

# John M Kennedy, U Toronto

- PMU 199H1F Oct 24th 2013 UC1773/BA5166 11-1

- Perception:

- Seeing & Pictures

- Bases of perception reveal HOW THE BLIND DRAW
- Six uses of line in pictures, foreshortening in vision & touch, crosstalk illusions and metaphor  
This is a richly illustrated talk about the basis of perception. The conclusions are controversial.  
**What is a picture in vision and touch?**

- Features in pictures by the sighted and the blind include 6 kinds of surface edges -- edges evident in cave art.
- Edges are perceived from a vantage point — so Renaissance linear perspective applies to the visible and the tactile environment.

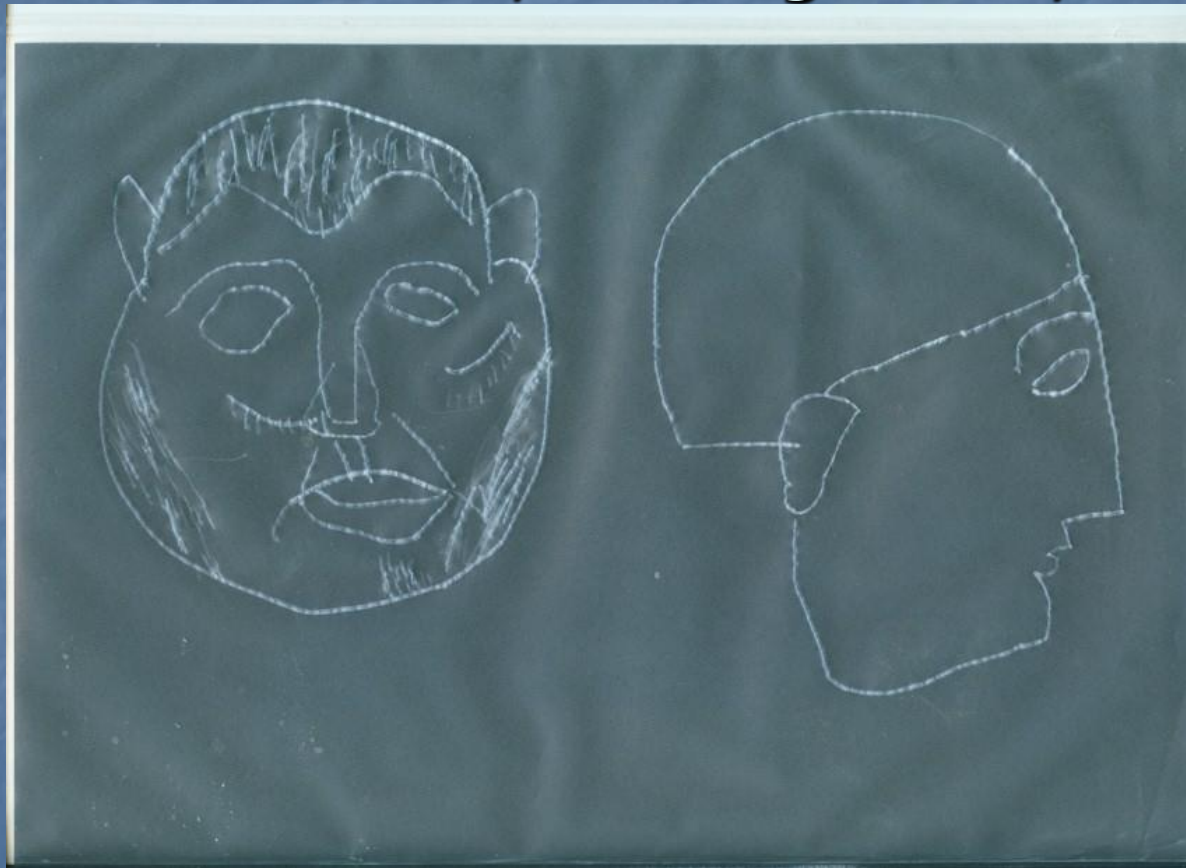
- Picturing unrealistically is a way of creating metaphors. Using metaphors, blind and sighted artists depict impressions and thoughts.

**Shortly:** I am a perception psychologist,  
born in Belfast, with PhD Cornell on a  
thesis about outline drawings, & author of  
*Drawing and the Blind* and  
*A Psychology of Picture Perception.*

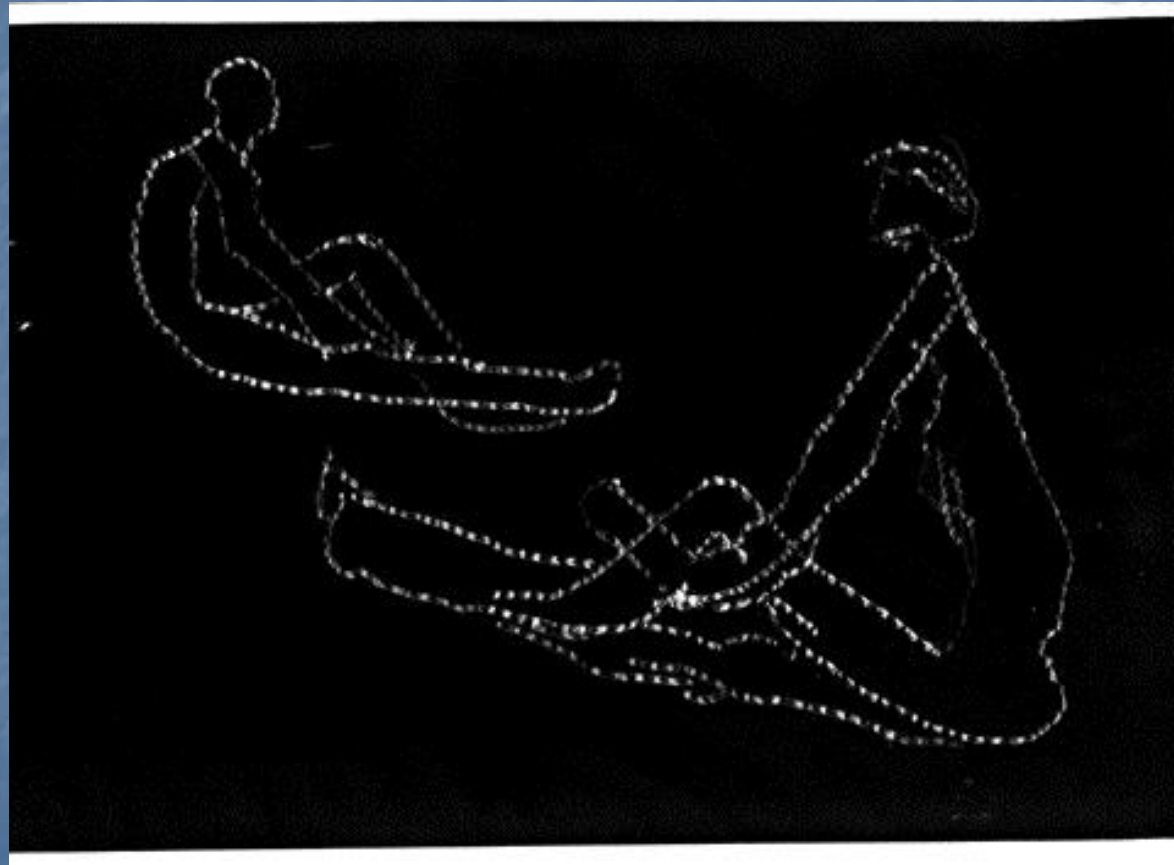
# Thanks for the invitation

- Thanks for the opportunity, Karan Singh

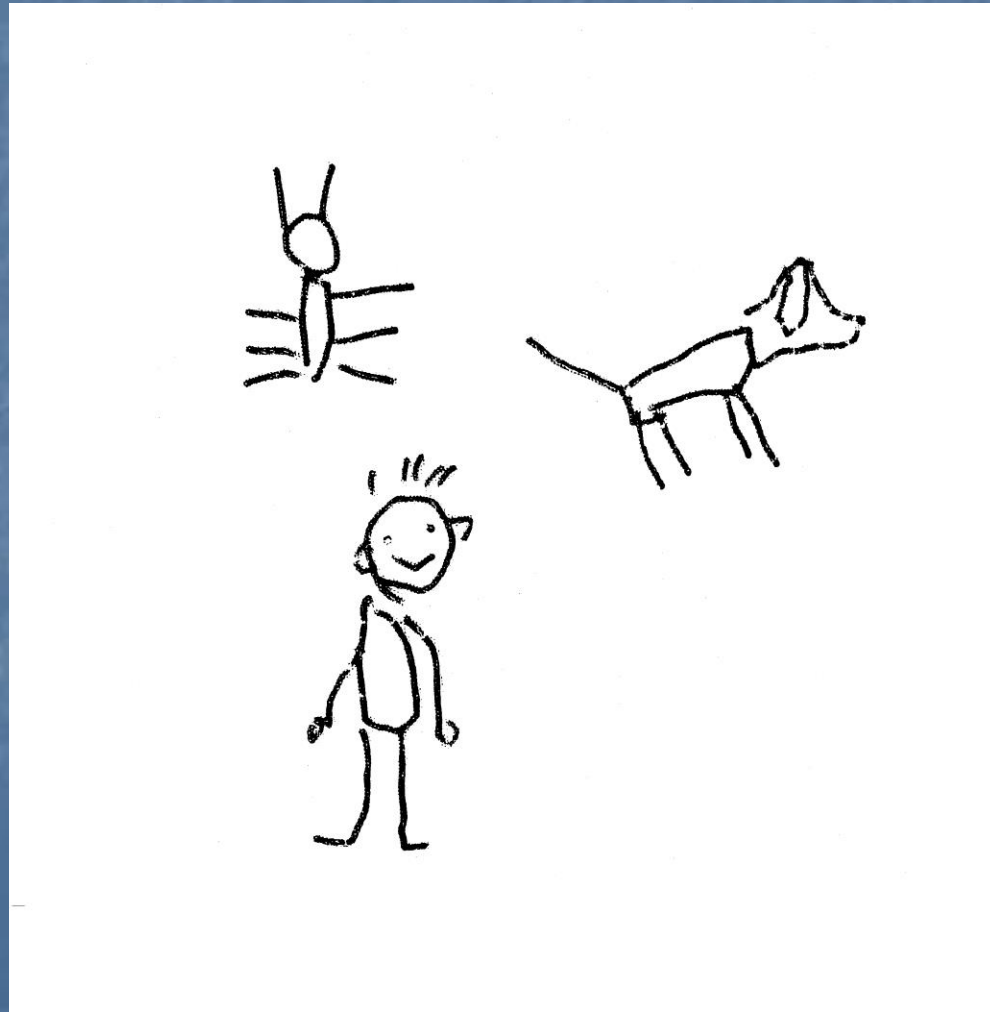
Several investigators have found the blind can draw: See here raised-line drawings of heads by early-blind man (via Heike Hamann, Bode gallerie, Berlin)



Raised-line drawings of seated, posed figures by early-blind woman  
(via Heike Hamann, Berlin)

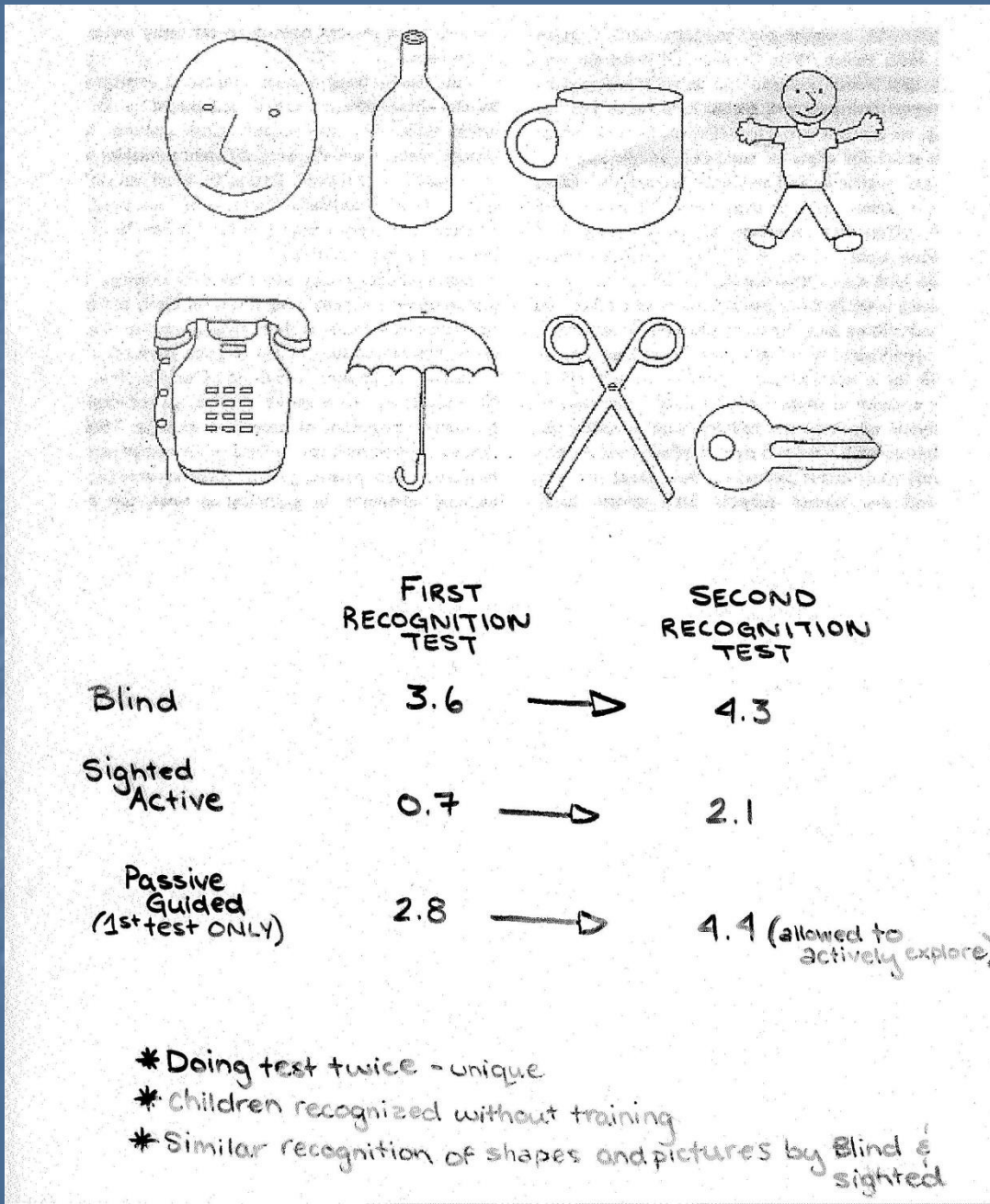


Example of a raised-line drawing by an early-blind woman: T T from Toronto: insect, dog & person:  
Lines show edges. The observer's vantage points are ABOVE, SIDE and FRONT.





