making it easier to think ahead and have the design flow naturally from the process. When computing, on the other hand, the amount of steps increases manifold and the process itself becomes more and more counter-intuitive the more complicated one's design becomes.

On top of that, designing with a computer will limit you to the possibilities of a designing program, such as when drawing with limited like drawing with Revit or Google SketchUp. Parametric types of forms, for example, are really hard to imagine in this program, and you end up having to use a program such as Rhinoceros, which in turn won't deliver a nice render, forcing you to use the program Maya. This creates a work process that is very counter-intuitive, requiring a constant back-and-forth that ultimately takes away from the final result, because so much time is spent on getting the tools to just work.

To make the process easy and understandable, a lot of architecture firms only use Google SketchUp to design something quickly. But it also happens quite frequently that these Google SketchUp images are used throughout

the entire design process. What has happened here is curious: The unwieldy nature of digital design forces the users to fall back on an easier option, yet the one that is often chosen is still a digital solution, when an even simpler solution - one that, as established, carries profound advantages even beyond speed and ease of use - is right there: just pick up a pencil and start drawing.

4.3. RELEVANCE OF THE TOPIC

All of the above work together to cause a sort-of 'leveling effect', as laid out by Francis Mallgrave in *The Architects Brain*. 'The glossy paper on which nearly all presentations are printed is now standardised in width and quality, thanks to the limits of the printer in the computer lab,' a sentence that can be taken on its own merits, but obviously serves as an example with wider reaching meaning. The overuse of the computer causes would-be architects to lose their unique handprint, and the sense of reality is lost in an overload of cut-and-paste designs.

Most would agree that the focus of the Faculty of Architecture should, for all intents and purposes be on teaching valuable design skills. After all, the ability to create a design from nothing is what makes the profession of architect special. Everyone can learn how to make a 3D model of a certain building, but to create architecture from scratch is much more difficult. Creativity is an invaluable characteristic of the architect, because it will lead him to new solutions for (design-)problems that can be revolutionary. By putting too much emphasis on the visual appearance of the end result, instead of on the design process, the essence of the profession of the architect is lost.

> The duty of education is to cultivate and support the human abilities of imagination and empathy, but the prevailing values of culture today tend to discourage fantasy, suppress the senses and petrify the boundary between the words and the self. –(Pallasmaa, 2009, p. 20)

The design process should draw from many different disciplines; students should be pushed to incorporate hand drawings, modelling studies, excursions to site etcetera into their design process, thereby activating several thinking processes and deepening their engagement. These kind of methods need to be practiced. Therefore, next to lectures, the projects that a student encounters need to be used to practice the various aspects of designing.

The practical part is essential to be fully aware of what you are doing as an architect. Before the digital age we were forced to do so:

> The connection with the construction site and processes of construction has also traditionally been intimate in the architectural profession. Until the modern era that has, however, emphasised specialisation and the consequent separation of the architect from physical work of construction. The fact that being apprentice at the construction site used to be a mandatory of architectural education, and that architects often practiced a craft, drawing, painting or sculpture as a hobby or means of acquiring manual skill and carrying out formal experiments, reinforced the connection between professional architectural practice and the realities of making – between idea and matter, form and its execution. (Pallasmaa, 2009, p. 65)

You can say that without visiting the site where your design needs to take place, you will not have a realistic idea about the environment there. Understanding how people manage their life up and around is a very important aspect to take into account, they are the ones who will use your idea to live in. Above that part, visiting the construction site will give you more insight in how things are made, how builders cope with your ideas and how they make them real. Trying to ‘visit’ the site on your computer, will make your design more one sided, because only the sense of vision is used. This will enhance lesser neural patterns and this will negatively effect your creativity.

Working solely on a computer to realise a design severs exactly that connection, between idea and matter and form and execution. It can serve as a roadblock and a deterrent to creativity, as opposed to a tool that aids the process and improves its wielder.

5. CONCLUSION

New research into the human brain, the way visual data is processed and the way this constructs memories has shown that the more multi-faceted an experience is, e.q., the more senses are involved in constructing it, the better it allows someone to inhibit a space or object. This is invaluable in designing, because the same process makes that our past experiences inform our future ones, meaning that the better we remember something - again, by feeling, smelling, seeing, hearing, *sensing* - the more nuanced our future experiences will be remembered.

The digitalisation of our modern society, a process which has completely changed the field of architecture, brings with it an erosion of 'traditional' or old-fashioned techniques. The lack of tactile feedback from our computers leads to less engagement with the materials and with that blander designs.

Moreover, the time it takes students to familiarise themselves with the tools and techniques necessary to work with the wide variety of software required of them to know, takes away from time that should be spent on the design process. The most valuable talent of an architect is not his skill, but his ability to make good designs. An increased emphasis on working digitally and working *quickly* leads to an erosion of quality and personality in designs.

This all makes that the practice of architect has lost its connection to reality, to the actual physical properties that make up the buildings our architects should be able and excited to design. Berlage did not Google images of the Italian countryside, he actually went there, and experienced first hand the intense, multi-sensory experience of being physically present. This engagement is sorely lacking in today's teaching climate. Therefore, see this thesis as a call to action - a call for designers to go outside, to experience, to draw and make models, in order to create lasting memories that'll inform designs and life experience. To know the reality instead of the digital approximation of it, and to feel what is real.

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