Hans Holbein’s *The Ambassadors* (1533)
A Computer View of Renaissance Perspective Illusion

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The authors of this article have subjected Hans Holbein’s painting of *The Ambassadors* in the National Gallery, London, to computer aided image manipulation. This has enabled them to identify viewing positions from which the well-known distorted skull becomes visually realistic. The analysis leads to the speculation that the painting was originally hung on a staircase and, in addition, further suggestions are made with regard to the iconography and meaning of the painting as it may be seen from different angles and viewing positions. Finally, some limitations of computer analysis are discussed.

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The computer is increasingly used by historians not only to analyse art and architecture but also as a presentation medium to explain the results of this study to a wider public. In recent exhibitions computer images and screen displays have been placed alongside artifacts which the computer had been used to analyse. Interactive computer displays and multi-media settings have become familiar enough features of exhibition design. Clearly computer technology now offers a new and powerful presentation and indeed research technique to historians, with Computer Aided Design (CAD) software facilitating four established areas of art historical study. Firstly, CAD allows for reconstructions of unrealised or destroyed architectural projects based on surviving records. These reconstructions can transcend traditional physical models in their precision and in their ability to simulate a spatial experience in virtual form. Secondly, the computer can facilitate the analysis of the use of perspective in painting and in stage
design, or in urban composition. Thirdly, the accurate analysis of the use of proportion and of particular ‘ideal’ measurements in, say, Renaissance architecture is greatly enhanced through the utilisation of photogrammetric surveys which are then digitised using computer software. And the fourth advance in art historical study is the growing use of computers as a presentational tool, representing the foregoing research to the general public at exhibitions in on-screen, video formats and graphic displays. Indeed, Robert Tavernor has recently pointed out that the computer offers art historians a technical means to transcend traditional discussions of style in determining more objective terms of discourse (Tavernor 1995).

A number of projects carried out at Bath University have explored the possibilities offered by computers to the analysis of Renaissance ideals of city planning. These projects include a computer reconstruction of Inigo Jones’s original Whitehall Banqueting House facade of 1620 and of Jones’s Covent Garden piazza of 1640 (Hart & Day 1993; 1997). The former model allowed for an accurate study of the proportions of every element of Jones’s Banqueting House facade and of its polychromatic appearance before refacing in 1829. The latter model facilitated an assessment of Jones’s piazza in its scale and arrangement without the market building erected in 1830.

However, we have also used the computer for research of a more technical nature in assessing the effectiveness of Renaissance perspective theatre scenery, and most notably the influential ‘ideal’ city stage set of Sebastiano Serlio (Hart & Day 1995) and the first adaptation of Serlio’s type of proscenium stage in England in the form of Inigo Jones’s temporary masque stage (Hart & Robson 1996). The physical reconstruction of such temporary Renaissance theatres is obviously an impossible task other than in model form. Further, computer models allow for a level of detail hitherto impossible within a physical model, with its limitations in scale, and they reveal for the first time the effectiveness of sliding perspective scenery and the distortions of fixed, or ‘constructed’, perspective scenes when viewed from seats remote from the single optimum viewing position. The computer can also be used to analyse one of the most striking forms of perspective effect employed in Renaissance art, namely the construction of a type of distortion called ‘anamorphism’.
A Computer View of Hans Holbein’s *The Ambassadors* (1533)

Hans Holbein (ca. 1497–1543) painted *The Ambassadors* in London in 1533 (see Langdon 1976 ed., Rowlands 1985). On the left this painting represents Jean de Dinteville, French ambassador in England between 1532–33, and on the right Georges de Selve, the Bishop of Lavaur. The meticulous realism of this scene, so characteristic of Holbein’s work, is disrupted by an anamorphic image barely recognisable as a human skull painted at the feet of the figures. In this study the computer will be used to demonstrate a possible reason for the enigmatic presence of this skull in the painting. Indeed with the aid of a computer model, the painting’s anamorphism will be investigated as a key to the picture’s possible meaning (see Baltrusaitis 1976 ed., 91–116, Pérez-Gómez & Pelletier 1993 & 1995, Kemp 1992, 208–12).

