Aspects of the Genesis of Linear Perspective

Pedagogical and theoretical comments on how sighted people and one blind girl perceive and draw a cube

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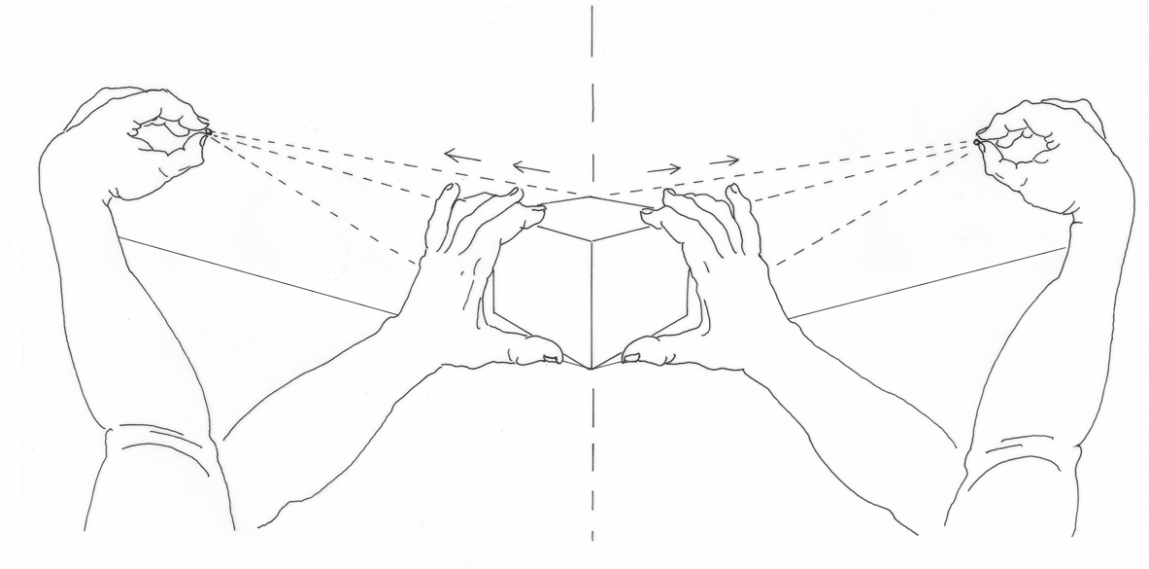

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- Pedagogical and theoretical comments on how sighted people and one blind girl perceive and draw a cube

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All illustrations by the author

Abstract: This article is a contribution to the study of how sighted and blind people perceive and draw cubes.
For many years the author has taught sighted people perspective drawing and published books in Scandinavia about drawing.
His point of departure in this article is pointing out typical obstacles sighted people run into seeing and drawing linear perspective. Blind people's conditions for drawing a cube are presented and compared with the ones sighted people meet.
The overall aim of this article is to contribute pedagogically and theoretically to explain a basic paradox, pointed out by professor of psychology John M. Kennedy, that blind people intuitively and rapidly seem to invent perspective drawing, a phenomenon sighted people in The Middle Ages used more than a hundred years to develop.

Introduction

In a very interesting article in "The New York Times Magazine 2002" "Even Blind People can Draw"[1] Daniel Zalewski writes about some of professor John M. Kennedy's surprising findings studying blind peoples depictions:

> "What has really shocked cognitive scientists, however, is that many blind artists seem to have the tricks of the Renaissance buried inside their brain. Foreshortening, vanishing points and other devices of modern pictorial realism – techniques that the artists in the Middle Ages lacked – can be found in blind art. At the Modern (Museum of Modern Art, MOMA, – BL) when Kennedy asked Carcione (an Italian girl living in Rome, born blind – BL) to draw a cube balanced on a point with three faces toward her, she began by drawing a Y-shape: three angels converging to a point. When a cube was placed in front of a cone on the table, Carcione drew the cone smaller, to convey distance. This discovery suggests that realistic art isn't just a nifty cultural invention: it is based on hard-wired systems of perception.
> But if that is true, why did it take Italian artists well into the 14th century to develop what Carcione came upon through intuition? It is still a mystery, but Kennedy theorizes that it has to do with the fact, that many blind people, out of necessity, develop an acute ability to

[1] "The New York Times Magazine", December 15, p. 88.

> imagine physical space. In other words, visual artists before the Renaissance were too bedazzled by sensory overload to grasp the fundamental architecture of pictorial space. If only one of those medieval painters had thought to close his eyes". (p. 88)

In the following I will comment on these findings trying to integrate some theoretical arguments and some of my pictorial experiences from drawing pedagogy, comparing the drawing-processes when blind and sighted people try to draw a cube.
It is my hope that these contributions might cast some more light on the mystery Kennedy points out supporting his theory:

> "… that many blind people, out of necessity, develop an acute ability to imagine physical space" (p. 88)

In this article I will therefore introduce the pedagogical strategy about drawing of 1-, 2 - and 3-point perspective[2], I developed in the late eighties in my book "PENCILDRAWING. An introduction to creative drawing". (Laursen 1988)[3]

Our bodies

Blind and sighted people share the phenomenon of the body: we are born as bodies, we live our entire lives as bodies, and finally we die and stop being a body. (Laursen, 2003)[4]. Existentially we have no other possibilities. Epistemologically that should be fundamental to all theories of human beings.
The multi-sensory qualities of our body seem to build an entity:

> "Not only do I use my fingers and my whole body as a single organ, but also, thanks to the unity of the body, the tactile perceptions gained through an organ are immediately translated into the language of the rest" (p. 317)

French phenomenologist Maurice Merleau-Ponty points (Merleau-Ponty 1962) to these foundational phenomenon – the importance of the multi sensory body – and this phenomenon you will find discussed as a point of departure in nearly all of his writings.
In his magnum opus "Phenomenology of Perception" (1962) he says what it means to understand space and time:

> "We must therefore avoid saying that our body is *in* space, or *in* time. It *inhabits* space and time" (p. 139)

And on the next page he continues to deepen his interpretation:

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[2] You can see an example of one point perspective in figure 5a-b, two-point perspective in figure 15, and a three-point perspective in figure 10.
[3] The basic principle in this book you can find in following article: Laursen, Bjørn – "Two different systems of drawing – outline and shading"
http://www.utsc.utoronto.ca/~psyc54/articles/laursen.html
[4] An English version of my "Paris in the Body"- article you can find on the address:
http://www.ruc.dk/upload/application/pdf/f51d6748/LaursenParisInTheBody.pdf

> "I am not in space and time, nor do I conceive space and time; I belong to them, my body combines with them and includes them. The scope of this inclusion is the measure of that of my existence" (p. 140)

Surroundings are always part in this inclusion:

> "Our body and our perception always summon us to take as the centre of the world that environment with which they present us" (P. 285/286)

Again he has a deep hermeneutic dimension to add:

> "…our body is not primarily *in* space: it is of it" (p. 148)

This body is the vital core, the anchorage:

> "To understand is to experience the harmony between what we aim at and what is given, between the intention and the performance – and the body is our anchorage in the world" (p. 144)

My method and strategy

Methodologically and theoretically this article is rooted in hermeneutical and phenomenological conceptualisation.
My strategy and progress in this work will be following:

- 1) Discuss a number of obstacles I have experienced for years teaching sighted people to draw 1-, 2- and 3-point perspective: it can be difficult for them to see perspective; it can be difficult for them to draw perspective, as well when they try to draw perspective a) looking at the surroundings, or when they try to draw perspective b) from knowledge of construction.

- 2) Compare these obstacles with the conditions under which blind people draw perspective.

- 3) Develop some hypothesis based on a symptomatic description of what I interpret as blind people's conditions, when they try to draw a cube. I will here try to use a method based on empathy, reconstructing and enacting how I, as a body – if I were blind – would experience these possibilities. I will constantly be very attentive to the existential fact, that as well blind people as sighted people are born as – and live all their different lives – as bodies

Limitations

This study is rooted in my pedagogical experiences and studies in perspective drawing for sighted people[5].
My hypothesis – concerning the part of it that refers to blind people's world – is primarily derived from deductive reasoning, imagining and experimental reconstruction.
I will also make it clear, that in this article I mostly deal with the task of perceiving and drawing a cube, and only to a minor extent I comment on more general aspects of drawing perspective in complex motifs.
Also, I only comment on one example, one drawing of a blind person, the Roman girl, who Kennedy worked with.

Obstacles for sighted people to see and draw linear perspective

What does it mean to perceive something? If we follow Kennedy's analysis (Kennedy 1993) we find following clear and complex explanation:

> "Perception occurs only when a chain of events is complete. The chain starts with an object in an environment and runs through to the actions of an observer in the environment. For vision, the object provides light – typically, light reflected from a few luminous sources in the environment. For touch, the object provides resistance – typically, resistance at a surface to compression. The actions of the observer, in the case of vision, include adjustments of the eye and changes of vantage point to gain more information about the object. The actions of the observer, in case of touch, include adjustments of the hand, the chief tactile organ. Theorists of touch often overlook other movements, which take touch from one vantage point to many others, all the while gaining more information about the object.
> Between the object and the observer's actions come many links. The complete chain is as follows: object; medium; receptor system; the nerves; brain reception; cognition; and motor areas (none easily distinguished from the others); and the adjustment and exploratory actions that change the vantage point." (p. 8)

If you look at figure 1, a sketch of a jumbo jet, an ink drawing I made in my note-sketching book when I was waiting to board, you may ask how your eyes perceive a motif?
Try to use this little sketch to study your eyes habits when you look at an object.
How much do you think you move your eyes when you look at an object?
What do you do in practice?

[5] I can add here, that I have made many experiments having sighted people drawing in absolute dark conditions with the equipment used by blind people

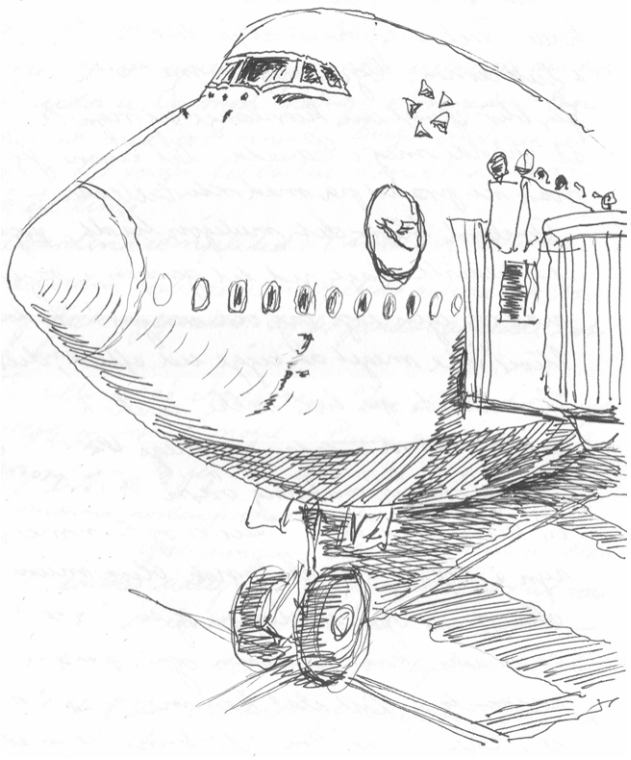

Figure 1. The pilots windows (is anybody in there?), the passenger windows, the logos, the wheels, the shadows, all these different areas are seen with your eyes moving into different positions. Please, make a check?

Obstacle. We move our eyes so much and so equilibristic that in most cases we do not notice at all. Did your visual study of figure 1 confirm this statement? It has become an unattended routine in our every day life. Following the vantage point discussion and the discussion of the movement of the eyes, it is absolutely vital to point out that we are also able not just to move our eyes, but also our head, and our body, and be moved (in a car for example). So we are used to the phenomenon of movement when we perceive, in fact so much, paradoxically, that it has become such a familiar phenomenon, that we tend to forget its existence! This might be a bit of an obstacle when learning perspective drawing. It might be a part of the explanation why sighted people are visually bedazzled.

