Foreshortening, Convergence And Drawings From A Blind Adult

John M. Kennedy and Igor Juricevic

University of Toronto

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Contact author address:

John M. Kennedy

University of Toronto at Scarborough-- Psychology

1265, Military Trail

Scarborough, Ontario M1C 1A4

Canada

email: kennedy@utsc.utoronto.ca

Tel : 416--287--7435

Fax : 416 -- 287 -- 7642

Abstract

Esref is a congenitally totally blind man, practiced in drawing. He was asked to draw solid and wire cubes situated in several places around his vantage point. He used foreshortening of receding sides and convergence of obliques, in approximate one-point perspective. We note that haptics provides information about the direction of objects, the basis of perspective.

Introduction

We present some drawings of cubes by Esref, a congenitally, totally blind man from Turkey, who has drawn frequently. We conclude their receding sides are foreshortened, with converging obliques, a combination present in one-point perspective.

Perspective has to do with projection and the directions of objects. Haptics obtains information about the directions of objects, so it could help provide features of the drawings. That is, the congenitally blind can have everyday, common experiences with direction and perspective which could influence their drawings. Previously, we illustrated this hypothesis with studies of drawings by a blind girl, Gaia, aged 12 (Kennedy, 2003) and a blind woman, Tracy (Kennedy & Juricevic, 2003). Gaia used parallel projection. Tracy not only frequently used parallel projection, but in one clear case used convergence and foreshortening together, in keeping with one-point perspective. We note Esref uses convergence and foreshortening together in several drawings.

Esref

Esref (aged 47) is totally blind (Pascual-Leone, 2005). He reports he has been totally blind since birth. Indeed, one eye is absent and the other is a microball, insensitive to light. He went to an elementary school, and can print and write in cursive script. He has been interested in pictures for many years. He has made many pictures -- of objects such a clown, a bowl of flowers, a house -- in many media, using instruments such as pencil or a nail to make indented dots or lines on cards or paper. He participated in a previous study on drawing moving objects (Kennedy & Merkas, 2000). In the present study, he was interviewed in Turkish by Joan Eroncel.

Method

Esref draws on paper usually, and here he drew in pencil on paper resting on a rubber-coated board, lying on a table, pressing heavily, leaving tangible indentations. In a pilot study he was asked for drawings of a cube. Esref indicated the requests were an interesting, novel challenge. He mentioned as examples of a cube a box or a backgammon die, and said that he knew a cube had six sides. In the formal test session, he was asked to draw pictures of wire cubes and solid cubes in several orientations (Figures 1 and 2).

Insert Figures 1 and 2 about here

In the pilot study, he drew cubes as wire cubes. They were mostly conventional pictures of cubes in parallel projection, like a Necker cube. He might simply have been taught a fixed schema for a cube. Alternatively, stipulating extra factors might lead Esref to modify his drawings to fit instructions about a vantage point shifting, with surfaces facing the vantage point or on the side of the cube. He might remodel his drawings to follow instructions about solid cubes, omitting lines to do with faces occluded from a certain direction – hidden line elimination. Indeed, to show depth, he might use foreshortening or convergence or both in keeping with the direction of the vantage point.

Procedure

Esref was asked to draw solid and wire cubes, in several positions – a cube directly in front of him, a cube moved to the left, a cube to the left and down. He was also to draw a cube balanced on a point (a vertex), with a vertex pointing towards him.

“Directly in front” meant only one face was in front of him. He was told the cube moved to the left should have one face parallel to the plane through his shoulders, and the edge of the table, and parallel to the front face of the cube in the previous drawing, but now one side face would be evident. The cube moved to one side and downwards should be positioned so that if one reached out to touch it, the top and side could be reached in a straight line, without having to bend around the front face. Its front face should still be parallel to the front face of the cube directly in front of him.

Esref was asked to draw solid cubes first and wire cubes second.

Results

Figure 1 shows solid cubes. The drawings are described here as squares, rectangles and other quadrilaterals, allowing for their freehand character. Line measures are given as lengths of lines between line junctions. Where a junction is not drawn completely, but lines approach the apparent junction location, the junction is extrapolated. Width measures are given from the outer contour of a line orthogonally to an opposite line in a quadrilateral, or through the midpoint of a parallelogram.