Independence  
 expt by Ottawa  
 psychologist Amedeo  
 D'Anguilli et al.  
 He gave 8 raised-line  
 pictures in two  
 recognition tests,  
 with no feedback to  
 children aged 9. The  
 blind children  
 recognized more than  
 blindfolded children  
 on average.



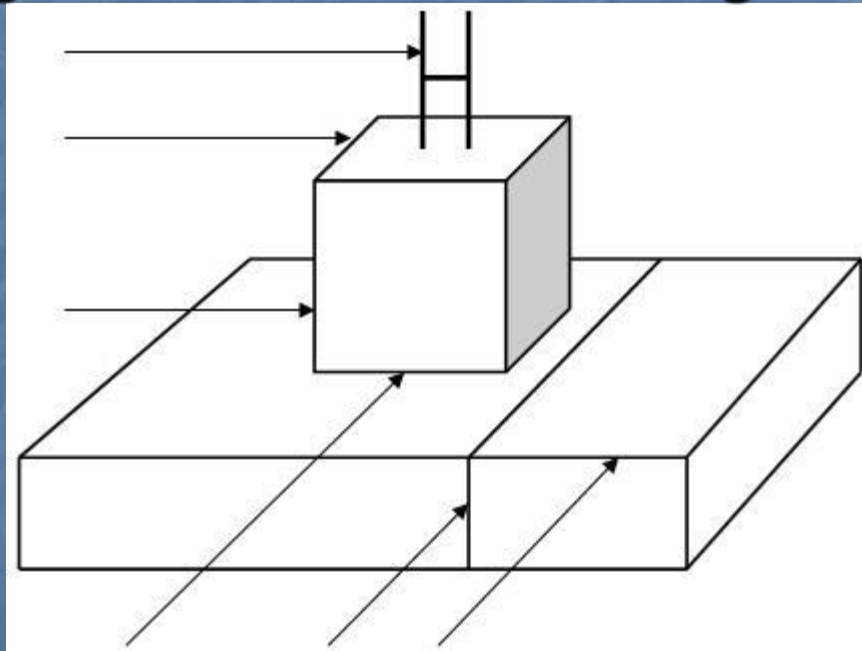
## Theory of perception: Key claim by JMK

- Outline stands for surface edges
- What is a surface? A polarized continuous plane i.e. a continuous grouping of elements with the quality: 2 orthogonal slants at any point.
- What is an edge? A polarized 1dimensional limit to a surface.
- Surfaces and edges are visible and tangible.
- Outline is evident in cave art. It can be used via touch (evidence in raised-line sketches recognized or drawn by the blind).

# PART 1: ELEMENTS

- The line shows foreground-background.
- in both dotted and continuous line drawings.

6 foreground-background (f, b) options for surfaces are shown by arrows: bfb, fb- meaning no definite background surface, fb+ meaning there is a definite background surface, ff with one foreground surface continuing beyond the line, fbf, ff with both foreground surfaces ending at the line.



# Cave art

- Pictures date from c. 40,000 bce
- Earliest known = Australia
- (bird pictures, found 2010)
- Other early pictures:
- Le Chauvet cave, France
  
- What do they show with lines?
-

Australian cave art: Bird  
40,000 bce: outline f/b at back,  
b/f/b at talons



Chauvet 30K years bce used line  
for surface edges, mouth crack (f/b/f),  
tail

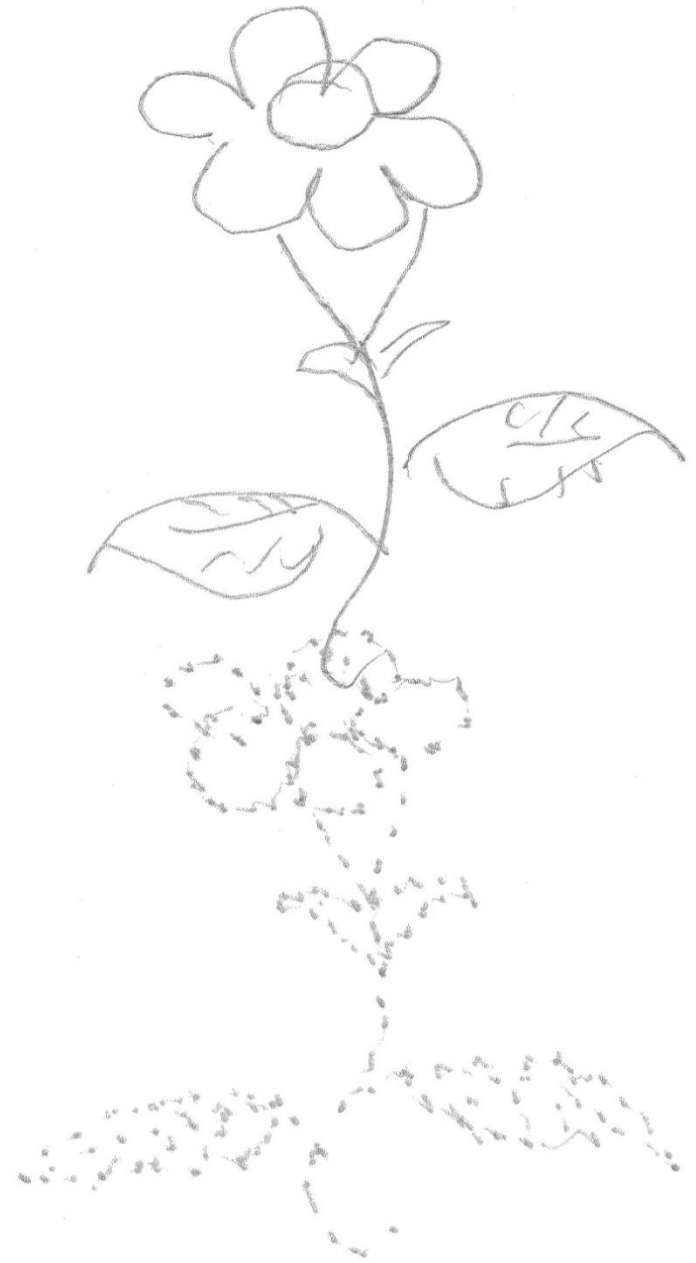


# Dotted lines: .....

- Dots group as lines and show surface edges.
- In some way they are equivalent to continuous surface edges.
- NB it is not true that continuity in perception means there is a continuous thread in the brain.
- That would be a picture theory of perception, meaning we see because we LOOK AT properties of reactions in our brain, like pictures in our brain. This leads to an infinite regress. To see GREEN (or continuity) neurones do not TURN GREEN (or become continuous.)



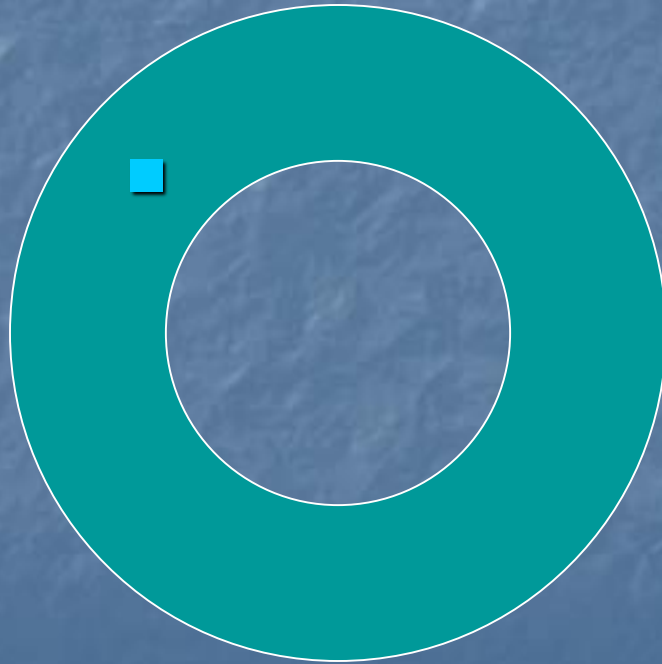
Solid & dotted  
lines show  
surface  
borders :  
Flowers  
by Esref  
(born without eyes)  
NB As a boy he  
drew by making  
dots in a card with  
a nail



# Equivalence

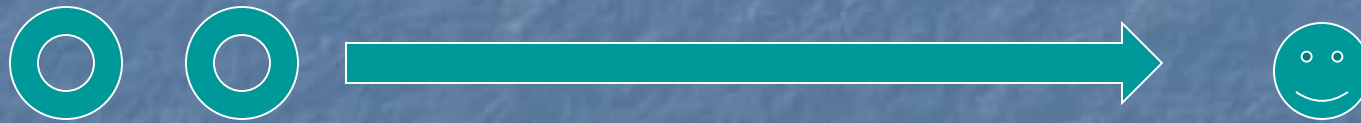
- Solid line, dotted line and continuous surface edges are equivalent in perception
- How? They must trigger a common mechanism.
- Which body mechanism?

A retina has many little ● regions full of receptors surrounded by a big ○ ring of other receptors. The receptors feed C cells deeper in the visual system. The deep C cells fire if the light on ● centre and ○ surround is not balanced.



# Retinal centre-surround receptive fields: Dot/line/edge

- THEORY: Dots trigger centre-surround C cells. Two C cells (Centre Surrounds) trigger an upper level cell C+



- Continuous line would also trigger C+
- Therefore both continuous & dotted lines trigger C+ cells

Luminance contours also trigger C+ cells:



# Continuity

- Q: A set of dots is seen as equivalent to a continuous surface edge.
- But a continuous surface edge is not equivalent to a dotted line. WHY?
- A: The dots trigger a continuous function
- E.g.  $y = ax + b$  or  $y = ax^4 + b$
- *These functions can be specific to a part of an environment: A means B is present. A giraffe pattern only came from giraffes prior to pictures. Specificity in that environment is information*

Outline shows surface edges:  
It does not show ALL types of  
edges. Line versions of shadow  
edges fail.

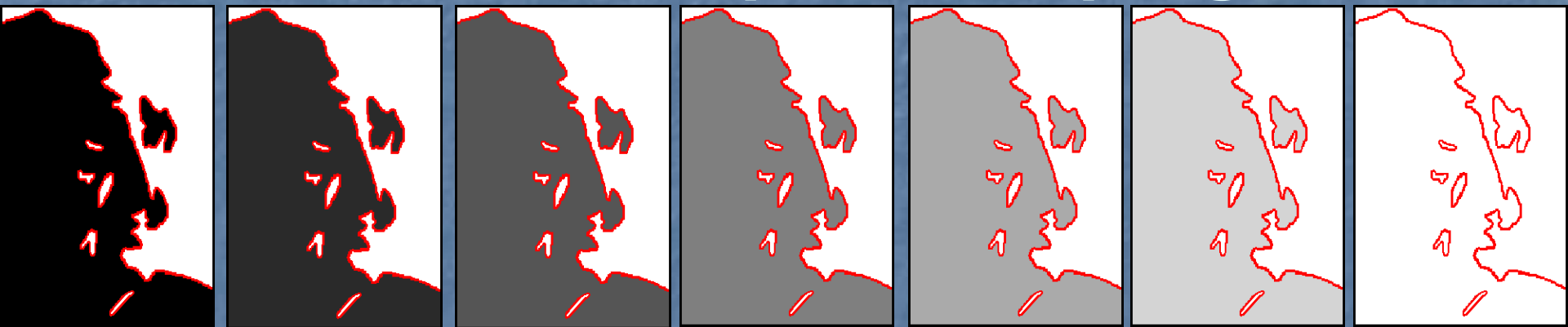


Lines do not show purely visual borders e.g. shadows. The woman's mouth in the line version is unrecognizable. Negative contour blocks shape-from-shadow processing.





# Shadowed face vanishes in line: Dr Juan Bai (PhD UT) figure



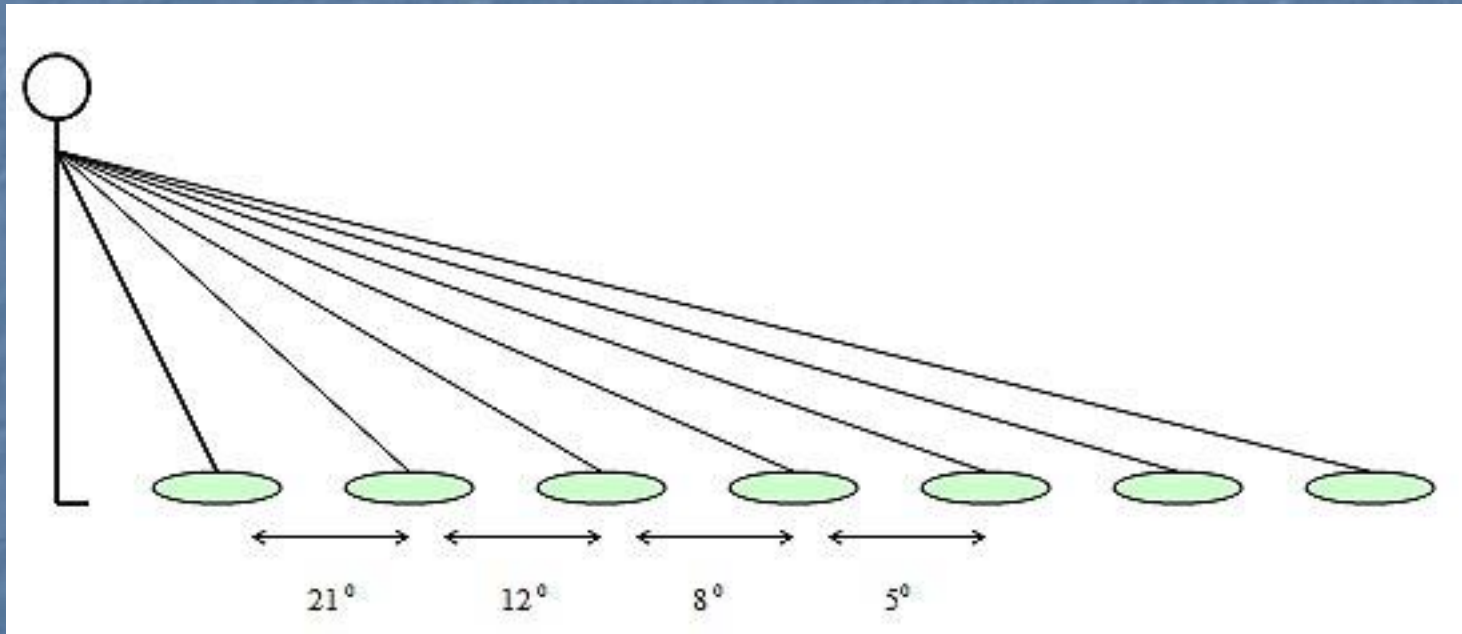
# Part 1: ELEMENTS : SUMMARY

- Surface edges are shown by outline
- Dotted and solid lines both trigger C+ cells
- Additional hypothesis, untested yet: there are 8 kinds of bases for visual borders:
- 2X2X2 combinations of = brightness/colour X monoc/binoc X static/kinetic.
- Outline may work in all 8.