A little experiment

I made a perceptual experiment trying to fix my glance, holding my head steady, gazing at a specific small area in the very same jumbo jet you have just seen.
In figure 2, I am sitting in a passengers seat, looking forward in the surrounding space.
I try to keep this fixed eye position, while I try to draw, what I am able to perceive visually, and realise immediately, that my habit of moving my eyes is extremely strong. I certainly have to force myself being very conscious to avoid moving my eyes, if I will study the “edge” of my visual field.

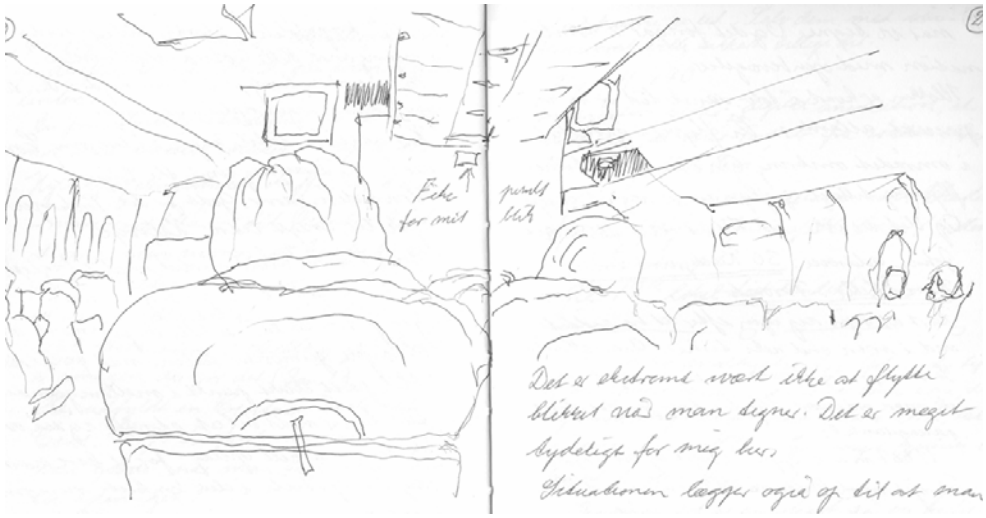

Fig. 2. I have written following remarks in Danish in my note- and sketching book: ”It is extremely difficult not to move your eyes when drawing. This fact became very clear to me “. The experiment I try to conduct here is to have my eyes fixed, staring at the tiny square in the middle of the drawing (marked with an arrow pointing upwards). Then I ask: Where are the limits of what I can see in a fixed position? That is what I am trying to visualize. Where do my visual field stop in this one-point perspective?

Obstacle. Merleau-Ponty has some relevant remarks about this strange and brilliantly functioning “edge” of our field of view, which turns out not to be an edge – or a line – at all, and it seems to disappear in our concrete everyday experience of our surroundings:

> “Once again, the edge of the visual field is not a real line. Our visual field is not neatly cut out of our objective world, and it is not a fragment with sharp edges like the landscape framed by the window. We see as far as our hold on things extends, far beyond the zone of clear vision, and even behind us. When we reach the limits of the visual field, we do not pass from vision to non-vision: the gramophone playing in the next room, and not expressly seen by me, still counts in my visual field. Conversely, what we see is always in certain respects not seen: there must be hidden sides of things, and things “behind us”, if there is to be a “front” of things, and things “in front” of us, in short, perception” (p. 277)

He includes even more complexity pointing at dominant multi-sensory aspects of perception, more than one sense here being active simultaneously.
A problem with this quoted analysis is, however, that here he points out what the edge of the visual field is *not*, not what it *is*! That is what I am trying to investigate in my experiment. But his remark that we do not pass form vision to non-vision is absolutely correct and logically surprising!
What I think is characteristic for the edge of the visual field is that is so brilliantly functioning spatially, that we are seduced by it and do not notice, what our logic tells us, that there must be a border, an edge or ending of the area of the visual field. We know that. We are sure of the fact, that we cannot see what is happening behind our back, but we can hear and react to it moving round and view what might be happening. Our eyes functions brilliantly, a fantastic perceptual tool-system. Carl Zeiss in Jena never made any optic tool as equilibristic as this. It is on one hand a wonderful phenomenon and on the other hand a bit problematic, because it avoids and seduces our consciousness to a degree, that might not always be preferable, for

example when we are occupied solving problems of perspective. Another reason to be bedazzled.

Obstacle. Sighted people in general may not wear spectacles like these, but we have two eyes that are functionally integrated.

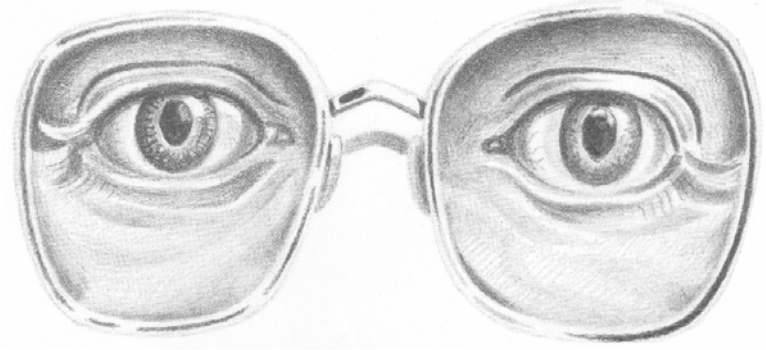

Figure 3. Sighted people have stereo sight; the two eyes interact fluently, but in some tasks it might still cause some problems for as well perspective seeing as perspective drawing. See the next figure:

Why this advanced functional capacity may also be problematic, you will realise, when you look at the following illustrations of a simple regular matchbox. I look at it from a very short distance (6 cm) right in front of my nose:

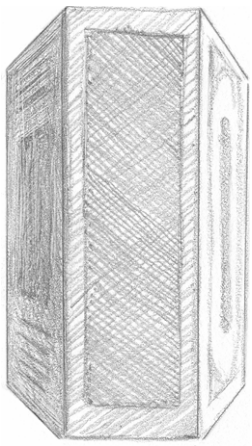

Figure 4. A drawing of an ordinary right angled matchbox seen in a position 6 cm straight in front of the tip of my nose; dimensions of this matchbox: length = 5,8 cm; width = 3, 5 cm; depth 1,8 cm. Drawing 1 : 1.

Try to look at a matchbox and experience it visually in a similar experiment

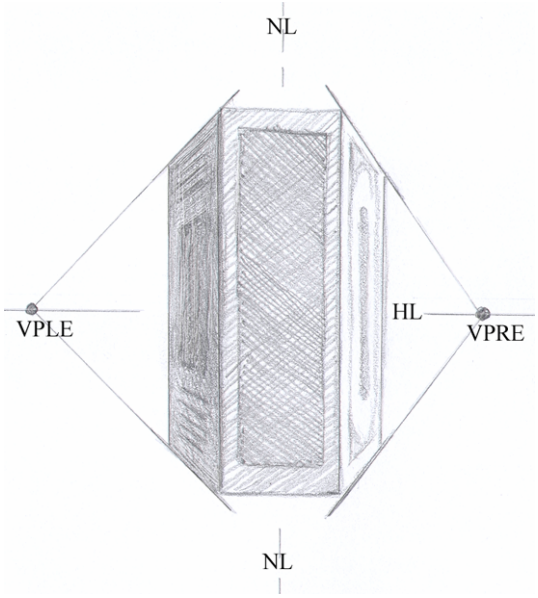

Figure 4a. A drawing indicating an extreme close-up double- or stereo view: my right eye can see one side of a matchbox; my left eye can see the other one simultaneously and – as you can see – this makes the matchbox look as if it is not right angled; if I look with both eyes simultaneously I get the above sight of the box; NL = Nose Line; HL = Horizontal Line; VPLE = Vanishing Point Left Eye; VPRE = Vanishing Point Right Eye.

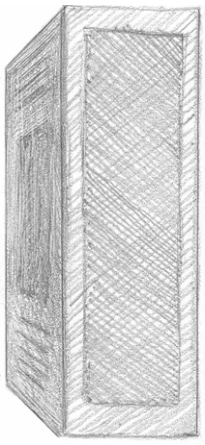

Figure 4b. If I hold the exact position and close my right eye I see following of the matchbox positioned close to my nose, the box I have analysed in former illustrations. Compare figure 4a-b-c

In an analogue way I can repeat the closing one eye experiment now changing to close the other one:

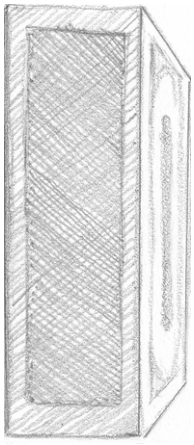

Figure 4c. If I hold the exact position and close my left eye I see this different part of the box. Compare with figure 4

You will notice, that it is two quite *different* pictures I see with my left or with my right eye open.
And if I look with both eyes open at the short distance of 6 cm, I see figure 4, which is a third and very different visualisation. In this example you get nothing less than three different views. Moreover figure 4 is spatially unreliable when we talk about the shape of the matchbox:

1) right eye, (figure 4c)
2) left eye (figure 4b)
3) and both eyes! (figure 4)

So what you can conclude is that perspective construction is built on a hidden obstacle or hidden premises, that the size of the cube depicted is bigger that the distance between the eyes, or/and it is seen from a certain distance like the cylinder one here in figure 6.
Figure 5a and b are drawings of a one point perspective motif, where we can see a cube bigger that the distance between your eyes and seen at a greater distance than the matchbox:

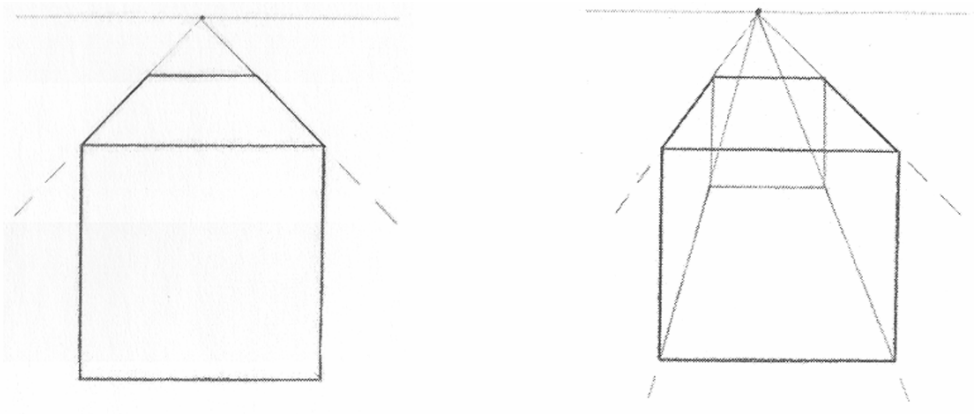

Fig. 5a and b. A massive cube and a transparent cube both showing one vanishing point. This is a typical one-point perspective drawing of a cube

In figure 6 the matchbox looks natural, although it has been changed from linear to curved forms because of the convex cylinder mirror surface on which it is mirrored:

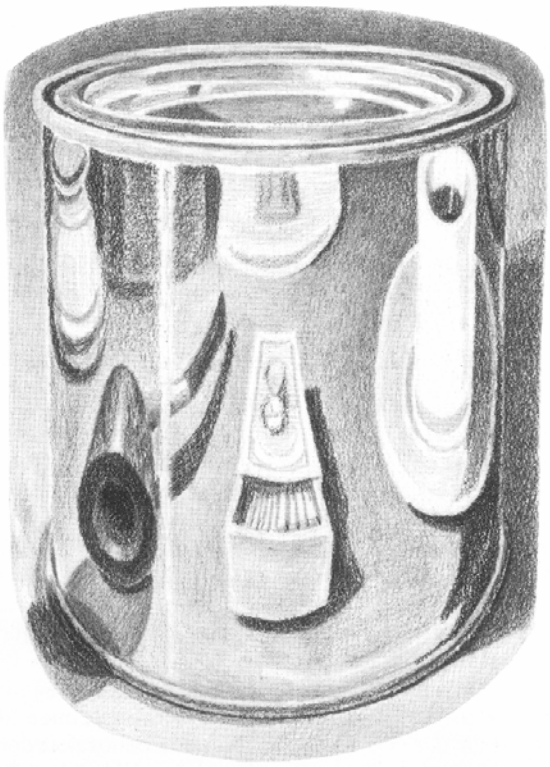

Figure 6. A matchbox is seen here in a one-point perspective at a distance of approximately half a meter. One might sense how my eyes have scanned the motif, trying to see and catch every detail ands bring it to the picture plane. A connoisseur of Danish pipe design (in Elliot Eisner´s meaning[6] of the term (Eisner 1991)) might even notice that it is a W. Ø. Larsen pipe!)