Esref’s lines are sometimes quite thick. We measured to outer contours. Some judgment is still required since occasionally extra pencil marks that could be irrelevant are located near lines, and have been excluded.

The cube directly in front (bottom right) is drawn as a single quadrilateral (slightly elongated horizontally 4.2 to 5.3 cm, measuring to the line junctions). In other studies we have conducted Esref commonly drew a rectangle slightly elongated horizontally and called it a square.

The cube balanced on a point (top right) uses a parallelogram for the top surface. It looks like a rectangle but, rest assured, this is a perspective illusion to do with angles. The angles at the top and bottom are obtuse and the angles left and right acute, in keeping with projection. Below, two narrower parallelograms depict the cube's sides. All the lines are about the same length, ranging from 3.8 to 4.5cm. The drawing is in keeping with parallel projection.

Upper left is the cube moved to one side. It is drawn as a quadrilateral (4.1 by 4.7cm, elongated horizontally) with a trapezoid that is drawn, in Esref's words, as "narrowing" to the right (3cm wide, .6 of the width of the rectangle).

The cube to-the-left-and-down is drawn (bottom left) as a square (about 4.4cm wide) with two parallelograms (3.2 to 3.5cm wide, a foreshortening ratio of .7 or .8) with a common corner at the square's top right. The foreshortening is difficult to see – a perspective illusion of length. The parallelogram on the right has a not-quite-vertical tilted line on its right side. The obliques for the receding sides diverge slightly from the central oblique but Esref did not comment on this, and so it may be unintentional.

Figure 2 shows drawings of wire cubes. The cube to the front (bottom right) is drawn as a horizontally elongated rectangle (4.5 by 6cm) surrounding another rectangle (2.6 by 3.8cm), with corners connected by short oblique lines (1 to 1.5cm long). The obliques are foreshortened to about .3 of the horizontal lines, much more than the .6 ratio in Figure 1 top left. Esref indicated the larger rectangle depicted the front of the cube.

The drawing of a wire cube balanced on a point (top right) has a central, top parallelogram about 4.5 cm wide (which -- once again -- has the illusory perspective appearance of a rectangle) above a quadrilateral (about 4.2 by 4.9 cm wide). The quadrilateral's uppermost angle is a right angle. The parallelogram and quadrilateral are joined by four vertical lines (forming four parallelograms). The upper and lower forms overlap, forming a small quadrilateral (1.1 by 1.6cm), with the verticals at its upper and lower corners aligned. In the top parallelogram, in keeping with projection the angles top and bottom are obtuse, the others acute. Once again, the drawing is in keeping with parallel projection.

Top left is the cube moved-to-one-side. It is drawn with two rectangles elongated horizontally, one to the left (4.4 by 5.3 cm), and the other (2.7 by 5.0 cm), displaced to the right, its left vertical displaced 2.4 cm to the right, and its right vertical displaced 2.3cm to the right (both showing foreshortening of about .4 of the horizontal width of the front face). The two rectangles are connected by converging obliques.

Finally, bottom left is the cube to-the-left-and-down. It is drawn as two horizontally-elongated quadrilaterals (one 3.7 by 4.9 cm, the other 3.5 by 4.4 cm, requiring convergence to show the receding sides), the larger one displaced down to the left. They are joined by trapeziums (the one to the left 3cm wide, and the one to the right 2.4cm wide (showing .6 and .5 foreshortening compared to the larger quadrilateral). The lower left oblique is 3.5cm (. 7 foreshortening compared to the horizontal) and the lower right oblique 3cm (.6 foreshortening).

Discussion

In several drawings, Esref draws using convergence and foreshortening together, as in rough, freehand perspective. This involves drawing the faces of the cube as requested while changing their shape and proportions. He draws the correct number of faces in proper position with respect to the vantage point. As requested in the instructions for the solid cubes, one face is shown for a cube in front of the observer, two for a cube moved to the side and three for a cube that has moved to the side and down. The shapes and relative locations of the side and top faces were not specified in the instructions, but they were drawn in keeping with their directions from the vantage point i.e. for a cube moved to the left Esref draws a face to the right of the front face. Also, he eliminates hidden lines aptly and in his drawings of wire cubes, the relative positions and shapes of all the faces are correct for each vantage point.

Esref's use of obliques for side faces is consistent with the vantage point, and like drawings from many sighted adults (Arnheim, 1990; Nicholls & Kennedy, 1992, Milbrath, 1998; Willats, 1997; Golomb, 2002).