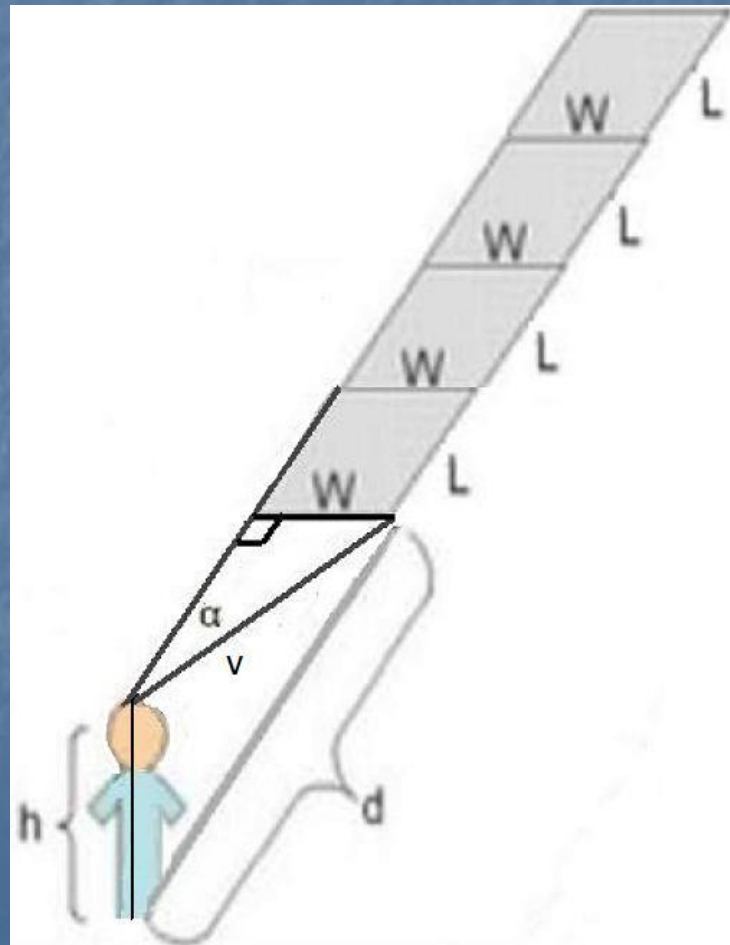
# PART 2: Perspective & Realism

- Edges have directions from our vantage point in vision AND TOUCH.
- Directions are governed by perspective.

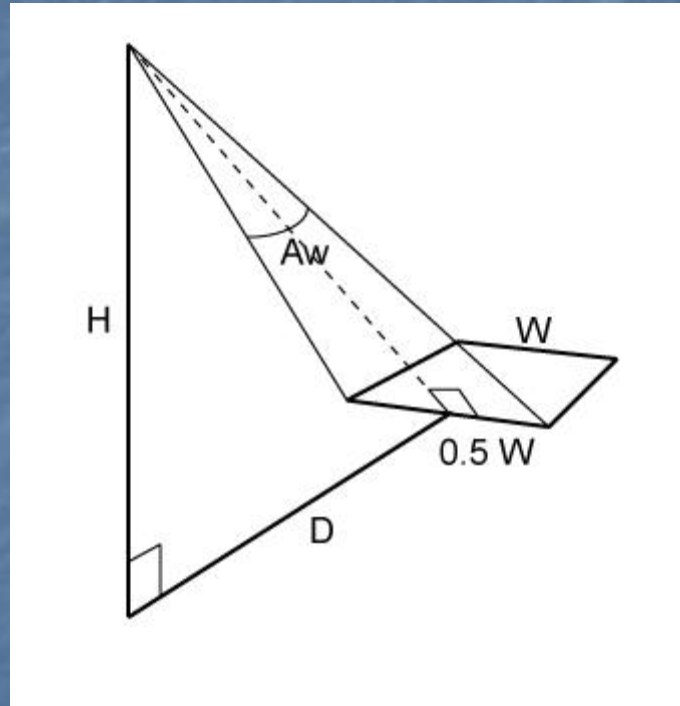
Perspective: Elevation angles.  
Spaces between steps shrink quickly  
with distance: Quadratic rate



Perspective: Azimuth angles  
(projected by width  $W$ ):  
Angles subtended by  $W$  shrink at a linear  
rate with distance

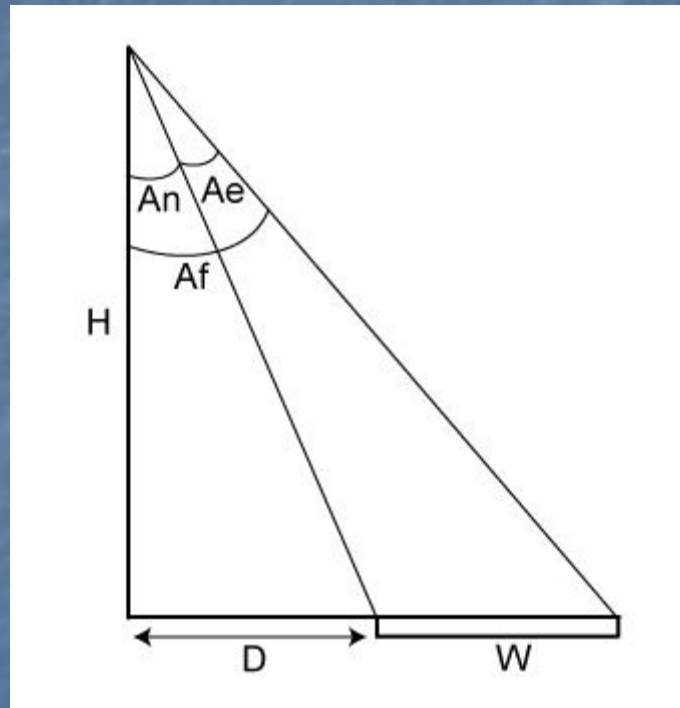


# Azimuth – width of a tile projects angle $A_w$

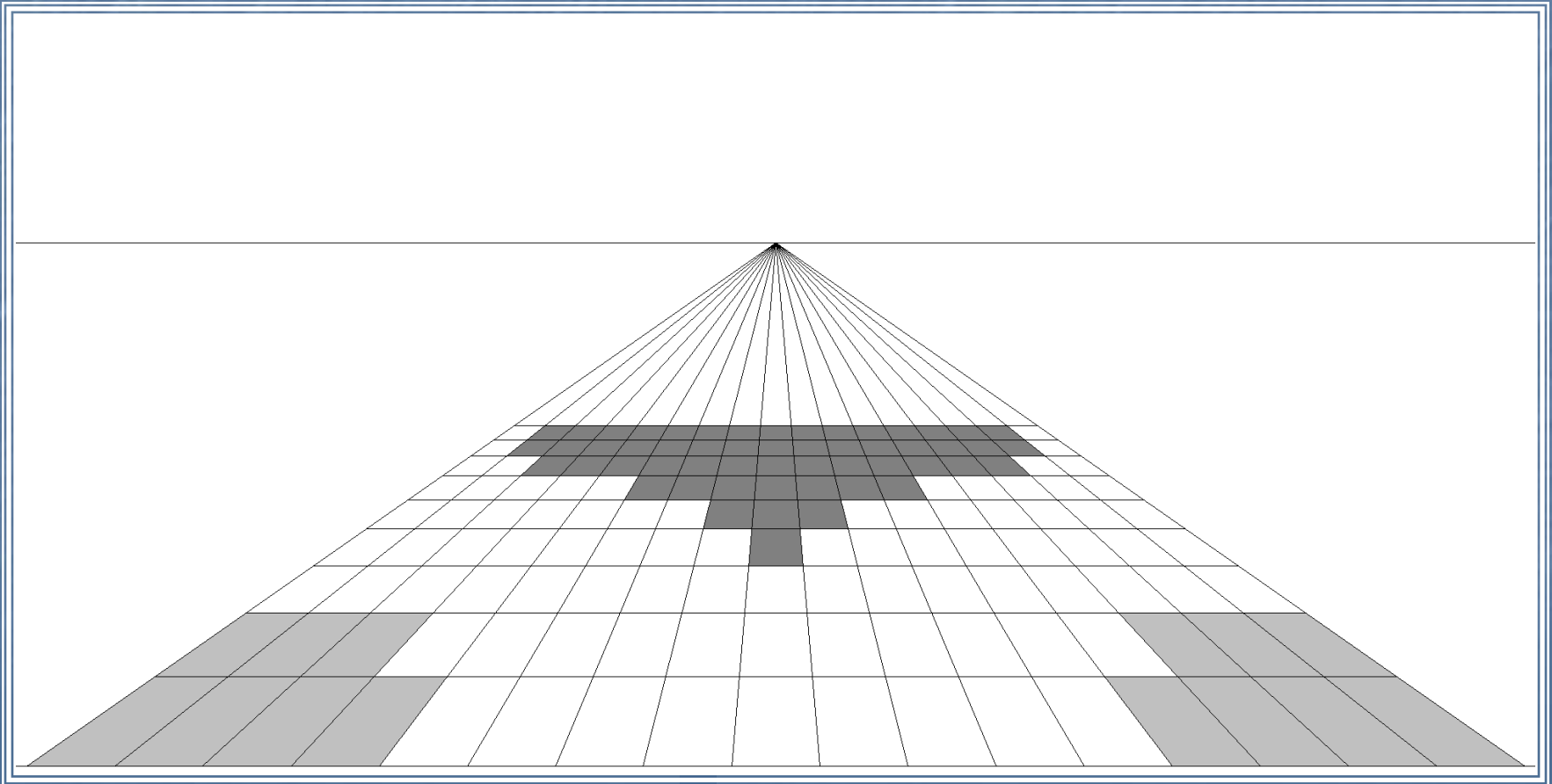


# Elevation

The Ae angle of a tile is governed by the tile's depth

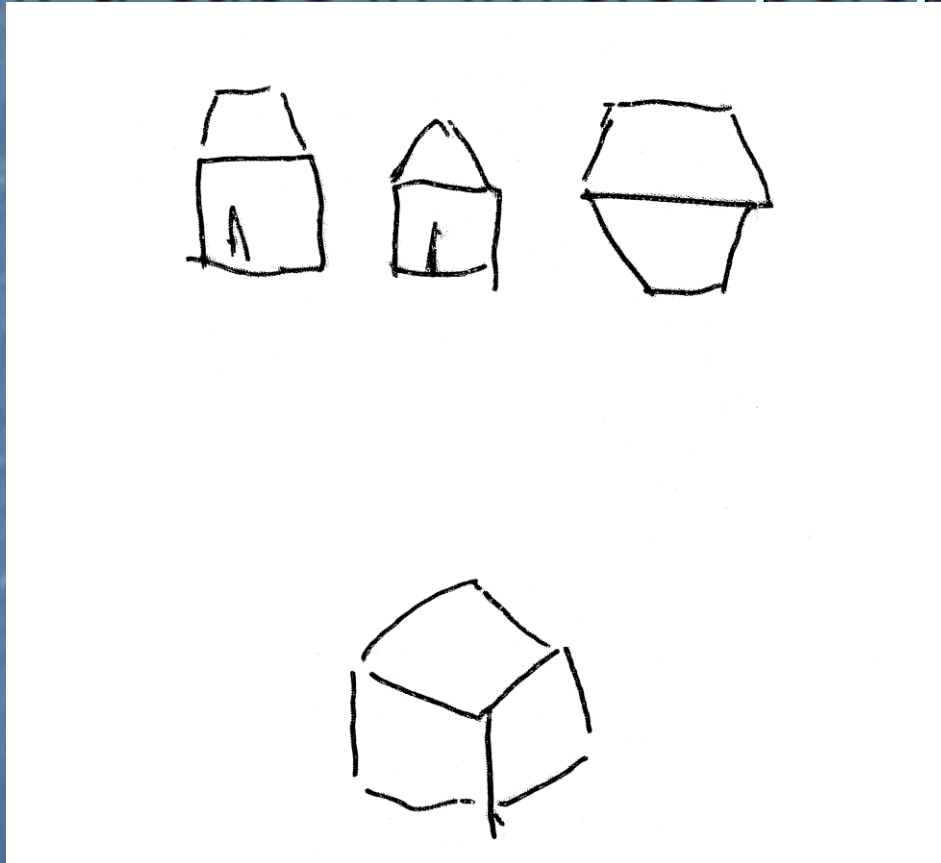


Depth (elevation dimension) changes faster  
(an inverse square law)-- than azimuth  
(width, a linear law): K & Juricevic





TT: Drew a house using convergence. Left: converges in one direction. Right: In two directions, shows 2 point perspective. Bottom: a cube in inverse perspective.