Obstacle: perspective is a one eyed construction. David Hockney (Hockney 2001) said about photo camera that it is a one-eyed Cyclops. The same goes to some extent for perspective drawing.

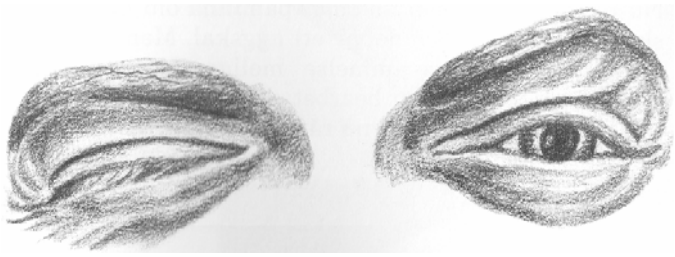

Figure 7. Looking with my left eye only; the right eye is closed

In principle perspective drawing is basically monocular. The world is depicted as a mono world, not a stereo world, but what we see around us is a stereo sight.

[6] You will find Eisners definition presented later in this article

Obstacle. One does not see Vanishing Points in your surroundings, one only *imagines* them, for example when looking at the cube in front of one or the road here one maybe is standing on.

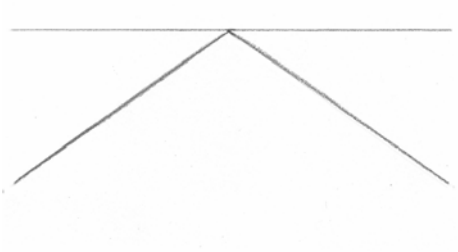

Figure 8. Standing on a road using their stereo sight, sighted people can easily see that it looks as if the borderlines of the road meet at the horizon and imagine – not see – a Vanishing Point. Compare with figure 14

Still when drawing sighted people have to imagine the Vanishing Point (where the borderlines or Vanishing Lines meet), because vanishing points as phenomena belong to the picture plane, where they can be drawn and seen, not directly to empirical surroundings. Compare with figure 14.

Figure 8a. One can easily recognize which of these two roads that is the dominant. One-point perspective is very dominant on roads. We see it easily. That is not the case with all the illustrations of perspective here

We live our different lives in different surroundings. And we observe these surroundings from many different angles and positions (vantage points). Some positions seem to "hide" vanishing points, others the opposite.

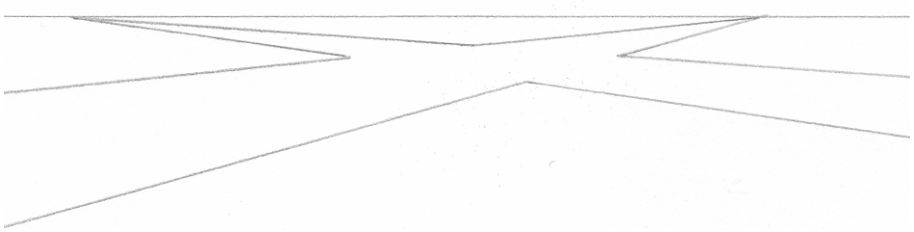

Figure 8b. Vanishing Points seem more difficult to locate or imagine in this illustration than in figure 8 and 8a

In figure 8b we are bodily outside the two roads and lower down experiencing that visually they are less impressive than the dominant one in figure 8 and 8a.

Obstacle: difficult and different surroundings

You will find huge spatial and visual differences when you draw perspective in a mountain area or a flat landscape.
The following illustration is a good example from South France of how complex an empirical scenery can look:

Figure 9. It may be difficult to see or imagine vanishing points in the concrete present surroundings. Here in Beaume-De-Venice in South France the horizon is hidden behind the mountain hill and a lot of details are blurring the architecture. But if you start looking in the foreground you might find some help identifying a regular two-point perspective

The way surroundings appear in the Middle Ages and in modern metropolis represent enormous visual differences. Just compare the Beaume-De-Venice village landscape and the New York skyscraper illustration in figure 10. The appearance of three-point perspective here is extremely different.

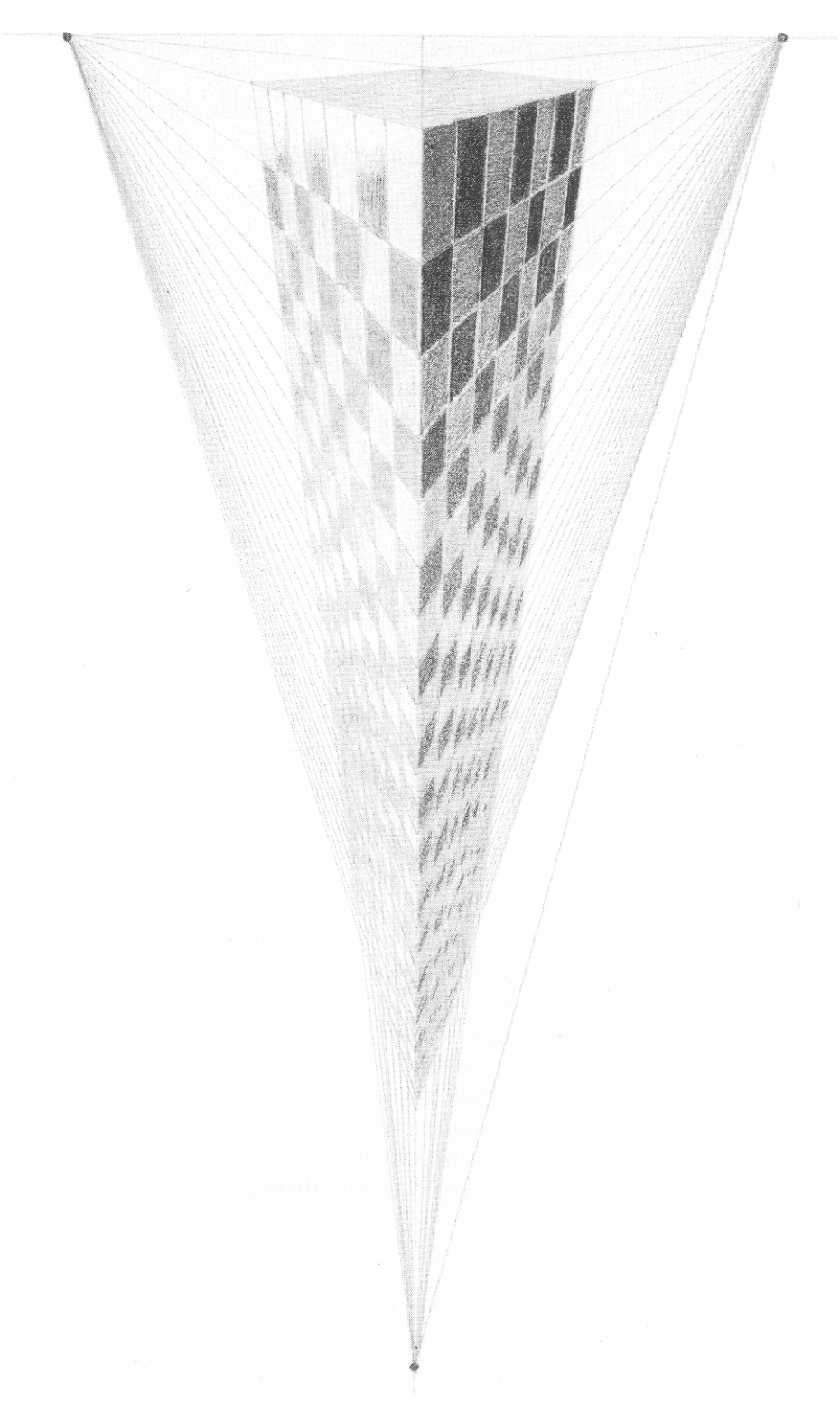

Figure 10. New York and other world cities are great sites to study three-point perspective

You have to be mentally capable of the function of imagining and identifying Vanishing Points. You see Vanishing Points only the moment you draw them. So drawing perspective you have to be able to combine between perceiving and add imagination to the motif.

Obstacle: Vanishing points can sometimes be difficult to locate. Even if one is familiar with the system of perspective drawing, a trained drawer:

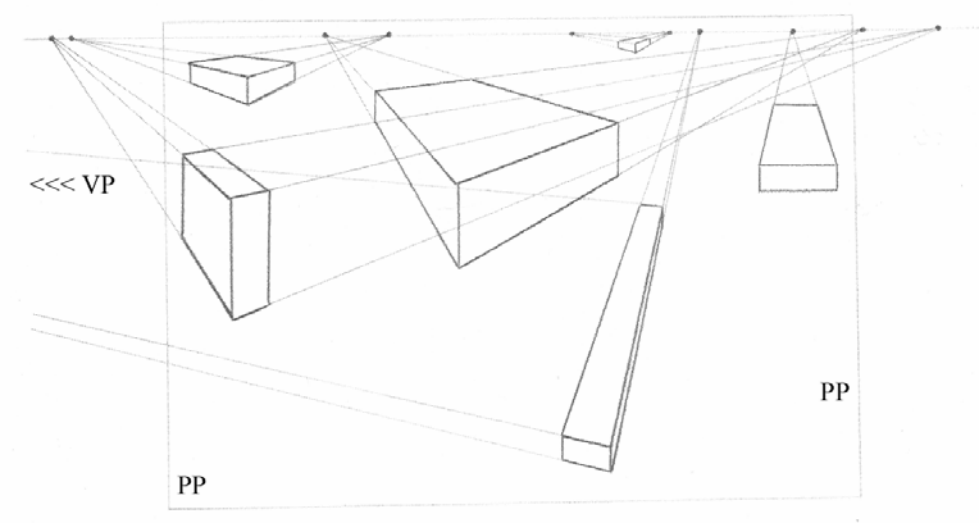

Figure 11. The left vanishing point from the long box in front is very difficult to place exactly, because it is far away from the rest of the drawing it is placed far *outside* the picture plane (PP)

As you can experience by drawing, it sometimes can be very difficult to judge, imagine, calculate, estimate where the vanishing points should be correctly situated, not at least as here in figure 11, where one of them is placed in a position far out of the picture plane of the drawing to the left.

Obstacle. Therefore it is often difficult to handle the Vanishing Points = VP; because some of them often are outside your field of viewing as in figure 11.