The ideal viewing positions for anamorphic images, as for scenes drawn in linear perspective, must lie along an axis perpendicular to a picture plane; however since in the case of anamorphic images this plane is necessarily at a different angle to that of the canvas and its scene, so the viewing axis is rotated accordingly. The result of this rotation is an image such as Holbein’s skull, which when viewed frontally appears to be blurred and only comes into focus when viewed down its axis at ninety degrees to its picture plane, that is necessarily obliquely to the canvas. Holbein must have considered very carefully the angle from which the undistorted skull was to be viewed in order to construct its distorted image as an integral part of his painting’s composition (X-rays have shown that the skull is not an overlay). Indeed it is reasonable to suppose that Holbein must also have carefully considered to what extent the painting as a whole would be distorted when seen from this oblique viewing angle. For he might reasonably have calculated the construction of the foreground skull by the resultant distortion of the background, thus carefully controlling the non-frontal arrangement of the painted forms. The arrangement of the background when the skull is in focus surely cannot be arbitrary or a visual accident, but this ‘alternative painting’ tends to be ignored by commentators. Jurgis Baltrusaitis notes that ‘the painting is a systematic study and a demonstration of perspective in all its forms’ (Baltrusaitis 1976, 93). Perhaps when
viewed from the alternative angle to the standard frontal view we
glimpse the otherwise concealed 'meaning' of the painting as a
totality, thus explaining the presence of a distorted foreground
object?

Finding the (hitherto unrecorded) exact vectors or angles of view
from which the skull is fully coherent was therefore the first stage
of this investigation. The computer was an ideal tool for this task,
since moving around the canvas within a virtual environment
enables a much more precise interaction with the painting than is

Figure 1 A three dimensional wire-frame model of a skull overlaid onto the
painted skull as a template.
possible with a physical examination. An image of the painting was
scanned-in and pasted onto a virtual canvas, and the computer’s
eye was moved around the virtual painting interactively until the
anamorphic image became coherent. A three dimensional wire-
frame model of a skull was overlaid onto the apparently coherent
painted skull to act as a template and overcome human error in
focusing the image (Figure 1).

Two coincident viewing angles from any point on which the skull
appeared undistorted were in fact found. Angle A, looking from the
right hand side above the skull (9.4 degrees from the picture plane
(i.e. measured in plan), 70.5 degrees from north (i.e. measured
frontally)) (Figure 2), and angle B, looking from the left hand side
below the skull (9.4 degrees from the picture plane, 250.5 degrees
from north) (Figure 3). Although fundamental to a full appreciation
of the painting, these viewing angles have been incorrectly gauged
by previous commentators (see Samuel 1963, 436, Langdon 1976
ed., 19). Recently Martin Kemp, for example, writes that the skull
‘only assumes full coherence when viewed from a particular posi-
tion to the right of the picture at the level of the ambassador’s
heads, at about one picture’s width from the edge of the painting,
and at a short distance from the plane of the picture’ (Kemp 1992,
208–9). Kemp’s suggested ‘ideal position’ is somewhat vague and
implies a viewing position rather than a viewing angle. Kemp also
fails to point out the second viewing axis, and with reference to
Baltrusaitis speculates that, to see the skull in focus, the viewer
approached the painting in its original setting, ‘through a door
abutting on the end of the wall on which the picture was hung’
(ibid. 209, Baltrusaitis 1976, 104). In fact such a view would only
have been possible if the door was at a considerably higher level
than the painting itself.

The identification of the precise viewing axes for the skull leads
to speculation on the spatial characteristics of the intended setting
for the painting which must have facilitated such views (the paint-
ing originally hung in De Dinteville’s chateau in Polisy until 1653).
This speculative hanging space can be modelled using the com-
puter. Since the axis of the skull lies on a diagonal, this might
suggest that The Ambassadors was painted for a staircase hall. For
the skull to be appreciated, the stair would need to follow the angle
of view, that is have a (perfectly plausible) rake of 19.5 degrees or
approximately one in three (Figure 4). And the painting would
obviously also have been admired from the normal, frontal view,
Figure 2  Angle A, looking from the right hand side above the skull (9.4 degrees from the picture plane (i.e. measured in plan), 70.5 degrees from north (i.e. measured frontally)).
implying a balcony opposite (a landing would result in a lower eye level relative to the skull’s axis on the upper half of the staircase, throwing the skull out of focus when viewed on this part of the stair). Since the view of the skull in focus must surely have been

Figure 3  Angle B, looking from the left hand side below the skull (9.4 degrees from the picture plane, 250.5 degrees from north). Detail of crucifix. Woodcut of Crucifixion by Albrecht Dürer.
Figure 4: Computer model of a possible staircase hanging for the painting.
regarded as of sufficient interest to merit close study, rather than be merely glimpsed at whilst climbing a stair, such fixed positions of view would most probably be located at either end of the staircase, and would limit the stair’s length.