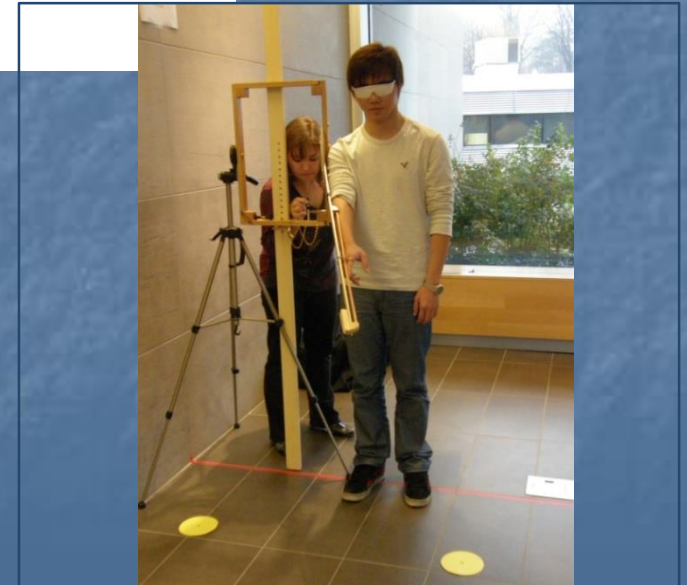
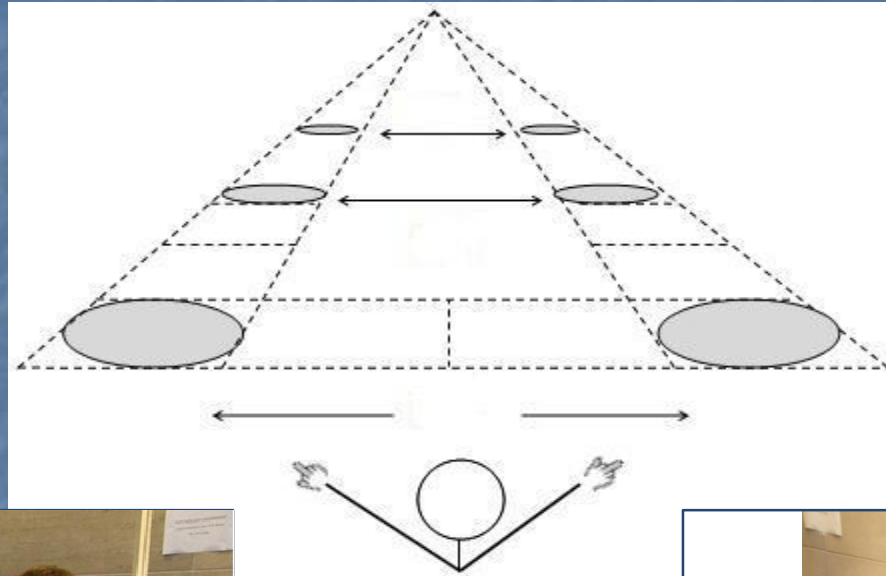


Hypothesis: We appreciate direction to parts of an object in touch as well as vision.

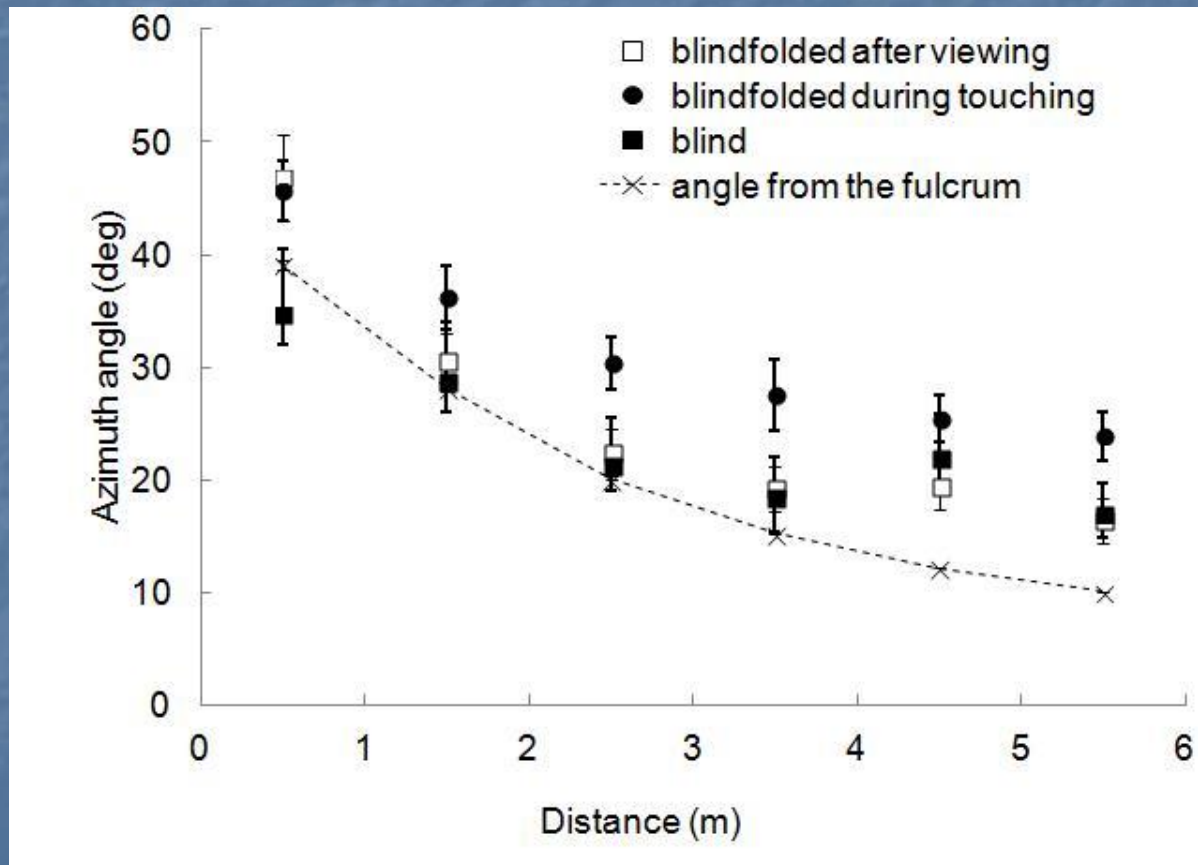
Expt: show paths of tiles to blind or blindfolded observers. Then ask them to point to the centres of the tiles.

Marta Wnuczko UT grad

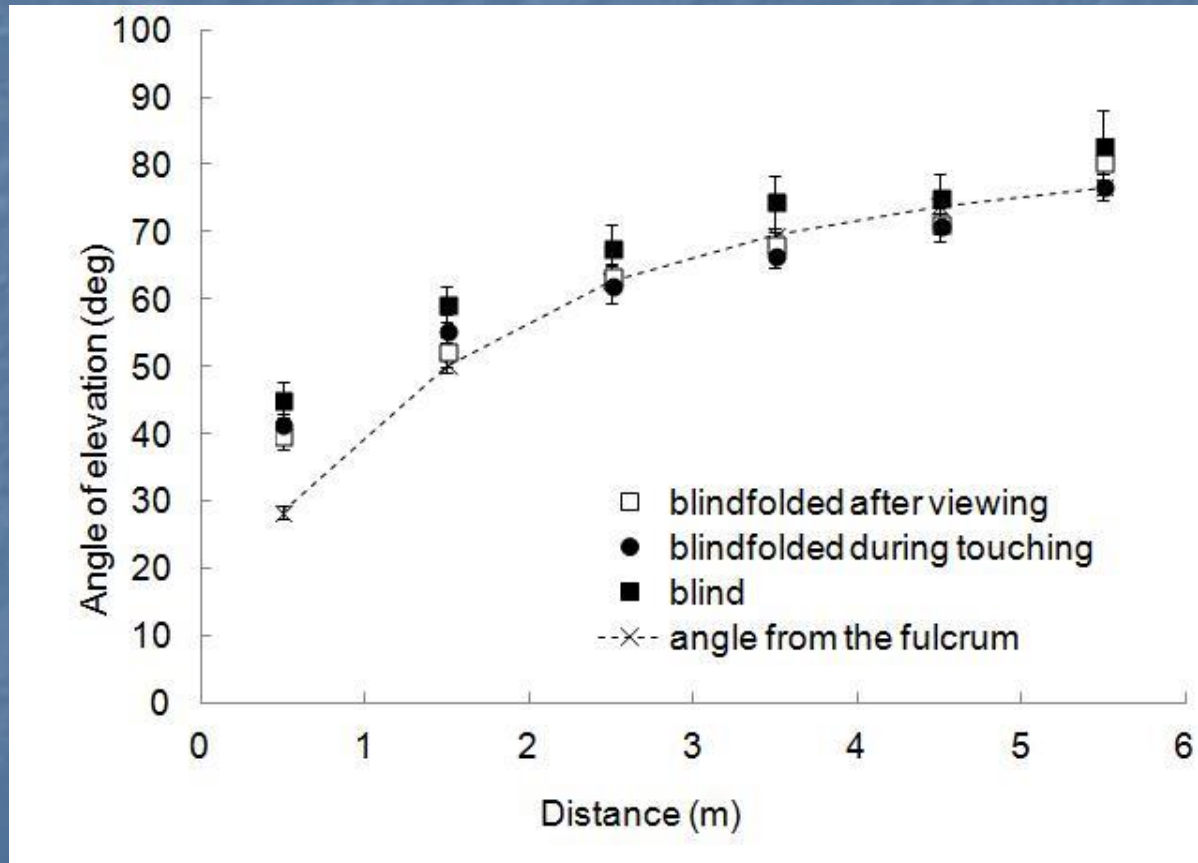
# Pointing in horizontal (azimuthal) & vertical (elevation) dimensions



# Wnuczko Experiment



# Wnuczko experiment



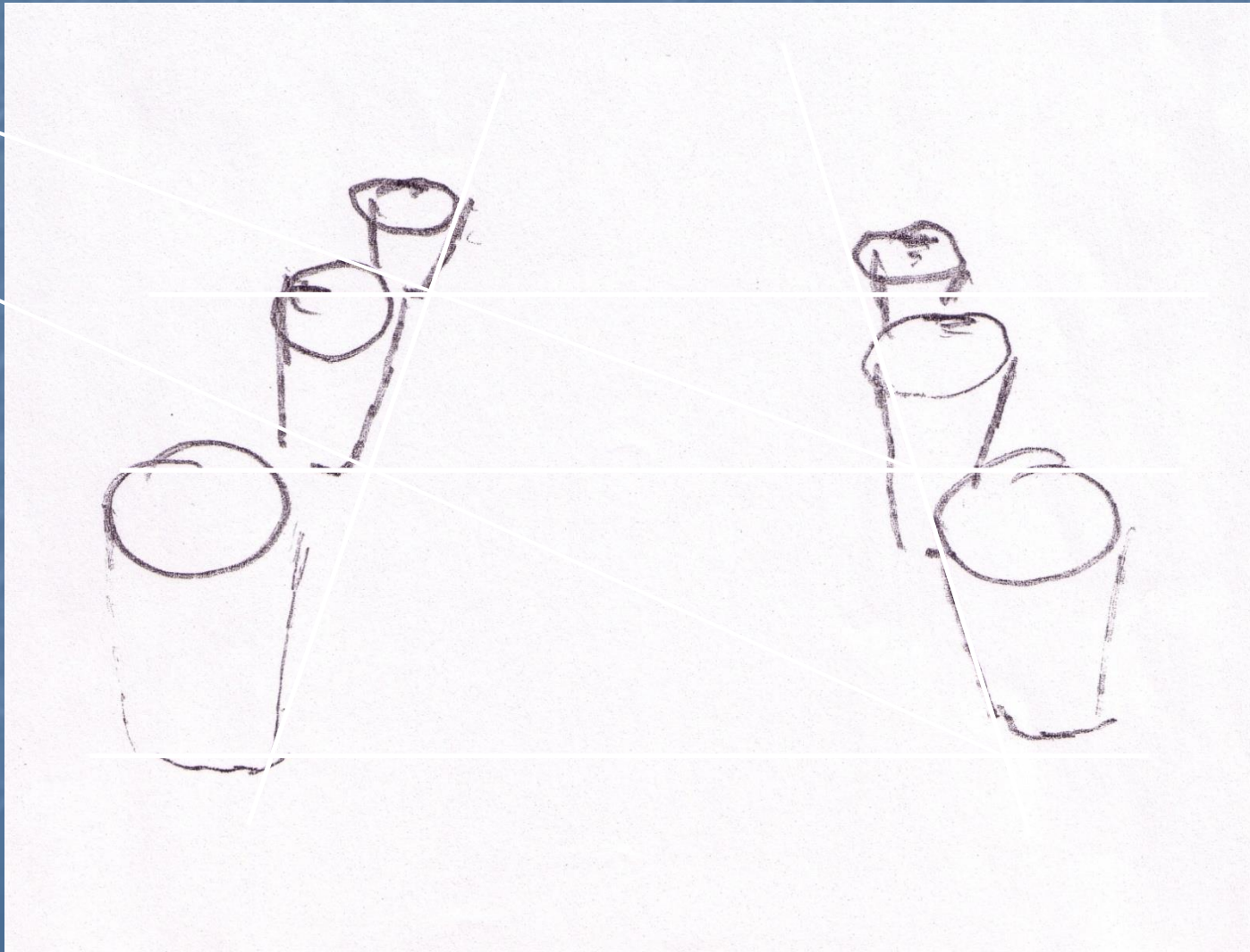
# Summary

- After viewing the circles or touching them with a stick while walking past them, participants pointed to targets blindfolded. Blind and blindfolded-sighted adults pointed similarly.
- Azimuth and elevation angles changed aptly with distance.