Obstacle. In figure 11 simultaneously you have vanishing points as well outside as inside the Picture Plane = PP. Such phenomena are difficult – most often impossible – to control for a non-experienced drawer.
To keep the Vanishing Points inside the drawing paper, the picture plane, is vital for a beginner.
An experienced drawer will always show some kind of respect for this serious problem of perspective drawing (and even some times try to speculate to avoid it!)
The problem here in figure 11 is, that it is not just difficult to determine the position of one of the boxes left Vanishing Points, it is even more difficult to *draw* it.
The problems in figure 11 might lead to what is illustrated in figure 12, a situation where you see severe mistakes in the construction principle, because the vanishing lines do not meet at all:

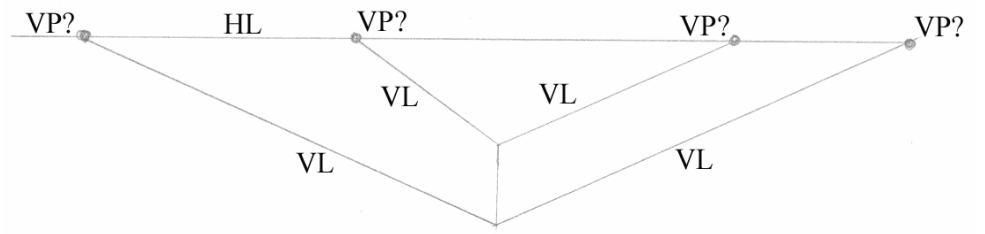

Figure 12. Note that the vanishing lines (VL) will never meet and cross two and two as they should in a vanishing point (VP) because they are constructed, so they follow wrong directions, they spread in stead of getting closer

It will never end up with following visual result described by Merleau-Ponty:

> "The perspective drawing is not first of all perceived as a drawing on a plane surface, and then organized in depth. The lines, which sweep towards the horizon are not first given as oblique, and then thought of as horizontal. The whole of the drawing strives towards its equilibrium by delving in depth. The poplar on the road, which is drawn smaller than a man, succeeds in becoming really and truly a tree only by retreating towards the horizon. It is the drawing itself which tends towards depth as a stone falls downwards". (p. 262)

The whole construction in figure 12 is wrong, maybe because the drawer has failed to "see", which means to imagine the Vanishing Lines and the Vanishing Points, when looking at the concrete empirical cube in front.
So it is a complex process to learn to handle Vanishing Points: you should be able to observe them imaginatively, seeing them with your inner eye, imagining the surroundings as a kind of drawing, where you detect the Vanishing Lines and thereby imaginatively construct the Vanishing Points.
It seems to many sighted people quite difficult to master all aspects of these processes achieving satisfying results in form of realistic looking drawings of objects seen in perspective.

Obstacle. It is hard to keep the exact position of your head. When you are sitting or standing still you may actually be moving your body and your head a bit. You will see the evidence of my postulation here if you are in a position like I was one morning in New York surrounded by skyscrapers in all directions. These extremely tall buildings are also mirrors. If you look at one of them you will see more than this one, because you will see some of the other ones mirrored in the reflecting glass surface of the mirroring building.
As we know most glass windows have a plane surface. But it is not a totally plane object, when they are placed in the building. You will find out if you go and check. They are often slightly curved, and that means, that when you look at them – functioning as mirrors – they show minor but significant irregularities if you study the mirroring of the straight lines. They become a little bit curved. And that means, that when you walk along such a mirroring building, the mirror effect seems to be "alive" because all the irregularities become visible simultaneously. So here you can study the effect of moving you body or vantage point: If you just move your head one inch you will see the effect in the mirror. That was what I experienced seeing the Empire State Building in the mirroring surface:

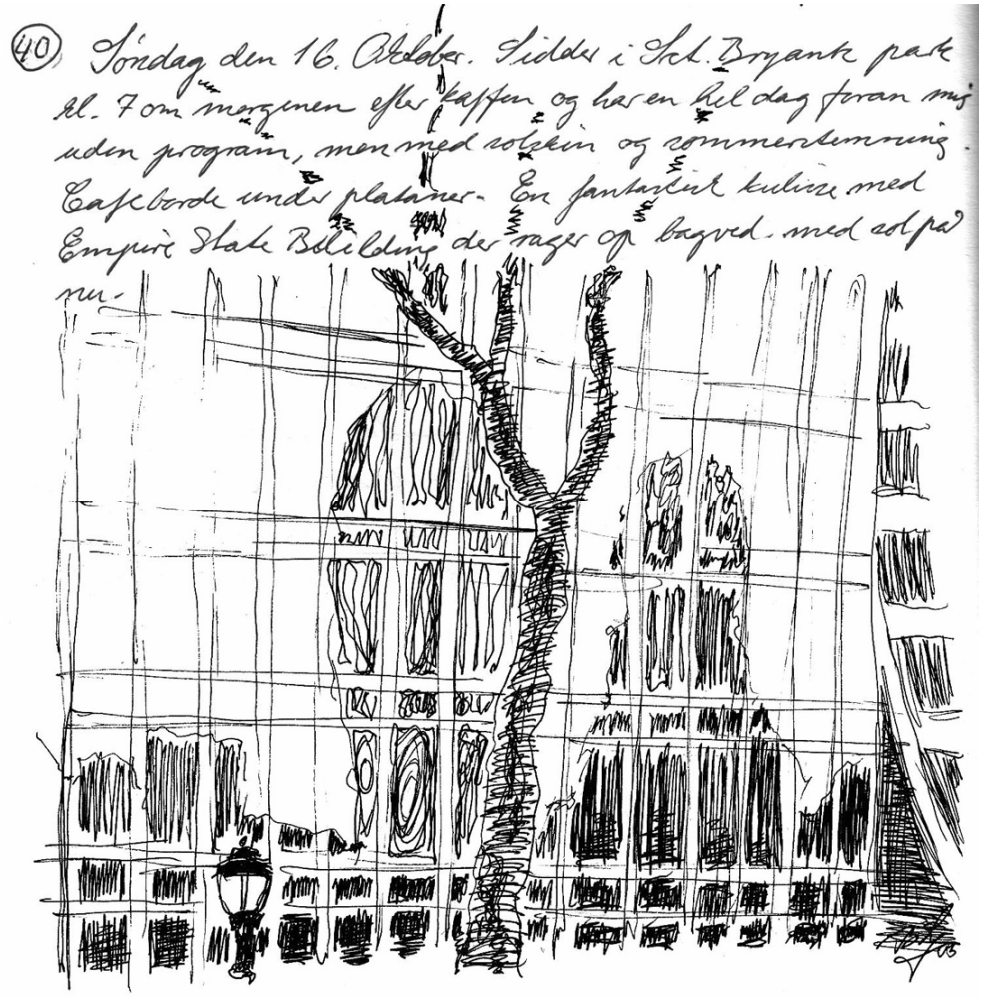

Figure 12a. Irregular mirroring of Empire State Building seen from Sct. Bryant's Park one sunny morning in October. Moving my vantage point just an inch, these irregularities would look very much "alive", reminding me how difficult it is to keep exactly the same bodily position

A pedagogical double strategy for sighted people

It was pedagogically negative experiences like those in figure 12, which made me aware of the need for more effective strategies for drawing one-, two- and three-point perspective. It should be a robust knowledge and part of their expressive visual capacity.

I asked the basic question: How can sighted people draw a cube?

My strategy was to combine the construction principles and the visually investigating staring aspect.

Pedagogically I developed a combined double strategy (Laursen 1988). To make sure that you do not run into the mistakes as in the above drawing in figure 12, I see the main task to be done to draw the first vertical Corner Line = CL and place the two vanishing points = VP on the horizontal line = HL, and draw the lines from the ends of the corner. That is an essential part of the construction. As pedagogical helping aspect of utmost importance here is the

tendency that you keep the distance on the horizontal line between the **V**anishing **P**oints ***relatively short***.

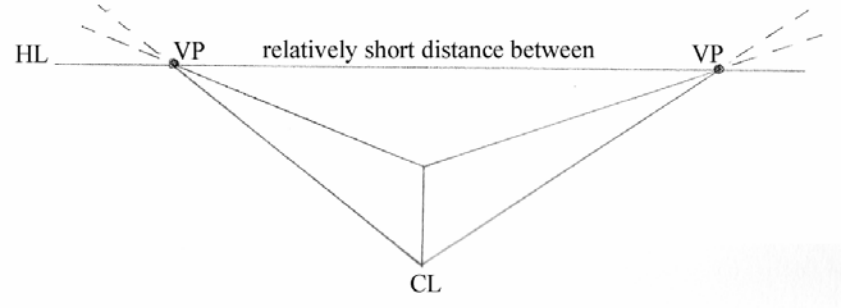

Fig. 13. For sighted people it is a core phenomenon to train to draw cubes where the distance between the vanishing points is small, because it stabilizes the judgement of what direction these lines are running and where they should meet

Short distance helps the process of remembering the directions and address of these lines, which was the problem in the earlier faults in the construction in figure 12.
The short distance between the vanishing points in two-point perspective drawing also secures the fact that your chance of keeping all vanishing points *inside* the drawing paper is much bigger. That is a vital pedagogical interest to secure.

The construction part of the strategy

To have a robust knowledge of how to construct a drawing of a cube is the first of the two basic elements of my double strategy. The principles are actualised here. The point of departure is the familiar knowledge of how the edge-lines of a road or a railroad look, when you are standing on it. You are in a one-point perspective, like Charlie Chaplin and Paulette Godard in final landscape in his marvellous film "Modern Times":

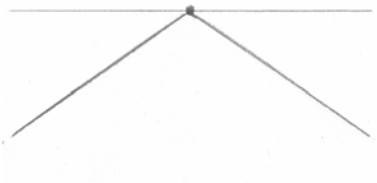

Figure 14. One **V**anishing **P**oint is drawn on the **H**orizontal **L**ine. We – who are sighted – share the experience of walking on a road and experience the visual paradox that we can see that it has the same width, but it looks as if it is smaller the more distant we are from the "end" of it. Compare with figure 8.

We see the very same phenomenon of identical size looking smaller at a growing distance, when we compare this principle with fig. 15. In the non- transparent box in the upper part of the illustration two walls and a top that get smaller as they get closer to the horizon line (HL). In the lower part of figure 15 the same box has become transparent, and the same principles about things looking smaller the more far away they are still consequently ruling the whole construction:

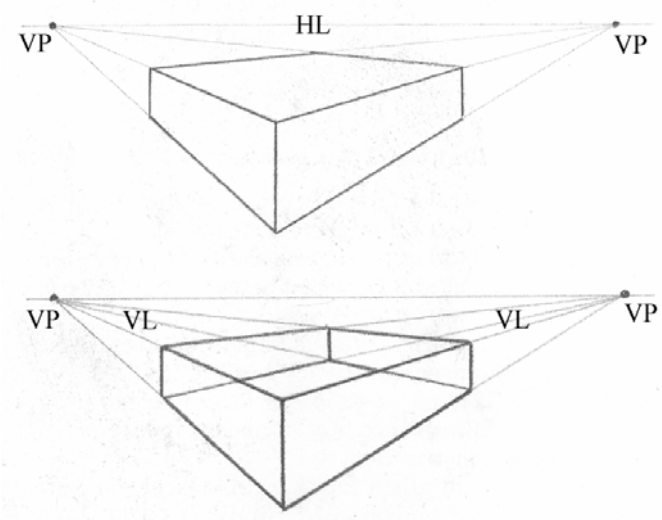

Fig. 15. Walls seem to get smaller the more distant they are as well massive as transparent boxes showing Horizontal Line (HL), Vanishing Points (VP), and Vanishing Lines (VL). The distance between the Vanishing Points is relatively short. Compare with figure 17

Short distance between the vanishing points (VP) (to avoid "traditional mistakes" about the "address of the lines) *exaggeration* of the angles of the vanishing lines (VL) as my *dominating pedagogical strategy*, a principle I developed teaching people to be able to make their depiction of their surrounding world recognizable (Laursen 1988, 1988a).