When the skull attains full coherence, strong shadows cast to its rear become particularly prominent. These indicate a light source to the right of the painting aligned with the upper viewing axis. This is inconsistent with the lighting within the scene itself, which is frontal and slightly right of centre. The painting thus has two light sources, consistent with its two viewing axes. There are no converging orthogonals within the painting, since the receding sides of the table are hidden by the two ambassadors. The absence of convergence and a discernible vanishing point serves to emphasise the skull’s viewing axis and vanishing points (which are expelled, as it were, from the frame) and thus encourages the spectator to view the painting obliquely.

It is obviously difficult to study the painting from these oblique angles, especially given its size (206 × 209 cm) and its present hanging in the National Gallery in London, but the computer can easily produce precise images of the painting with the skull in focus from any position along the upper and lower viewing axes. When viewed from angle A, the simple crease in the tablecloth, apparently unrelated to any particular element when viewed frontally, increases in prominence and now forms a central line unifying the centres of the focused skull, the hymn book, the lute, and the apian torquatum on the table (Figure 2). This astronomical instrument might be seen transformed into a figurative candle, and the table as a whole to become more ‘altar-like’ in character. From this view the otherwise meaningless fold in the tablecloth is seen now to have a direct relationship with the focused skull, the ‘altar’ and the ‘candle’.

The most striking imagery assumed by the composition when viewed obliquely is however evident from angle B (Figure 3). For when seen from this angle, the ambassador on the left can be seen to be distorted into the shape of a cross. His shoulders become very pronounced and linear, denoting the horizontal part of the crucifix, and his left leg vanishes into the darkness of the ‘altar-like’ table, making the ambassador appear to be supported upon one leg only. This leg can be seen to form the vertical crucifix member, emphasised by its positioning in the centre of the circular pattern in the floor. Indeed this pattern copies the 13th century mosaic floor in
Westminster Abbey, giving the picture a formal ecclesiastical setting. The ambassador's cross form is of course further suggested by the presence of the (now focused) skull, since Christ was crucified on Golgotha, or 'place of a skull' (S. Mark, 15.22). Albrecht Dürer, an important influence on Holbein, frequently depicted a skull at the base of Christ on the cross in his woodcuts (see Kurth 1963 ed., nos. 85, 88, 97, 125, 142) (Figure 3). And Christ's crucifixion was itself also a common subject of Holbein's work (Rowlands 1985, nos. 11, 19, 56).

The most compelling evidence for this crucifix reading of the left-hand ambassador's form is the presence of an actual crucifix icon in the painting, which can now be seen as a strong frontal clue to the way in which the distorted picture should be understood (Figure 3). For a crucifix is partially hidden behind the curtain on this left side of the picture, with Christ showing only his right leg in a similar way to which, as the computer shows, the ambassador's right leg is brought into prominence and his left leg is obscured by darkness when seen from angle B. When viewed frontally, the right leg of Christ can be seen to draw attention to the right leg of De Dinteville directly below. A skull on his hat pin further links this ambassador to the anamorphic skull, perhaps again prompting the viewer to examine De Dinteville's distorted image in relation to the skull in the obliquely viewed painting. Holbein's intention to covertly identify De Dinteville with the crucifix form would account for what Baltrušaitis has observed are the ambassador's 'broad shoulders... further accentuated by a wide fur coat with puffed sleeves' (Baltrušaitis 1976, 91).