# Perspective is understood by blind

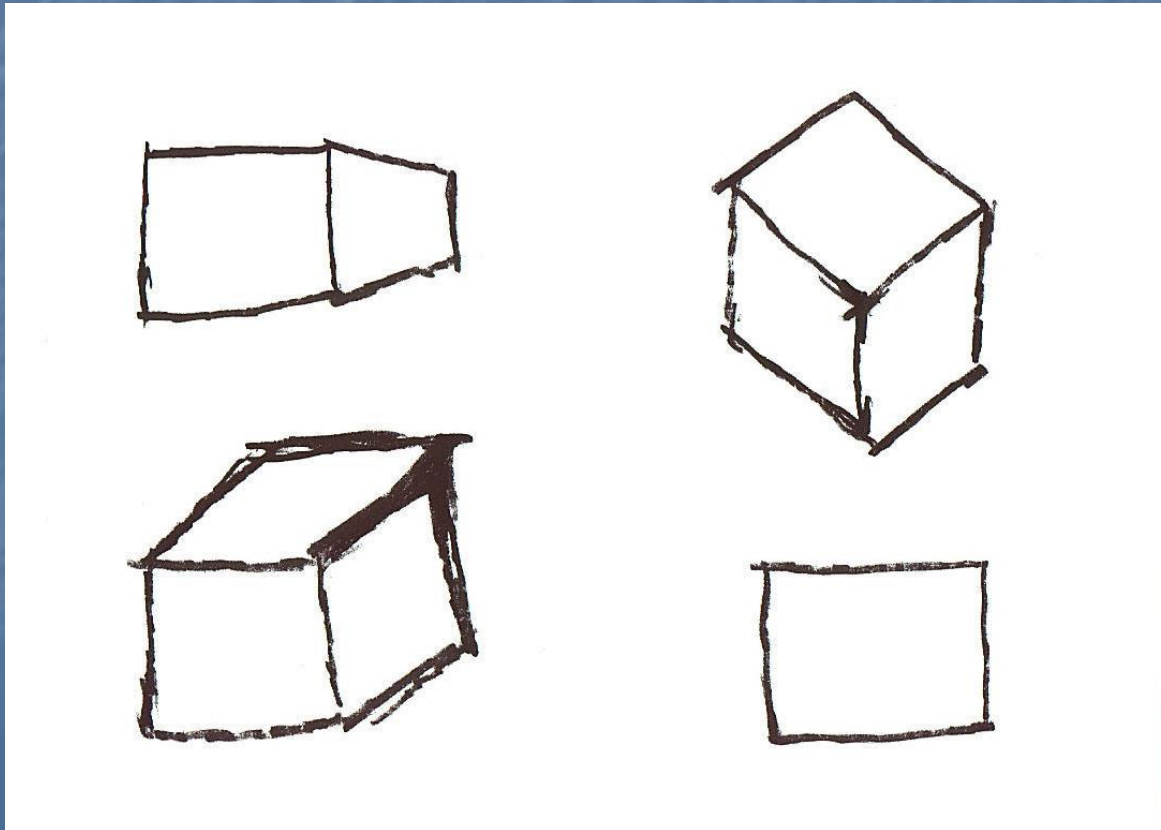
- Will they use it in pictures ?
- Pictures show a set of directions!
- **Esref:** Youtube: Extraordinary People: The artist with no eyes: Esref Armagan reaches over 1 million hits (removed for copyright reasons 2012). Re-uploaded with Turkish subtitles 2013 as [www.youtube.com/watch?v=Ii9VuuxBYk0](http://www.youtube.com/watch?v=Ii9VuuxBYk0)

1-Point: Esref & Savas Ceviz (Berlin 2011)  
MOVIE: "One who sees with fingers"

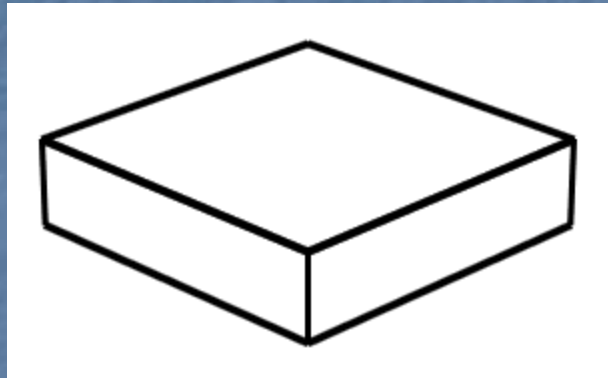




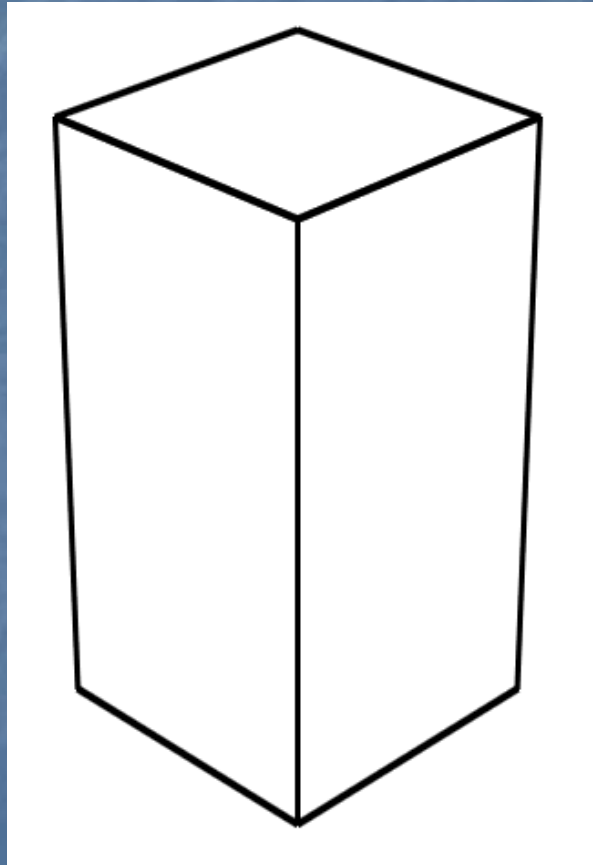
Esref: Cubes from vantage points: NB Sherief Hammad UT grad showed there is an angle illusion in the top right figure. Its top looks rectangular but its angles are acute and obtuse. Surface angles are biased towards what they depict.



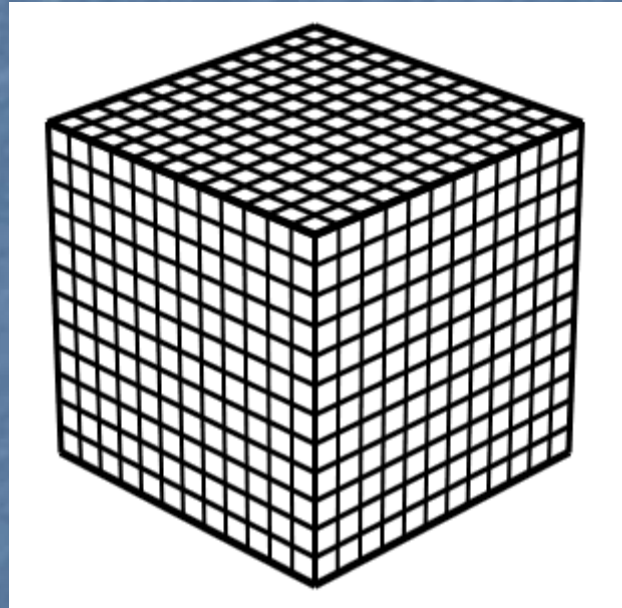
The picture-surface angle bias is present for thin tiles.



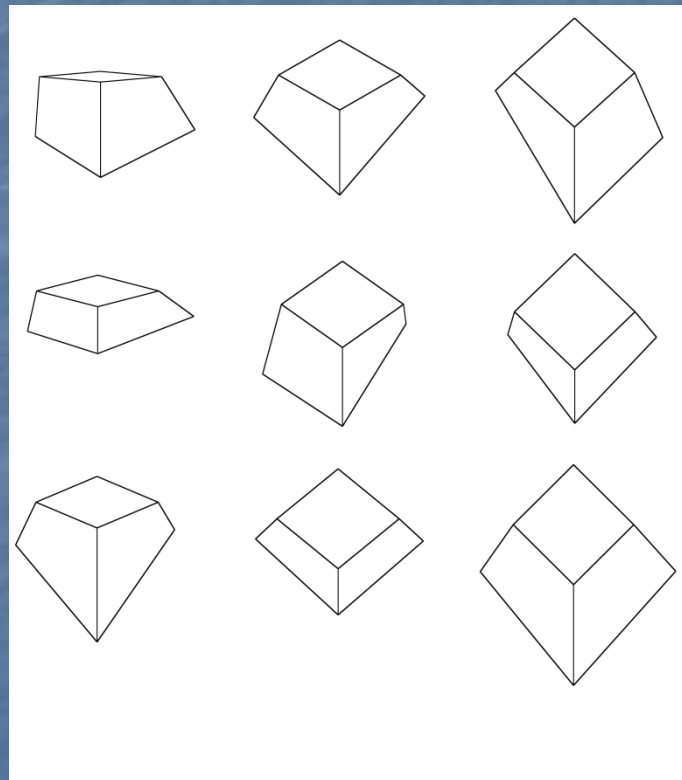
The bias is present for tall blocks.



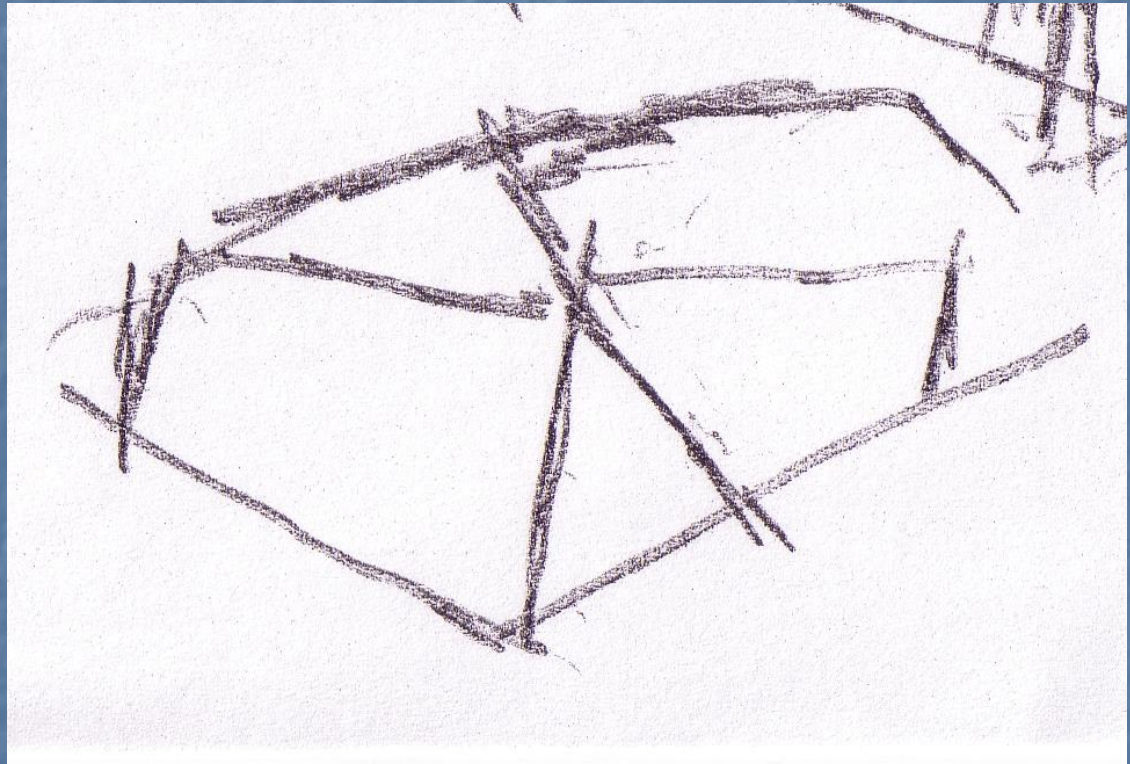
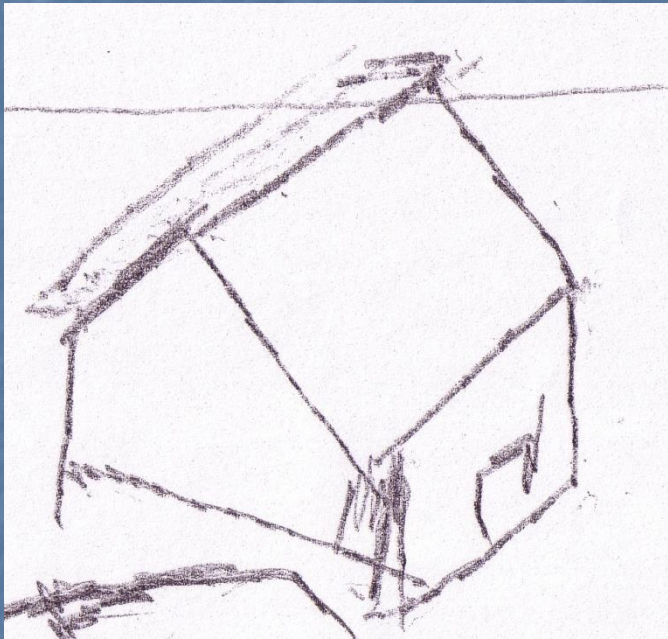
The bias is strong for textured blocks.



The bias is present for irregular blocks.



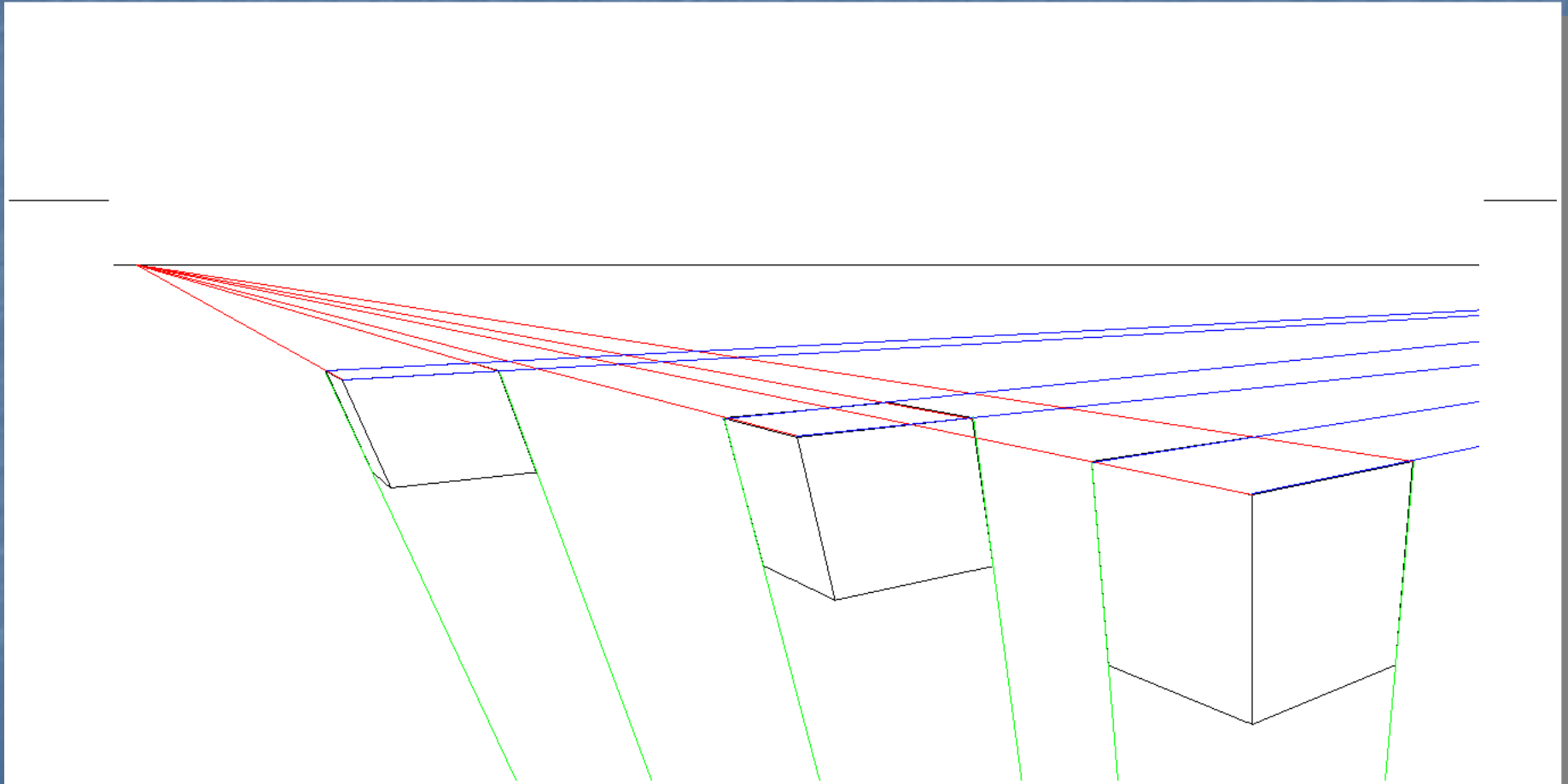
Esref: Left has parallel perspective.  
Right has 2-Point Perspective.