The staring or gazing part of the double strategy

Figure 15 shows the very same construction of a box as figure 16. The differences are that:

- I have decorated and depicted a concrete box with a pattern
- Then I have drawn an identical picture of the box using the above shown construction principles (fig. 15)
- Using the already existing Vanishing Points, I have then mirrored the box
- Using quite a lot of time I have made a careful visual study of this specific box motif and
- Simultaneously observed every area of the motif and the emerging drawing very carefully, activating what Elliot Eisner calls primary epistemic seeing, and drawing it staring and gazing simultaneously switching between the motif and the drawing (Eisner 1991)

Elliot W. Eisner defines *primary* and *secondary* epistemic seeing in following way:

> "The processes of connoisseurship I have described can be regarded as examples of epistemic seeing (Dretske, 1969). *Episteme* refers to knowledge, and epistemic seeing is the kind of knowledge secured through sight. My emphasis on seeing is the kind of knowledge secured through sight. My emphasis on seeing should be regarded as a shorthand way of referring to all the senses and the qualities to which they are sensitive. //
> We have seen that awareness of qualities is a primary means of epistemic seeing; indeed, it is foundational. We must become conscious of qualities before other considerations can be taken into account. Thus, awareness of the qualities of voice, manner, movement, and

> visual environment, at the very minimum, provides knowledge of those qualities per se. But as I have indicated, those qualities can also be regarded as samples of a larger class. We see something "as". The lecture is not only a lecture, it is an example of lecturing. By seeing the lecture as belonging to a class, and by seeing the class as a varied array of examples, we can situate any particular lecture in that array. *Primary* epistemic seeing depends upon awareness of the particular. *Secondary* epistemic seeing refers to seeing the particular as a member of a larger set. (p. 68)

Visually my attention is focused on the particular motif, this particular surface of this particular box. And I try to imitate in the visual appearance of the motif on the surface signalling in the medium of a soft pencil drawing what I perceive visually gazing intensively, or scanning with my eyes, the decorated box in front of me:

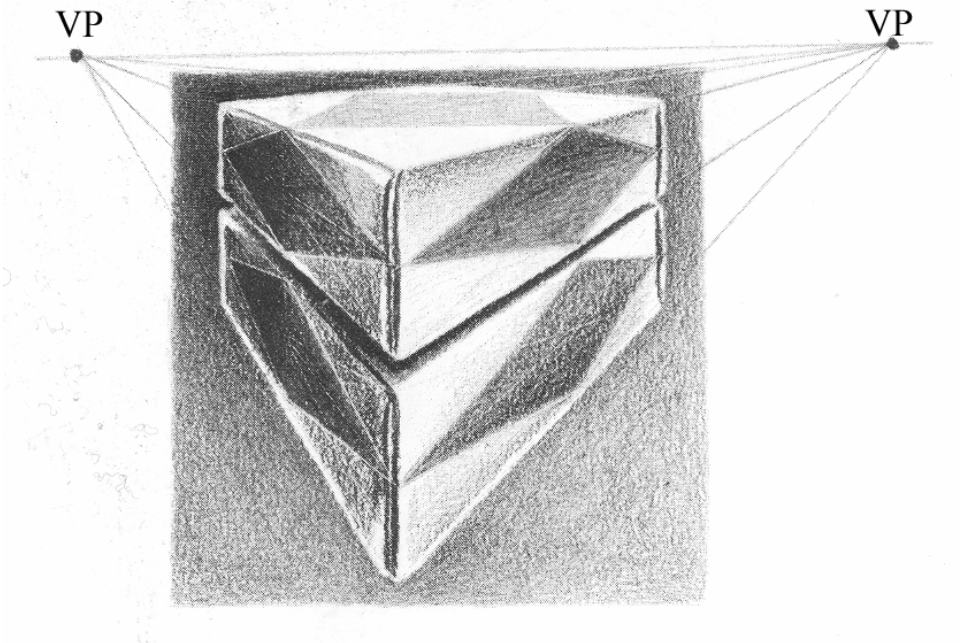

Fig. 16. Here again I use the very same short distance between the Vanishing Points (VP). The visual effect of the mirror is particular strong, because the vanishing lines (VL in previous illustration) ends in the same vanishing points. That makes the mirrored forms look very dynamic

If you compare fig. 16 and fig. 17, you can easily see, that in figure 17 the distance between the Vanishing Points is relatively much bigger that in fig. 16. That makes fig. 17 a more naturalistic drawing, because it is actually closer to what we see in the world around us:

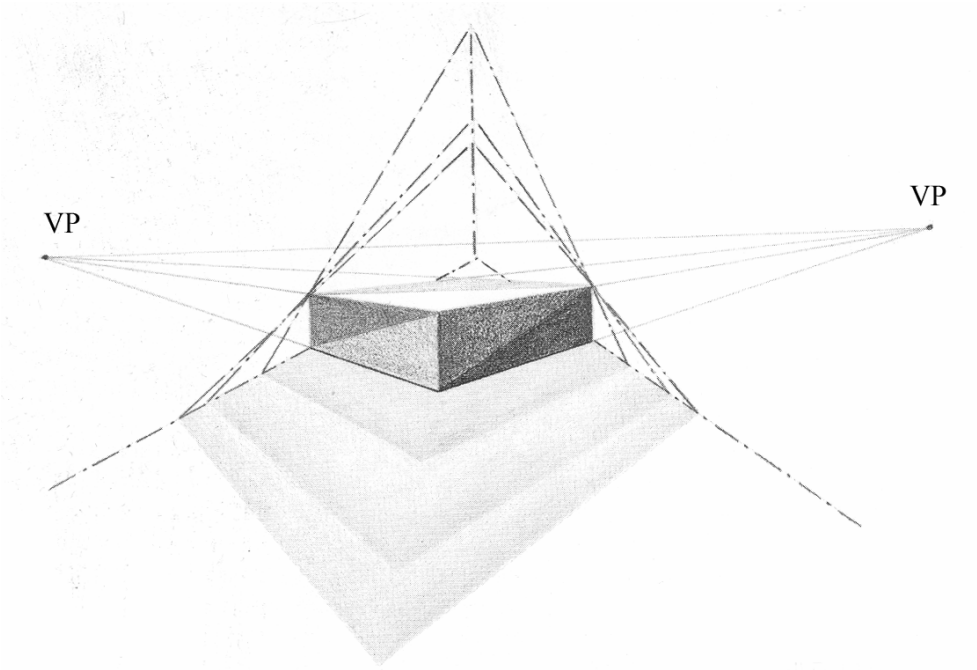

Fig. 17: Longer distance between the vanishing points than in the earlier illustrations. In this drawing I have also shown how you can construct different shadows by varying the height of the light source

The longer distance you see here between the vanishing points (compare with the previous drawings) is closer to the concrete way a rectangular box looks (go and see yourself!), but the possibility of making mistakes during the construction of the drawing about where to place the vanishing lines and determine the exact directions, often lead to the problem that the vanishing points often end outside the picture plane.

To facilitate the construction problem, I sometimes draw “helping lines” *directly* on a given object like the box in figure 18 where I want to show people how you can construct a cylinder in a box.

Both construction and primary epistemic seeing is characteristic of the illustration in figure 18, where I show a little box I have first built out of cardboard and second I have drawn the diagonals and the circles; as a third step I have drawn a picture of the whole thing, using as well construction principles in my drawing process as epistemic seeing, scanning every detail of the whole substance:

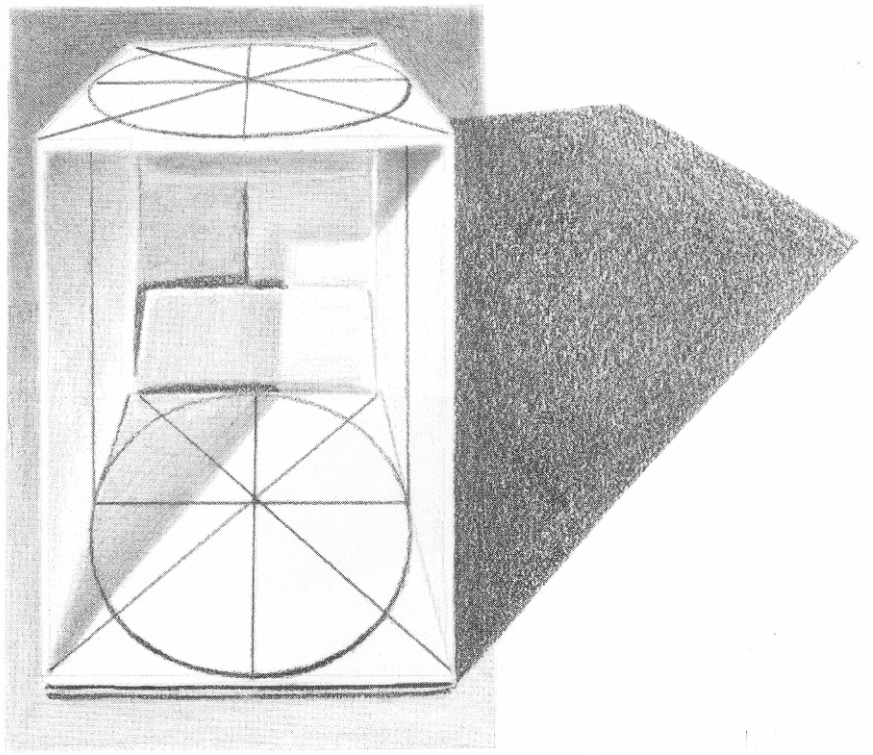

Figure 18. A cardboard box with "helping lines" drawn directly upon its surface to facilitate the drawers analysis of the motif and then I have drawn it once again, but this time as an empirical part of the motif

My pedagogical intention in my double strategy of simultaneously constructing and watching, is to make both processes function without problems as parts of one deeply concentrated integrating drawing process.

A preliminary conclusion

My double strategy can help sighted people to learn how to *see* and how to *draw* perspective, but they really have to train seriously for a longer period to make this knowledge robust and well functioning, solving the problems (and perhaps more) I have illustrated on the previous pages.

It is a complex and relatively difficult process – filled with the illustrated obstacles – to master as well seeing as drawing linear perspective.

If you doubt it, you can continue my line of pointing out obstacles, reflecting on and experiment with a case where the cube is *not* placed on a plane surface now studying the potential consequences for the vanishing points?

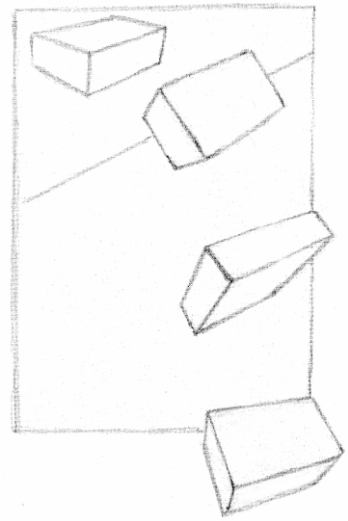

Figure 19. Falling boxes. Where are the locations of the vanishing points?

Drawing perspective and the blind

My next step will be to ask and try to answer the following question: Will blind and sighted people face the same obstacles when they try to draw a cube?
As a central condition for answering this question I must point to the fact that I am not blind, I am sighted, so in that important way I am "disqualified" to answer the question.
On the other hand I also share the qualification with all human beings of being a body. Therefore I can "pretend" to be blind for a period by going to absolute dark places like the surroundings in the "Dialogues in the Dark" – Project[7] have created. Or similar dark surroundings or places that can be darkened totally, like the studio where I teach my performance design students[8].

Absent obstacles for blind people drawing perspective

Blind people will not meet the obstacle I pointed out about being confused by rapid the eye movements, that sighted people regularly meet and which makes it problematic and confusing for them to find out whether something is seen in one glance or many, as I have illustrated.
Furthermore blind people will never meet the problem of the seductive missing edge of the field of view. They feel surrounded by space and time in the Merleau-Ponty meaning of it, I anticipate.
Neither will they meet the obstacle of stereo sight, which I showed earlier, or identify the problem that constructing a linear perspective is a monocular action. That turns into a problem only for sighted people. Blind people feel with the tip of their fingers and this process will not result in optic confusions and errors, because the tactile feeling can be centred in one point, the

[7] "Dialoques in the Dark" is an exhibition run by blind people where sighted people using a stick can be guided in complex and multi facetted surroundings, built in a totally dark world. In Denmark it takes place at The "Experimentarium", a museum in central Copenhagen
[8] http://www.ruc.dk/performance-design/

tip of the pointing, feeling finger. Feeling a surface and a distance with the fingertip is an exact empirical matter.
These absent obstacles lead to a central question: with what sensory background and with what potential will a blind person meet the task of identifying and drawing a cube?