Esref's drawings use foreshortening. Both the lengths of obliques and the widths of quadrilaterals depicting receding faces are foreshortened. The drawing of a wire cube to the front uses the most extreme foreshortening (.3), but perhaps as a knock-on consequence of drawing the quadrilateral for the cube's back inside the one for the front (Freeman, 1986). In drawings of a cube to the side, it would be easy to draw the quadrilateral for the back considerably to one side of the one for the front, which would drag out the lengths of the obliques. It could easily make the obliques equal the length of the lines for the front face, or be longer (Kennedy & Juricevic, 2002). However, Esref places the rear faces so the foreshortening is about .4 to .8.

In several drawings, Esref uses convergence as well as foreshortening. It is clearly intentional since he described it explicitly as "narrowing towards the back." It appears in 3 of 4 drawings of cubes moved to the side. The exception is the solid cube moved to the left and down, in which obliques diverge slightly, and may be intended as parallel.

Esref uses parallel obliques for solid and wire cubes balancing on a point. He foreshortens receding sides. He draws obliques that are simultaneously converging and foreshortened in keeping with one-point perspective projection to a vantage point.

Convergence and foreshortening together are a combination only used once by any blind subject in the literature -- by Tracy, though she has been tested several times, and has used foreshortening several times. She used the combination only in the most recent test we have given her (Kennedy & Juricevic, 2003, Figure 3, p.1064). In the sighted, the combination is a developmental advance on parallel projection, evident in many of 12-year-old Gaia’s drawings.

The blind and the sighted often hear that things in the distance are pictured small, and look small. Esref reports being told that roads converge in pictures. Esref’s drawings may be applying this principle to cubes, combining it with foreshortening. Since we get information about the direction of objects from us via haptics as well as vision (Heller et al., 2002; Millar, 1994; Holmes et al., 1998; Cabe et al., 2003; Kappers & Koenderink, 2002) their combination in one-point perspective may make considerable sense to Esref and to other congenitally blind people.

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Figure captions

Figure 1. Drawings of a solid cube. By EA.

Figure 2. Drawings of a wire cube. By EA

Acknowledgments

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Figure 1

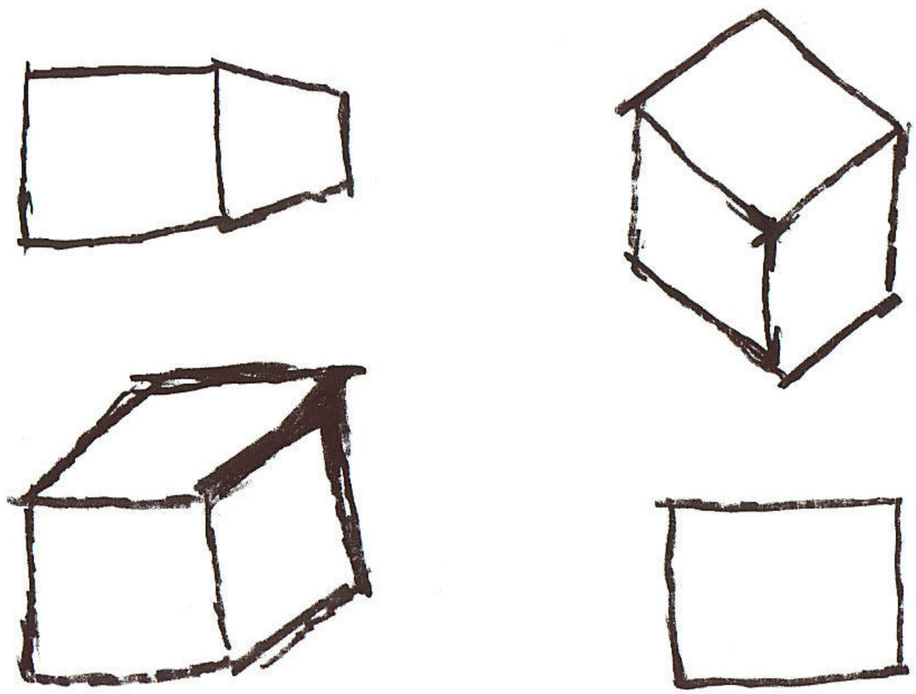

Figure 2