# Try drawing

- Draw three cubes in a diagonal row on a table.
- One cube is in front of you. You can see its front and top.
- One cube is farther and to the left
- One cube is farther still and more to left.

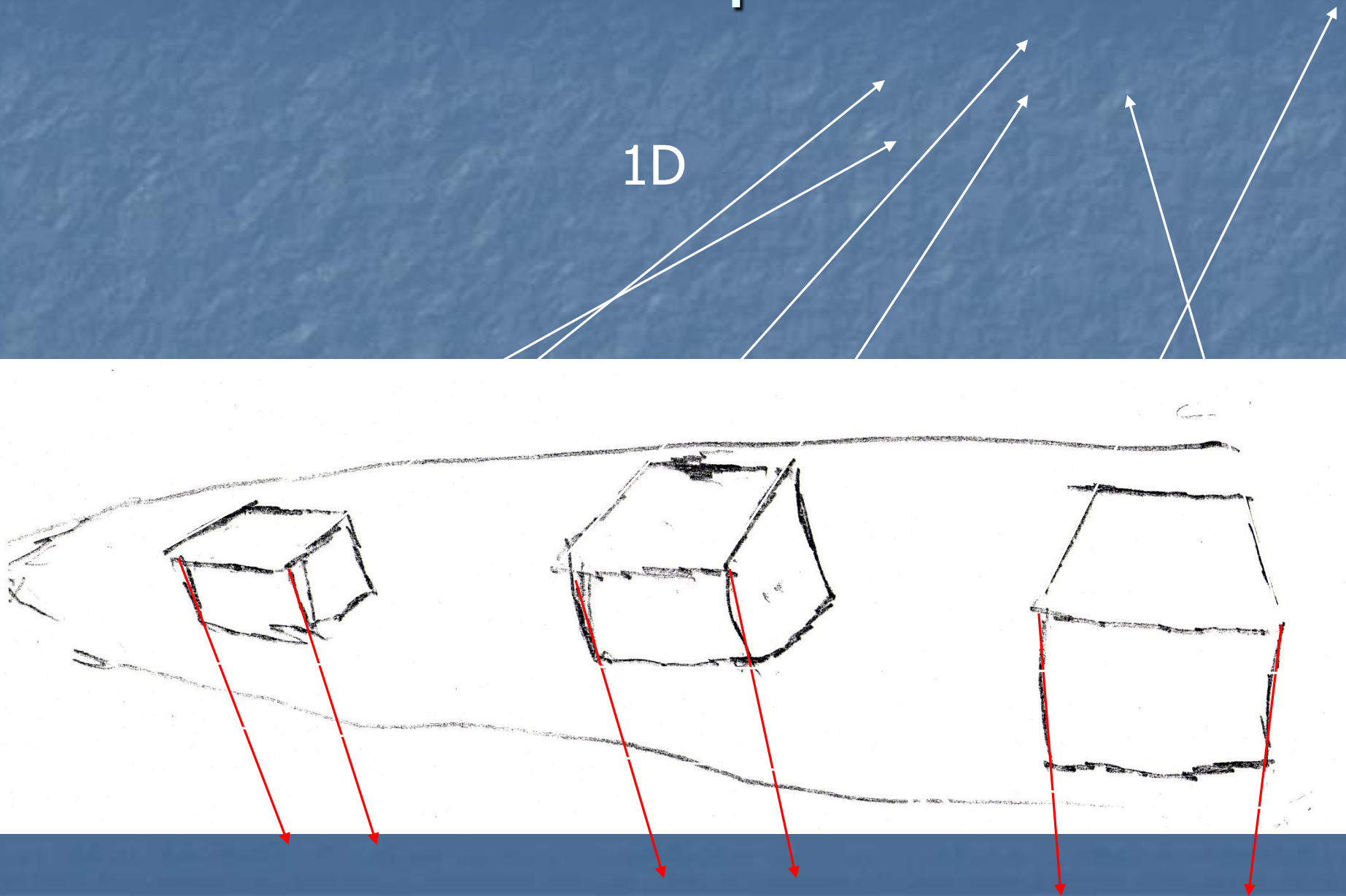
# 3-Pt Perspective: Convergence down: Blocks look tilted and not rectangular





# Three-Point Perspective? Esref

1D



# Esref and the Baptistry

- Discovery Channel, 2007

Florence: Baptistry: Where  
perspective discovered: 2 point  
convergence left and right.



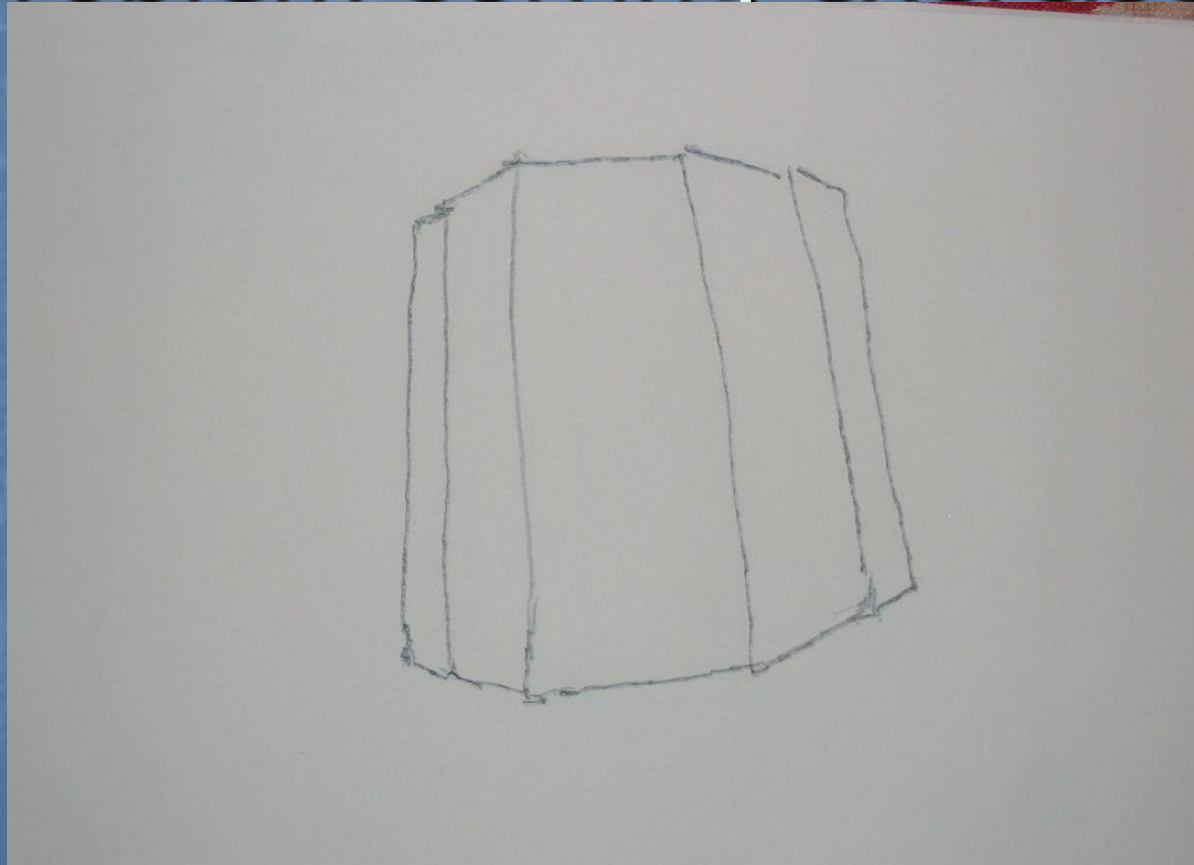
Please draw this building, Esref



Esref's drawing has 2 pt perspective.



Initial drawing has 3pt  
perspective?: Was this a  
Problem solving exercise?



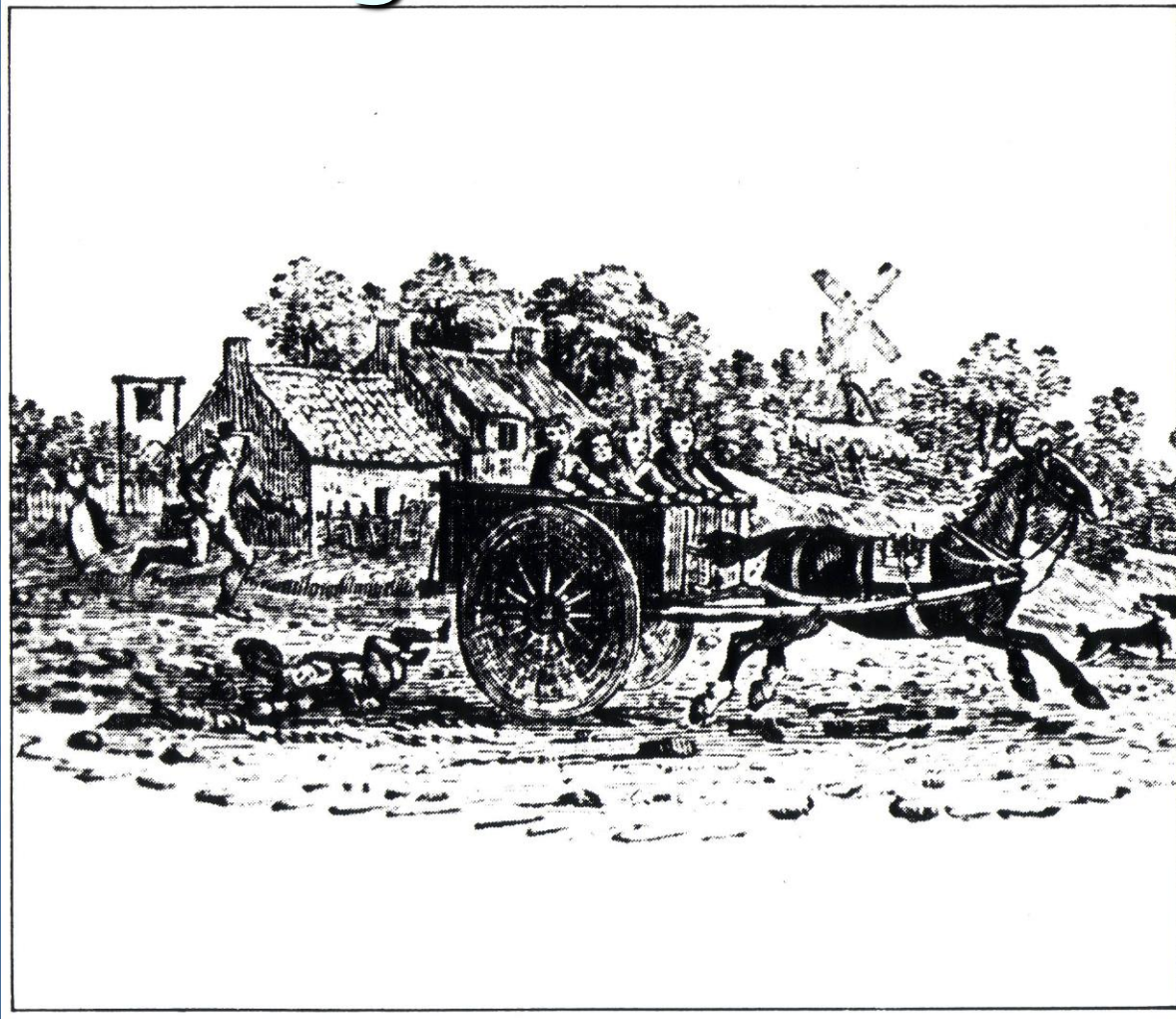
SUMMARY: REALISM =  
elements + geometry