Carcione´s example

In the concrete example with Carcione mentioned in the beginning of this article in Zalewski´s description of Kennedy's surprising findings the blind girl draws a y-form initially when:

> "Carcione …(was asked) to draw a cube balanced on a point with three faces toward her, she began by drawing a Y-shape: three angels converging to a point." (Zalewski 2002)

Figure 20a-b. Here is illustrated how the edge on the cube is touched by one pointing finger (one hand) to the left (a) and with two pointing fingers (two hands) to the right (b); the form of the corner is a y-form, which is also a symmetrical form

Also, the phenomenon of reducing size – to signal and indicate empirical distance – is practiced by the Italian girl:

> " When a cube was placed in front of a cone on the table, Carcione drew the cone smaller, to convey distance".

The following illustration is showing the principle of distance reduction in the object of a cube:

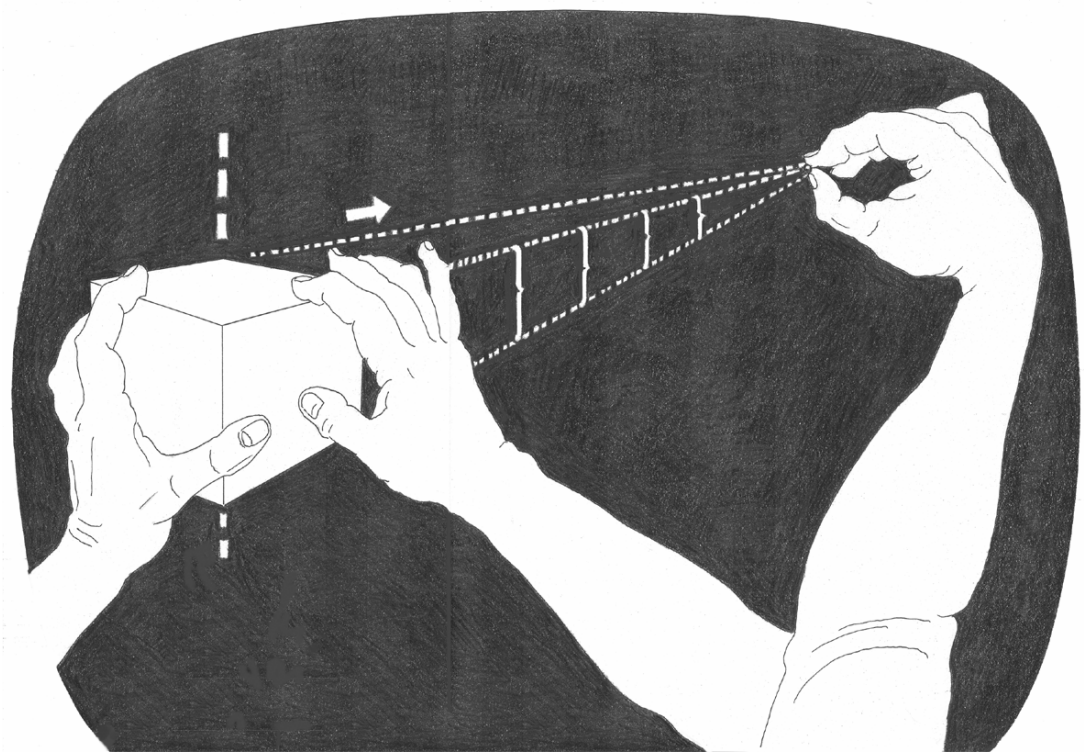

Figure 21. Here the medium – the air – is drawn black, or without light, as it must be for totally blind people. The illustration signals a part of the zone of the body, where I feel the edges of a minor cube. The vertical "brackets" illustrate the spatial anticipations and imaginations: things appear smaller the more distant they are. The vertical brackets appear smaller the more far away positions they occupy. The vertical dotted line through the cube illustrates the centre line of the zone of the body. The whole drawing and the darkness is intended to signal some of the feeling of bodily intimacy in the zone of my body acting as a blind person

How this principle is anticipated to function in the concrete example, I am going to describe in the rest of the article.

The zone of the body

Empirically blind peoples world is the very same as the one sighted people live in. But it is perceived differently, because the sense of sight is not functioning.

If a blind person has no other handicaps and all the other senses are functioning, these senses are constantly detecting the surrounding space, when the person is awake. These other senses are used permanently.

James Gibson said addressed to sighted adults:

> We live boxed-up lives. Our ancestors were always looking around. They surveyed the environment, for they needed to know where and what there was in all directions. Children pay attention to their surroundings when they are allowed to do so. Animals must do so. But we adults spend most of our time *looking at* instead of *looking around* (Gibson 1986: 203)

Blind people need to know what there is in all directions.
Blind people are very attentive to sound, and hearing is spatially interesting for more than one reason!
Multi directional hearing is also qualified space detecting. A fine tuned set of ears can detect a lot of complex qualities about its surroundings: a small room, a huge room, sound absorbing walls or hard material, distance, a person walking far away, closer, passing and going away, the intensity of the sound has clear implications for distance.
Therefore sound detecting ears – potentially and often in practice – are equilibristic instruments for fine grained spatial measuring, revealing the fact that equal sound level will appear louder the closer it is to the listener and it will diminish, be smaller, the more distant it is.
This seems to be a basic spatial rule that blind persons use as a core parameter. Elements close to you seem bigger than when they are distant, then they decline, seem smaller. This seem to be a robust multi sensory knowledge to blind people.
The same goes for smelling to a minor and less exact extent, the nose detecting smells coming from all directions. Also our tactile feeling of/on our skin is absolutely sensitive to what direction any breeze might come from or where the hot fireplace can be found (Kennedy: 1993: 14).
So missing the sense of seeing – which is a directed sense – blind peoples potential for using the available senses in all direction can be seen as sharper compared with sighted people. We also use these other senses, but we are not dependant on them to the same extent.

Symmetry

Sensorial detection of the world is basic for cognition. Like Kennedy and Eisner also Merleau-Ponty points to this foundational fact:

> "All knowledge takes its place within the horizons opened by perception" (p. 207)

And to continue to expand on how we as bodies are brought into this world, Merleau-Ponty continues:

> "The thing, and the world, are given to me along with the parts of my body, not by any "natural geometry", but in a living connection, comparable, or rather identical, with that existing between the parts of my body itself.
> External perception and the perception of one's own body vary in conjunction because they are the two facets of one and the same act" (p. 205)

I do agree, "the world is not given to me by any "natural geometry"". Still I think that when sight is not a functioning sense, as is the case for blind people, something that reminds me of geometrical phenomena might come into my mind.
I think, that if I were blind, being a body, I would experience more intensively the feeling of bodily symmetry as a characterizing phenomenon.
Biologically we are not symmetrical, but we still have two mirrored arms that functions coordinated; we have two hands "the chief tactile organ" (Kennedy: 1993: 8), and we can bring them to touch elements in the world, also our own body, as Merleau-Ponty points it out clearly.
I suggest – as the initial hypothesis of my experimenting emphatic study of why blind people have special potential to innovate the principles involved in perspective drawing – that bodily I

would regard myself (maybe subconsciously) as a relatively symmetrical creature[9], symmetrical round a vertical line running through my nose and up and down the rest of my body and the space right in front of me! I have tried to illustrate it in figure 22:

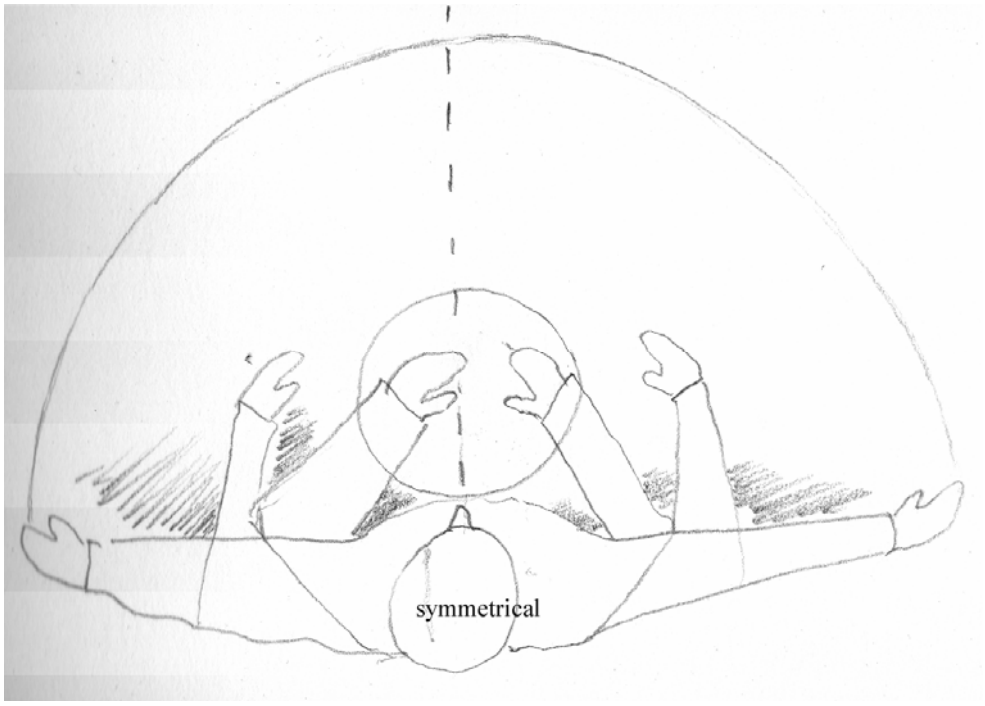

Figure 22. First of all I think of the zone of my body – the area, the space, I can reach with my arms until they are fully stretched – as having significant symmetrical qualities. My two arms are brilliantly coordinated with the extremely sensitive hands having their domain where things can be explored centrally. Of course the arms and hands can do much more than illustrated (touch my back or feet for example), but this sketch is first of all an illustration of the most common and uncomplicated movements

In general I think that you can describe the zone of the body as an equilibristic and well functioning 4-D scanner where physical objects can be detected by sensitive hands and fingers. It is a 3-D scanner in the meaning, that it detects the form of a physical object in all three spatial dimensions and the forth dimension is that of time. It "lives its way through" these investigations over time, as Merleau-Ponty probably would say. So time is the forth dimension in this epistemological process.
Merleau-Ponty has already told us where the point zero of my bodily experienced spatiality is:

> "It is a space measured from me as point zero of the spatiality. I do not see the space from outside as an outer shell, but I experience it from inside, being surrounded by it. All in this world is not in front of me, but around me" (Merleau-Ponty: 1960 : 41)(translated from the Danish by BL)

As you can see in figure 22a, I have indicated different distances and also specified them in rough categories:

[9] At least and roughly speaking on the outside of the body, the heart, for example, is not situated in the middle and is not symmetrical.

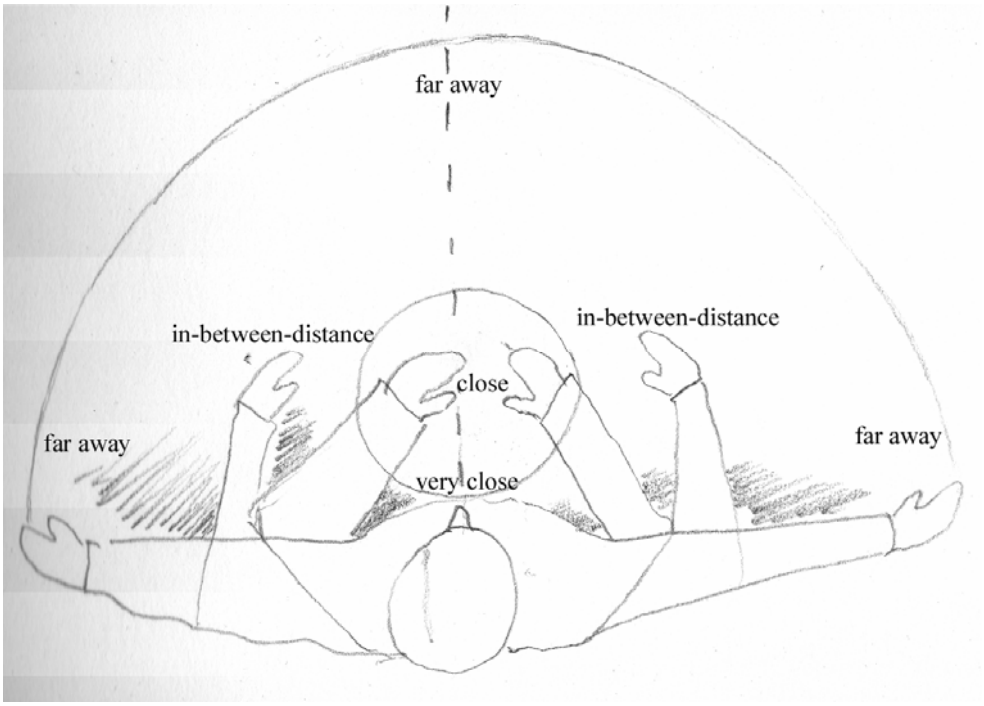

Figure 22a. The positions: “very close”, “close”, “in-between-distance” and “far away” are positions which my arms and hands can reach without difficulty; the illustration also indicates the zones: “very close” and “close”; finally it also shows the whole area I can reach; this drawing shows a birds eye perspective (and I will just make one comment about this terminology[10] related to birds physiognomy).