NOW: PART 3

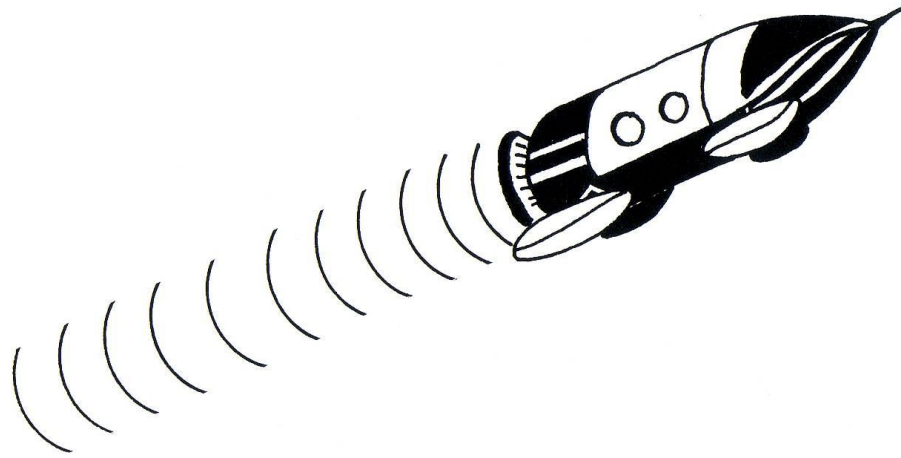
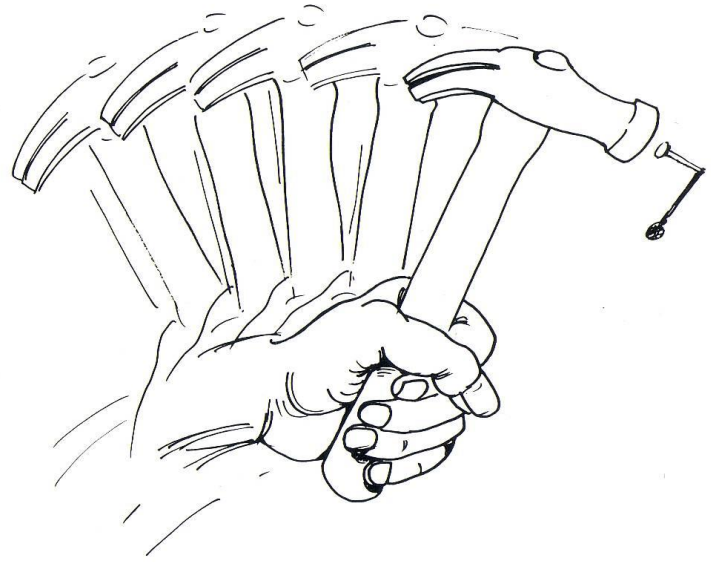
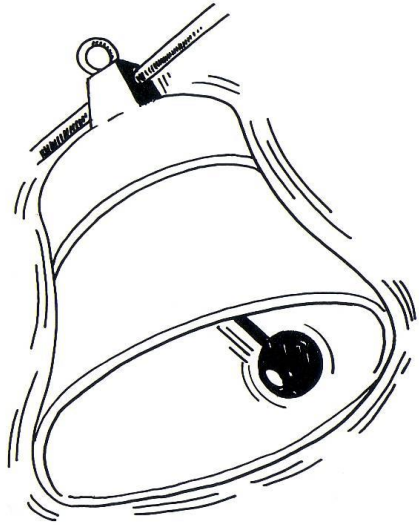
Metaphor in pictures:

We can violate  
the rules for line elements or  
the geometry of the world.

# Berwick 1810 invents motion devices eg circles and fading





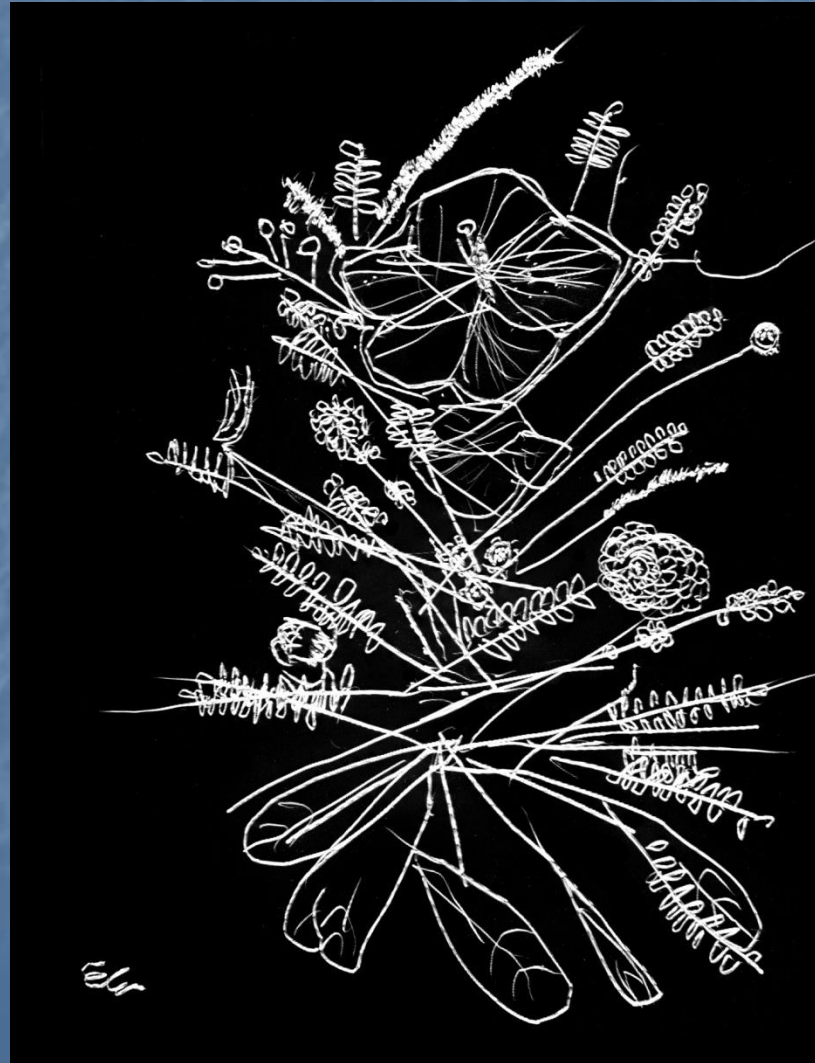


## Eriko (EW): Uses metaphor:

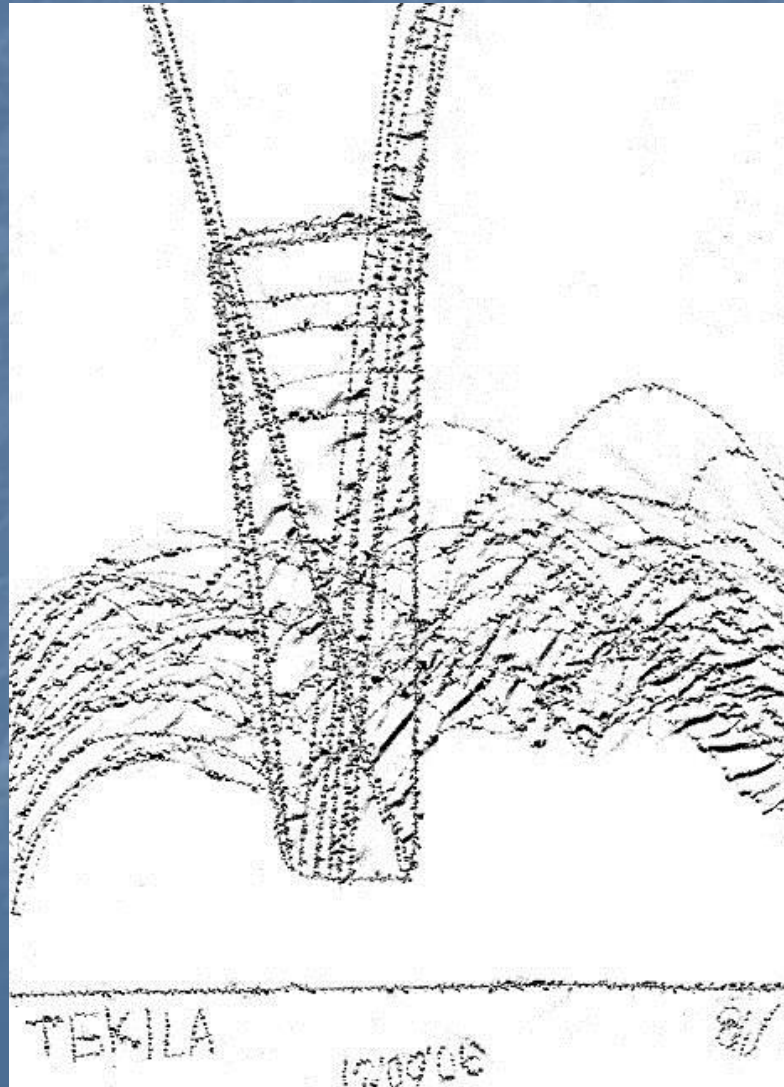
- Totally blind
- Early 30s
- Blind from early in life
- Was discouraged from drawing by her teachers in Japan
- Encouraged to draw by Elke Zollitsch, grade school teacher, Passau, at a meeting in Berlin, and started to draw

# EW (blind since 1): white line for edges

- EW: raised-line sketch:
- Bouquet of flowers.
- Spiky lower half suggested pain to one viewer



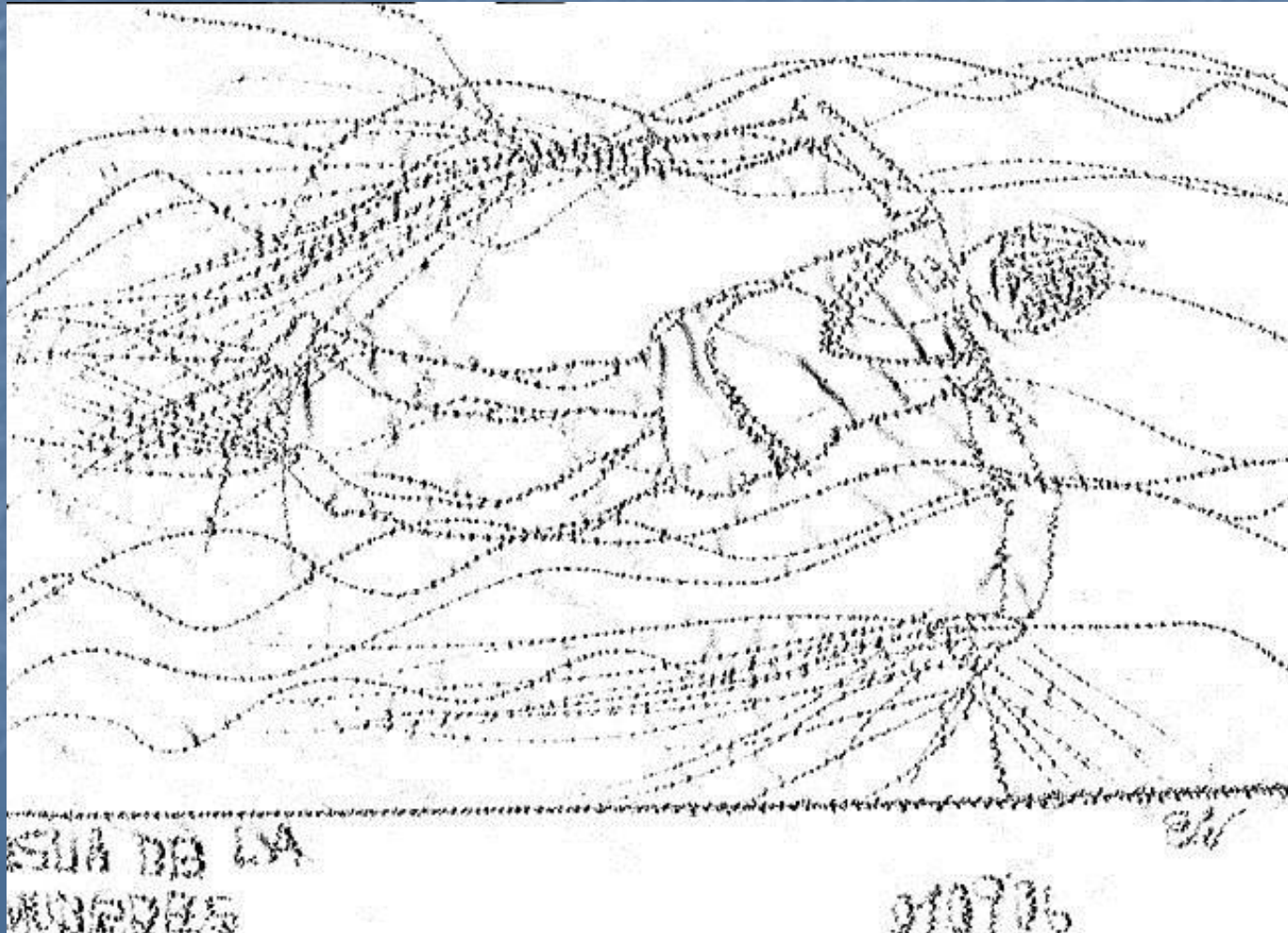
EW: metaphor of wavy lines for dizzy



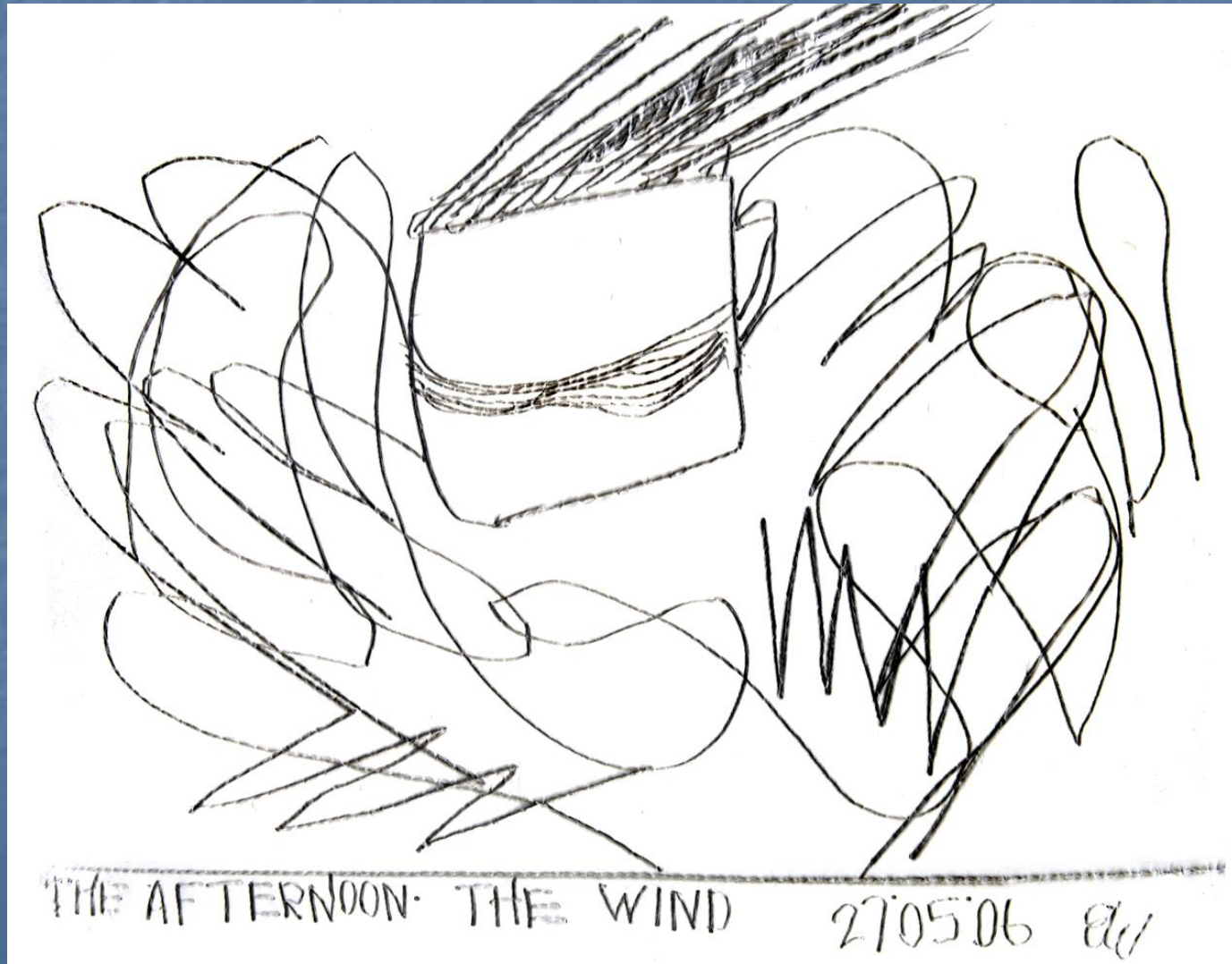
EW: "Mariachi" + metaphors for sounds of trumpet, violin, guitar, drum:



EW: "Isla de la mujeres" +  
metaphor: streams through fingers



# Metaphor for thoughts: Meandering



THE AFTERNOON. THE WIND

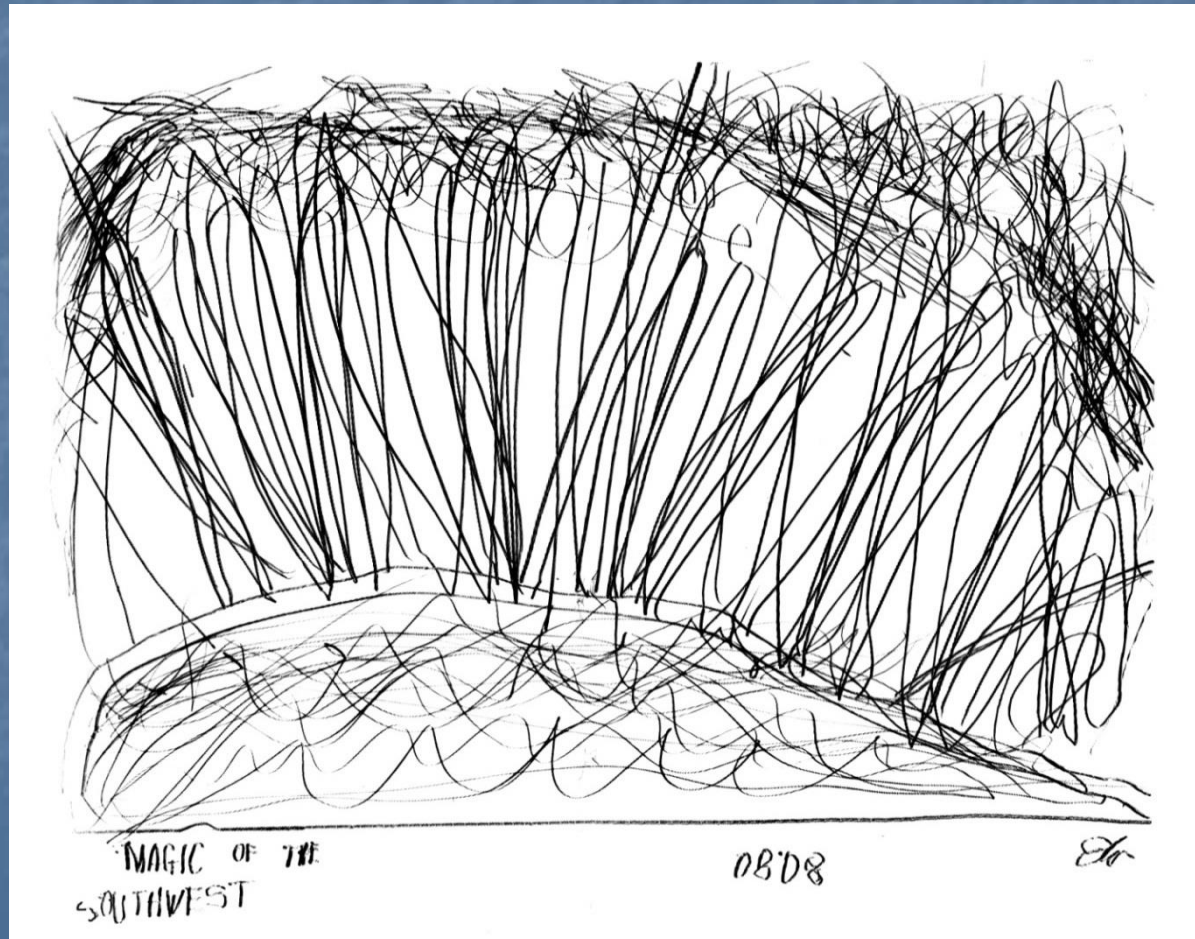
27.05.06 Ed

# Special interpretation

- The Isla de la Mujeres drawing is described by EW as having metaphors for the sighted but literal use of lines for edges of streams of water for the blind.

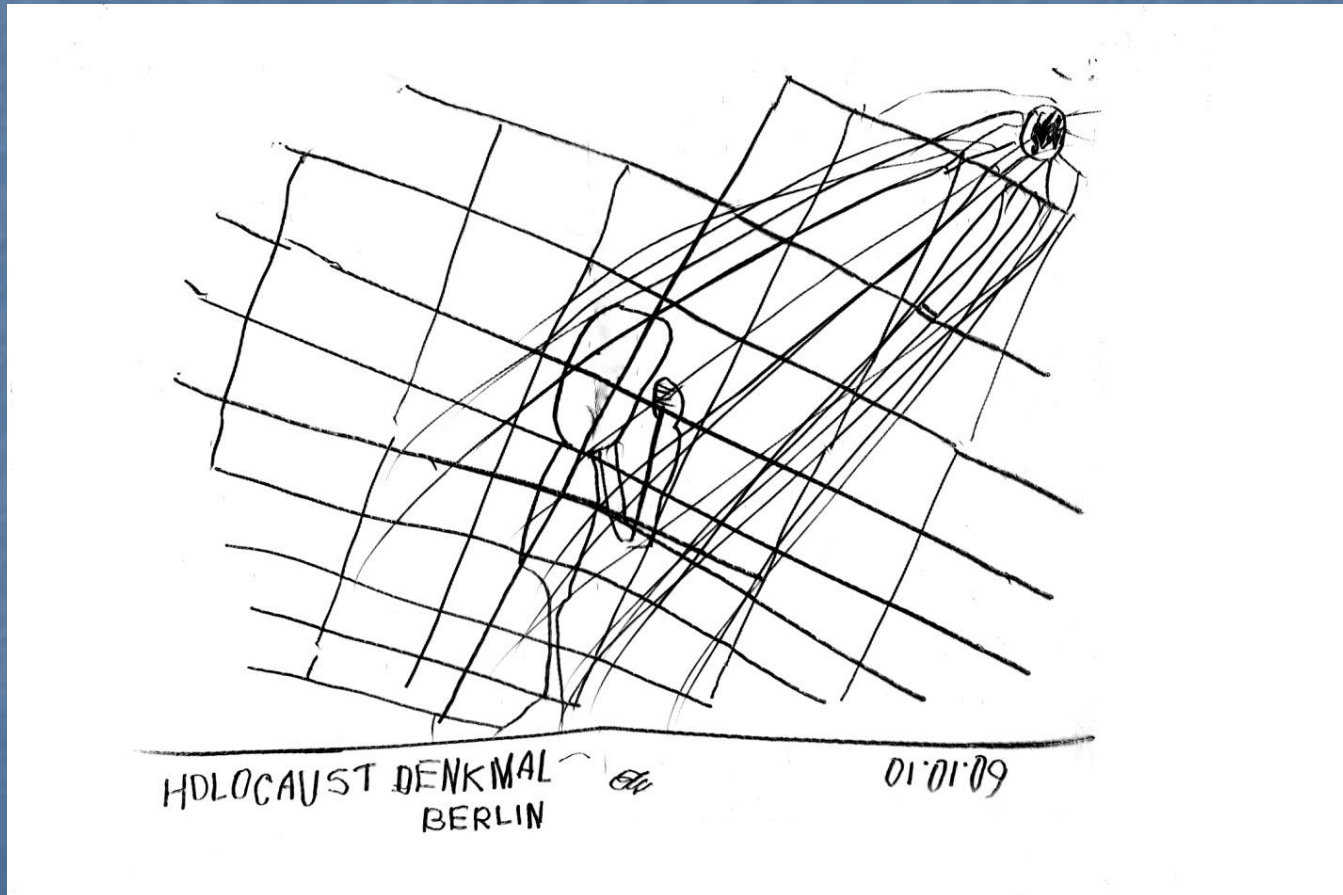


EW: Magic of the Southwest  
light wavy lines mean light-headed, special,  
quiet, protected, spiritual, sanctuary



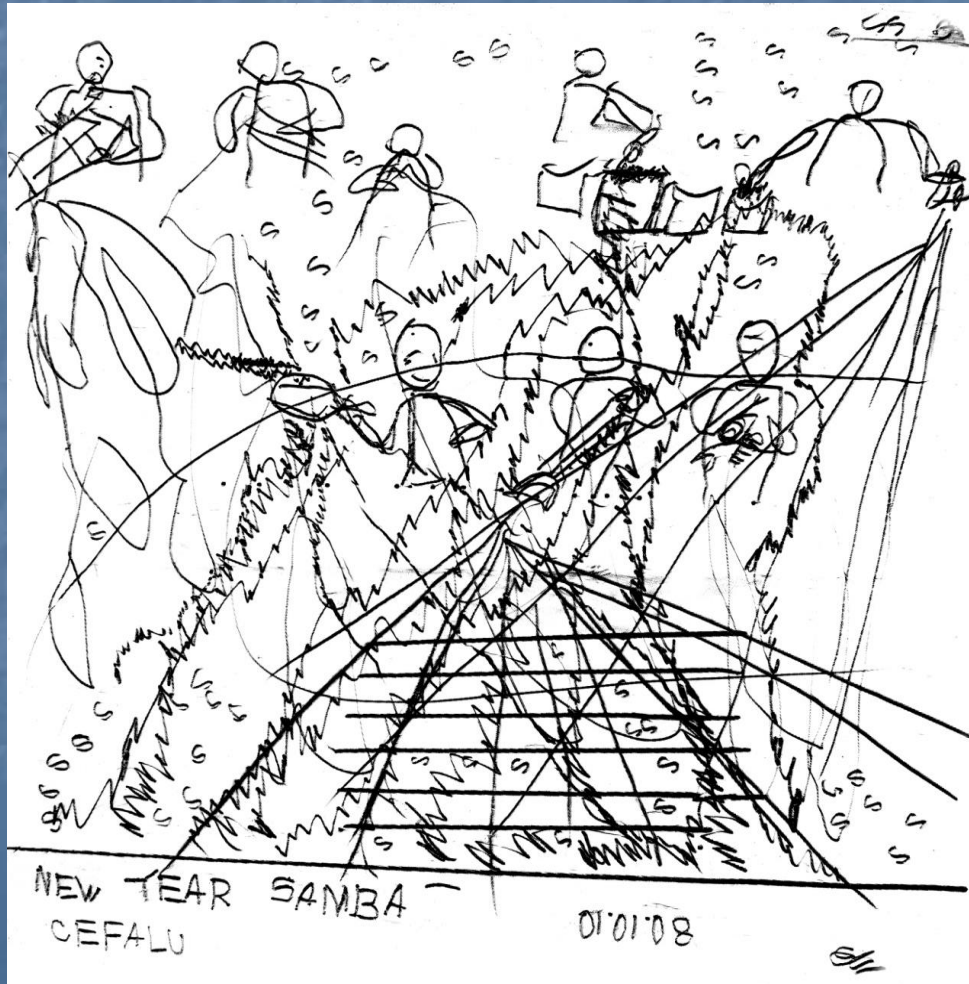
“In the southwestern part of Australia, we did some nice hikes in the woods. The trees there were very tall, often over 60 or 70 meters high or even higher, very proud, very serene. When I stepped into those woods, things did sound and feel different from all that I knew before. It was like if I had stepped accidentally into an enchanted world far from our everyday life. The birds' calling, the murmuring of rivers, the rustling of forest breezes - all protected safely by the solemn trees - the whole thing was so mesmerizing and so overwhelming that I could not help dropping my voice to a whisper not to disturb anything in this sanctuary.”

# EW: Holocaust Memorial, Berlin diagonals mean off-base, twisted, wrong



“a twisted way. It is a super clear day; the bright, warm sunshine seems like a brutal contrast to the weighty and tragic history this monument indicates. The entire picture is drawn on the plastic sheet placed deliberately tilted on the table. With this I wanted to express how wrong (crooked) things seem to have gone where that part of our history is concerned, how scary it can get, when things get built up on the already biased basis, and how lopsided our knowledge can be.”

# EW: Sounds-- music represented



# Eriko und Michael



# DIDEROT (1713-84)

- DIDEROT: Blind man from Puisseaux recognized profiles drawn on his hand:
- A profile is A SURFACE EDGE OF A FACE
- ALAS: No-one thought much about the Puisseaux finding till just a few years ago....

# Controversial Conclusions?

- Lines show surface edges in vision & touch: 6 types
- Perspective is in vision & touch
- Pictures for the sighted & blind can be metaphoric
- Acknowledgments: Sherief Hammad, Marta Wnuczko, Justin Deonarine, Heba Ragheb, Marcelo Santos, Hsin-Yi Chao & Peter Coppin  
Don Heights, Rosemary Sheppard, Jim Mitchell, Lorna Weigand



# Recent references

- Kennedy, J. M. (2013). Tactile drawings, ethics and a sanctuary: Metaphoric devices invented by a blind woman. Perception, 42, 658-668
- Kennedy, J. M. (in press) Tactile drawing aesthetics and a blind woman's drawings of sounds. British Journal of Visual Impairment