Visual distance representation

This symmetry in the zone of the body straightens my feeling of my two hands as two wonderful tools working brilliantly together, detecting and determining right in front of my breast, what I am examining using haptic means.

[10] Some birds – not birds of prey – have their eyes situated on each side – not the front – of their head, so this term seems physiologically to be a bit problematic.

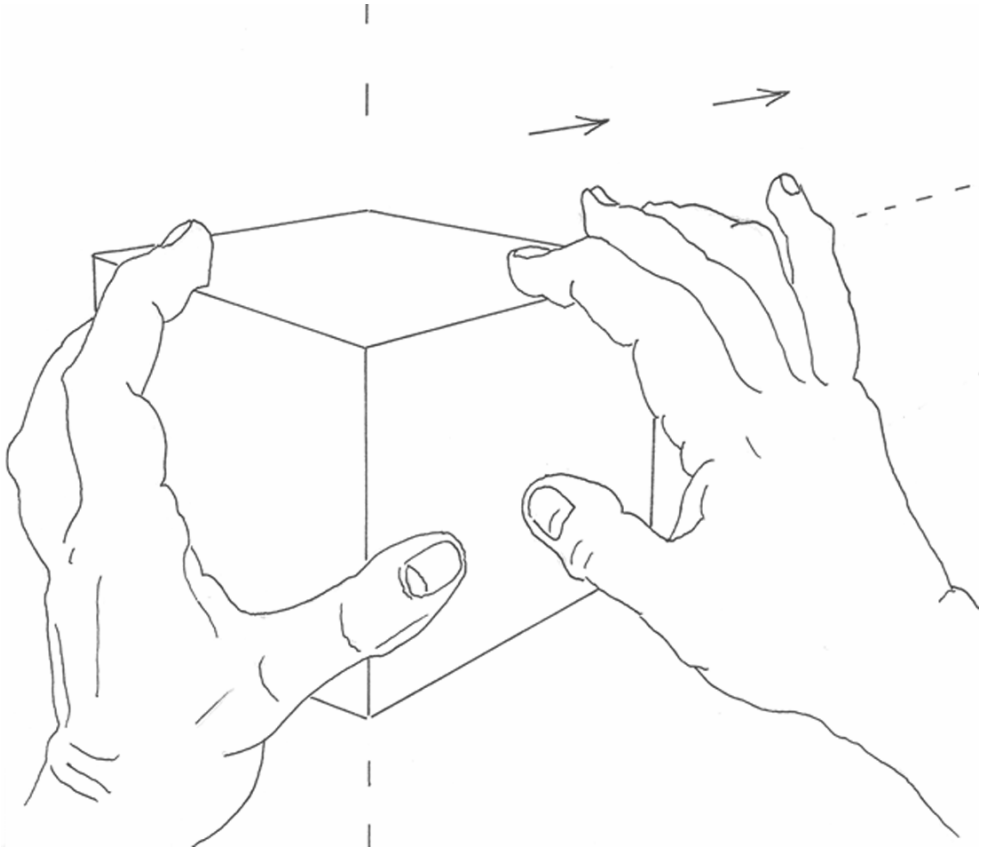

Figure 23. My left hand is holding steadily a minor cube at the same time as my right hand is moving its way along one of the upper edges of the cube in the direction suggested by the two arrows above. The doted line to the right of the right hand is indicating the imagined and felt direction of the movement of the pointing finger following the examined edge. The vertical dotted line is an indication of my imagined centre line/plane of the experienced zone of my body as a blind persons body, and it runs through the plane of my spatial point zero in my body

I do not write right "in front of *me*", because – as Merleau-Ponty elegantly indicates – my hands are also a part of me! I inhabit the whole zone of my body so to speak. About the space in front of me, I think I would easily feel this symmetrical line/plane of the cube, when measuring being the intention, as also being in the centre line/plane of the centre zone of my body. And that gives me a destination I can measure from. That is foundational for a good distance judging system.

I could say that I often will have this centre area and centre line as a point of departure for my studying, judging and measuring things and space. My point zero of my body in Ponty ´s terminology.

Studying a cube like this, I might also use my right thumb combined with my pointing finger to measure the length of the side of the cube. That will be the same, because these edges are parallel in cubes.

However, some parts of the cube are near and some are more distant from my centreline/plane, and these differences of distance can be represented and depicted combining audio- and visual experiences.

These distances you can see in figure 21: vertical brackets are drawn as looking smaller and smaller in more distant positions from the centre line of the cube and also the centre.

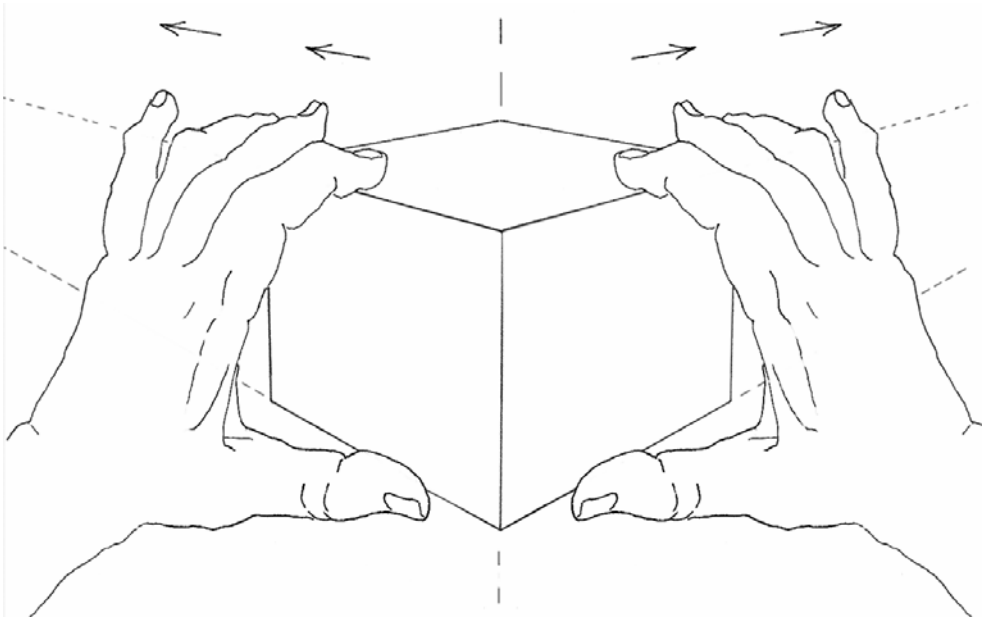

Figure 24. Symmetrical positioning of a cube in front of my breast

I could ask the challenging and teasing question: I can easily put my arms to the left or to the right and examine the cube in these positions? Does that ruin the hypothesis of symmetry and of a centre line?
I do not really think so.
In fact it does not in practice, because we humans – blind and sighted – develop practical, natural habits, and it is the most comfortable for me to bring in things *in front* of me when I examine them. Natural habits will be dominant.
What is typical for the *examination* of the cube is that I have to sort of "enact bodily", when I detect it, when I feel it, touching it with my finger(s) moving them along.
I have to move my fingers concretely over the edges of it to make me familiar with it, to *understand* it spatially, meaning that I *re-imagine* the movements mentally (see figure 21, 23, 24, 25).
And when I *draw* it, I also have to sort of as well enacting the movements I have just practiced with my hands and fingertip on the surface of the cube, simultaneously also activating my imagination and memory of these movements when drawing. To some degree it shows some *analogical* phenomena, because when drawing I "mime" related movements, but now if I am blind in the medium of tactile drawing on plastic sheets on rubber boards, using ball pen as drawing instrument raising a tactile, kinaesthetic detectable line on the sheet, the picture plane.
Following processes I anticipate are going on in the blind drawers mind / body:

1) Feeling with the fingertip the edges/form of the cube over time
2) Re-imagining this feeling over time, re-structuring mentally a form of the cube, built by straight lines, angles related to the vertical centre line/plane and these features being combined with fine grained judgements of different cube parts distances from the centre line
3) Drawing, re-imagining the feeling experience (the fingertip and the ball pen are both sharp (analogue) phenomena (edge/outline), both very exact elements in the blind persons tactile world, and in most cases the pointing fingertip – when feeling an edge

and when drawing an edge – is close to an identical position as where the fingertip is actually working

4) Transforming three dimensional feeling (or four with time) to a two dimensional picture plane (or three with time), attentive to signify differences in the exact felt distances in different parts of the cube, and thereby constructing converging lines (figure 21, 25, 25a) that logically and spatially will meet in one point on each side of the centreline, and thereby *inventing* the two Vanishing Points in two point perspective as well imaginatively as concretely
5) Checking, re-feeling the drawing, re-imagining simultaneously as well the cube feeling as the drawing feeling
6) Checking and comparing concrete cube feeling and the concrete drawing feeling of outline route and form, maybe producing and giving (self) critique

This example is a kind of *spatial* analogy. I anticipate the way a blind person detects the form of the cube in a position where the person has three surfaces directed towards he or she. The imagination of the cube form and concrete drawing process of it, moving the drawing hand in directions which to some degree mime some of same directions felt bodily in the detecting process, may also point towards some degree of analogy. And – following next paragraphs analysis – it also seems to be combined with spatial, multi sensory logic.

Distance representation as "multi sensory logic"

I think that the study zone and the drawing zone are experienced as being more symmetrical by blind than sighted people, at least in the process of experiencing and drawing a cube right in front of the drawer.

Imagining myself as blind, I think that I – as anticipated and illustrated – have developed a quite strong feeling of bodily symmetry, stronger that if I were sighted.

If I am asked to examine a cube I think I would place it right in front of me and feel and notice, that all the edges and sides are of the same size. Without problems I could draw one side of the cube as a square. I will always be sure of the permanency of the solid form of the cube.

Intuitively I am point zero, when I examine and draw things, my nose will be the middle – the centre area, the central plane – of my arms and body's world. The distance from my nose grow bigger if I stretch my arms all the way to two arms length.

The zone of my body is the space in which I – being awake – can feel existence of my limbs simultaneously.

Intuitively – having coordinated arms and equilibristic hands – I create a feeling of a measuring and examining centre in front of my breast, where bodily I have the best possibilities for my tactile study of objects, but still I can also feel the world being around me, being surrounded and centre simultaneously.

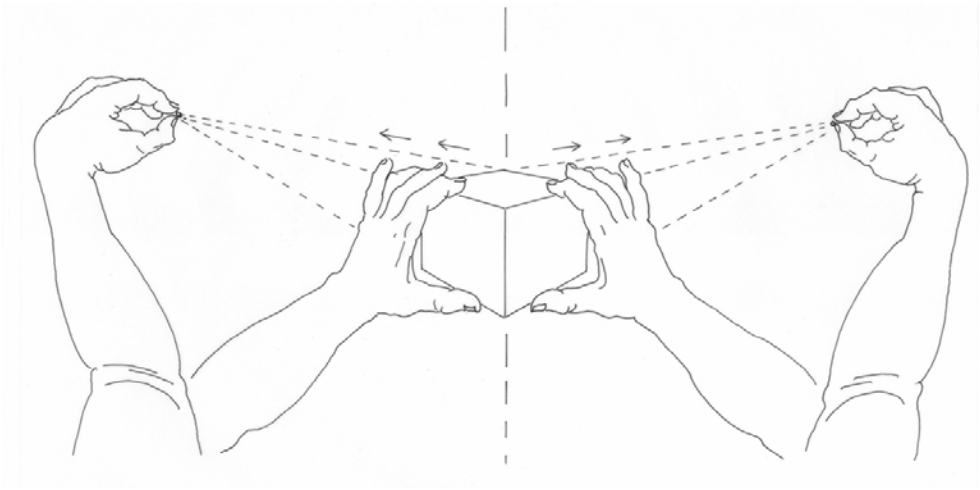

Figure 25. Hypothesis: the length of the side of the cube may look smaller the longer it is away from my central body plane. If I enact this diminishing of the cube side while I move my hands and arms away from my centre line – as illustrated by the outer set of arms – my fingertips will logically have to meet in a point. I imaginatively can hold one point in each hand, when three sides of the cube are directed towards me. All of this can take place inside the zone of my body, and simultaneously I am also aware of the permanent size of the side of the cube, see figure 25a

This symmetry and centre feeling – in combination with my well functioning arms and hands – is my point of departure for measuring things, which I easily examine inside the zone of my body.
Merleau-Ponty says:

> "In order to perceive things, we need to live them" (p. 325)

Examining and also drawing a cube the blind drawer mentally operates primarily in the zone of the body (if it is a relatively small box that the person has in front and can touch).
I think I am right, that boxes meant for experiments are chosen following the principle: not too big, not too small? (Are there any experimental results with blind people touching really big/huge boxes?)
Qualified measuring- and distance-judging competence will also mean, that I will be able to produce quite exact indications of how distant my hands might be from the centre nose line/plane in any given positions I can handle inside the zone of my body: (see figure 21)
This might for example mean, that if I place a cube in the centre line I might at any time determine whatever locality I touch on the cube whether it is nearer or more distant than that of any other position as in figure 21, 23, 24, 25 and 25a.

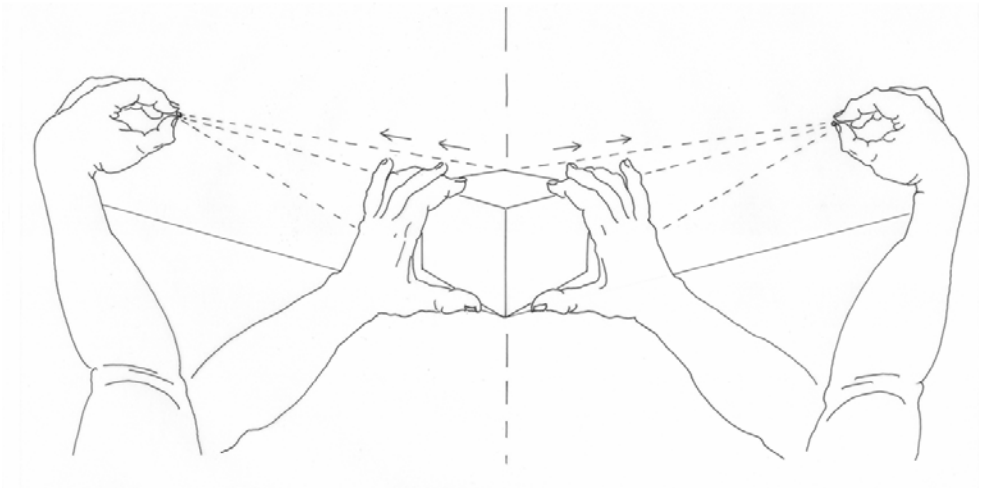

Figure 25a. Simultaneously I – or a blind person – am not just imagining the diminishing of the cube side to communicate the phenomenon of distance visually as in figure 25, but I am still conscious of the concreteness of the size of the cube. So here two levels of consciousness are active simultaneously: I know the exact solid and permanent size of the cube and I also know how to show that parts of the cube are near to the centre of my body and some are more distant

If you look at figure 25a, the lines that indicate the horizontal edges of the cube are drawn in two different kinds of perspective.

- The hands that are "holding" the vanishing points illustrate a linear central two-point perspective
- The low lines – beginning at the tip of the thumbs, combined with the parallel upper horizontal edge-lines – illustrate an isometric perspective

You can say, that the isometric perspective represents the tactile experience of a constant distance between the parallel edges of the cube, and that the two point linear perspective represents the innovative visual communicating phenomenon, that the near part of the cube is represented as appearing bigger than the far away part of the cube, being re-presented logically as appearing smaller. That is a cognitively elegant way simultaneously operating with two different types of perspective. But these perspectives – or what they represent spatially and cognitively – are not confused by the drawing blind person, who is simultaneously being sure of the concrete parallel and solid shape of the cube and also able to depict it indicating the phenomena of as well distance as logic.
Merleau-Ponty says about our surrounding world:

> "The natural world is the horizon of all horizons, the style of all possible styles, which guarantees for my experiences a given, not a willed, unity underlying all the descriptions of my personal and historical life. Its counterpart within me is the given, general and pre-personal existence of sensory functions in which we have discovered the definition of the body" (p. 330)

The zone outside the body

The zone outside the zone of the body is most often in no way symmetrical, but instead arbitrary, sometimes chaotic, sometimes casual and must be detected "in medias res". (Laursen: 2003)

To blind people using all senses, this often means using a stick, to avoid risks, that is a major problem. Here we partly are outside the more comfortable 4D-scanner position, because now the scanner is moving around itself, so a much bigger space has to be detected when the detecting person is mowing around!

Estimating distance is a core phenomenon here: Simultaneous experiences from the zone outside the body, things far away get smaller confirmed multi sensorial experiences.

Logically the far away edge will appear smaller that the edge in the centre, because if things are more distant they tend to look a little bit smaller. That seems to be a part of also the Roman girls knowledge, and it is probably acquired as well outside as inside the zone of the body.

Therefore, if parts of parallel sides are more distant that the part in front they will tend to appear smaller, as the road does for sighted and for blind people.

If the far away parts of the cube tend to appear smaller the line of the edges will tend to converge.

If the lines converge they will meet in a point like the road experience. For the blind drawers these logically and spatially meeting lines will cross in the *innovation,* the *invented* Vanishing Point(s).

If the vanishing points are related to the zone of the body they can be reached, as I show in figure 21, 25 and 25a.

If the vanishing points seem to be "reachable" they will be relatively close.

If the vanishing points are relatively close, they will have a good chance to be inside the edge of the drawing area.

Here we start to see *analogies* between the logical constructive experiences made by blind and the pedagogical double strategy I developed for sighted people.

If the vanishing points are inside the edge of the drawing area the tendency of converging may seem to be exaggerated, in both cases underlining a logical constructive principle visually.

If the tendency of exaggerating the converging of the lines towards the vanishing points is clear, it is a pedagogical enhancement making the principle of converging more clear, it will – as I showed with sighted people – reduce the tendency of making constructive faults.

Merleau-Ponty says about logic:

> "Expressed in more general terms, there is a logic of the world to which my body in its entirety conforms, and through which things of inter sensory significance become possible for us". (p 326)

Haptic examination is an empirical action, a kind of examining or scanning theatre, acting on the object to be studied by touch of the hand(s), so that the examiner in principle is able to re-enact the movements this tactile scanning examination had caused, re-enacting without the object, the movements being registered cognitively, spatially and figuratively over time as potentially re-creative movements.

Drawing also is an empirical action that enacts the former re-creative results of the tactile examination and by spatial analogy three-dimensionality is turned into two-dimensionality, the drawing person intending and succeeding to transfer and fix the spatial results to the picture plane so a drawing of the cube emerge over time, the fourth dimension.

Combined zones

I move my "zone of my body" round in the world when I move my body, because my zone of my body is always also in the zone outside the zone of the body.

> External perception and the perception of one's own body vary in conjunction because they are the two facets of one and the same act" (p. 205)

We are existentially equilibrists. The principle of always being in both zones simultaneously and sometimes even more than that Merleau-Ponty says:

> "I have the impression that the world itself lives outside me, just as absent landscapes live on beyond my visual field, and as my past was formerly lived on the earlier side of my present". (p. 333-334)

The primary attention can be in one zone for a time, but a secondary attention will always be present immanent, also when a blind person is using a stick, feeling simultaneously the hand holding the stick and feeling the end of the stick:

> "Learning to find one ´s way among things with a stick, which we gave a little earlier as an example of motor habit, is equally an example of perceptual habit. Once the stick has become a familiar instrument, the world of feelable things recedes and now begins, not at the outer skin of the hand, but at the end of the stick" (p. 152)

And he continues:

> "The pressure on the hand and the stick are no longer given; the stick is no longer an object perceived by the blind man, but an instrument *with* which he perceives. It is a bodily auxiliary, an extension of the bodily synthesis. Correspondingly, the external object is not the geometrised projection or invariant of a set of perspectives, but something towards which the stick leads us and the perspectives of which, according to perceptual evidence are not signs, but aspects." (p. 152)

Blind people live different lives from sighted people meaning, that they constantly have to build a series of hypothesis about the zone outside the zone of the body: what it there, what surrounds me?

> "Whether a system of motor or perceptual powers, our body is not an object for, "I think", it is a grouping of lived-through meanings which moves towards its equilibrium" (p. 153)

I think, that when a blind person feels the edge of a cube moving the fingers along it gathers spatial aspects of the phenomenon as a lived-through process and it continues to work its way through the connected drawing work also as a performed lived-through process.
Maybe following sentences should be read from behind:

> "Space is not the setting (real or logical) in which things are arranged, but the means whereby the position of things becomes possible" (p. 243)

Final conclusions

I think that I can conclude, that what I have named "the zone of the body" to some important degree plays a different and more specified role to blind than to sighted people.
I also think that I can conclude that blindness to a considerable degree means a reduction of the complexity of linear perspective drawing.
Blind people do enact physically (like a 4-D scanner), when they examine a cube, touching it cautiously; sighted people do not, primarily they just look at it.
Clear logics and physical enacting – detecting the cube by moving the hand(s) away from the centre of the persons body, feeling and detecting the form of the cube – creates the innovation, the emerging vanishing points in the universe of the blind person, they are born out of this process where directions, size and size reduction are brought together experienced in a "lived through" process. The far away part of the cube is depicted smaller than the nearer, to communicate distance, inventing the linear perspective, logically creating vanishing points because the diminishing distance between – and crossing of – the vanishing lines, but the blind person is simultaneously fully aware of the concrete physical parallelism between the edges of the cube, which might have resulted in a drawing of the cube, showing an isometric perspective. But the blind person invents the elegant linear perspective solution because of an impressive spatial equilibristic and some times innovative competence.
I think there is a strong parallel between feeling the object of a cube, enacting the finger-moving, touching-the-surface process over time, and the enacting of the drawing-process over time, plus finally the finger touching process of the enacting of feeling-the-drawing of the cube over time.
I also think that I can conclude, that blind people's way of drawing a cube and the pedagogical double strategy I developed, to some degree operates analogically, seeking reduction of complexity, meaning reducing perceptually complex empirical motifs in front of sighted people to more clear cut linear constructions (short distance between vantage points), so the drawing principles over time will also help sighted people to look at and visualise more complex linear phenomena sufficiently.

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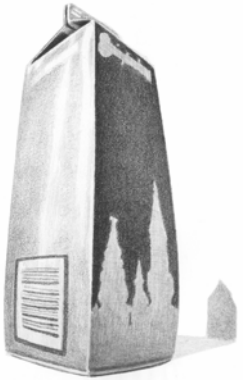

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