The snapped string of the lute is frequently understood to signify the contemporary discord in Christendom (see Rowlands 1985, 86). The year of the painting, 1633, is concurrent with a key stage in Henry VIII's break with Rome, since his marriage to Anne Boleyn was in the spring of that year following his divorce from Catherine. In representing De Dinteville as a Christ-like figure, with the actual crucifix icon half concealed directly above, Holbein could be seen to signify, naturally enough in a cryptic fashion, the legitimacy of the ambassador's mission, which most likely sought religious harmony and tolerance (see ibid., 85–6). John Rowlands concludes that the painting was 'meant to reflect in a discreet way the sitters' earnest concern over the religious crises facing Christendom, in which they were active protagonists' (ibid., 86). Indeed the hymn book is open at Martin Luther's Chorale (Baltrušaitis, 1976, 91), implying sympa-
thy towards religious reform (Rowlands 1985, 86). The religious upheaval of the time of its painting would surely have meant that The Ambassadors could not have avoided being considered from a theological point of view. The iconoclasm of the English Reformation would have made it impossible for anyone, least of all a Catholic official, to identify themselves directly with Christ.

Since Holbein sought to represent his subjects with meticulous accuracy, with every element arranged following an apparent rationale, the distorted skull and its alternative viewing axes is a significant stylistic anomaly. The Ambassadors is Holbein’s only painting which strayed from naturalistic representation and use of linear perspective, and this deviation surely suggests a deeper meaning than that apparent from the frontal view alone. The ability of the computer to manipulate the image and move around the canvas interactively makes it an ideal tool for the modeling of otherwise impractical viewing angles. Using the computer a reinterpretation of the painting can thus be suggested as its famous distorted form is brought into focus. The skull’s presence, if not its distortion, is frequently explained as a Memento Mori, a reference to the futility of man’s power over death (see Samuel 1963, 440, Langdon 1976, 19, Baltrusaitis 1976, 96, 105, Kemp 1992, 209). However the open references to Christ suggest a theme not of death but of redemption, perfectly compatible with Holbein’s possible hidden representation of the Savior as revealed by the computer.

**Conclusion: Historical Research and the Computer**

In conclusion we shall briefly explore some limitations to such applications of the computer, and to point to the problems of interpretation and presentation inherent in the use of this new technology as a research technique. For whilst the advantages of the computer to research has been recognised, these problems have enjoyed much less discussion (see Fiore 1995). The issues can be characterised into three points.

Firstly, the computer has the tendency to lend a definitive air to the historian’s speculations, obscuring behind an ‘evenness’ of presentation the relative status of primary sources used for, say, architectural reconstructions. The historian should make clear what documentary or archaeological evidence has been used to produce computer reconstructions of buildings or stage designs. These
models should mark clearly the physical boundary between the surviving architecture and the parts of the model which represent speculation as to the original intentions for the building or a hypothesis on the nature of destroyed work. As Francesco Paolo Fiore has pointed out, the computer is in fact an ideal medium for the simultaneous presentation of alternative hypothesis (ibid., 231). Indeed, in this way the computer might easily present the history of the actual design of a building through reconstructions of earlier schemes when records of these survive. Further, due to the seductive nature of computer imagery, the presence of the computer screen in exhibitions has the tendency to rival works of art, and computer generated images are elevated from technical drawings to artworks in their own right. This may not matter, but frequently the difference between the computer used as an analytical tool and its equally valid, but different, role as a new medium for the presentation of scholarship is not understood, with the result that presentation influences analysis.

The second problem in the application of computers to historical studies is that although the computer has been used to model two dimensional, painted space in three dimensional, virtual form as if it were ‘real’, Renaissance painted space was intended as an illusion, with the vanishing point often established for a particular point of view uniquely designed for the artwork’s intended setting. Fiore notes that such a computer reconstruction is ‘off-track as a research tool, because it artificially reconstitutes space to which the painter only wished to allude in his representation from a single point of view’ (ibid.) Hence such models of painted space might at best reveal only the technical aspects of the painter’s skill, that is in his application of a particular method of perspective representation, and as such these models may throw little light on the art-work’s symbolic ‘meaning’. However, despite Fiore’s reservations, should specific areas of distortion in elements painted in perspective be revealed by such models, this would illustrate the relative importance of those distorted parts to the painting’s message or help establish the intended viewpoint of the picture as a whole. This would be of particular relevance to a work in which there is an obvious distorted form such as the skull in The Ambassadors.

The third limitation to computer models is that CAD packages are designed to represent images of objects in perspective. This is useful for the analysis and representation of art and architecture conceived in this way, but of limited value as a research tool in the study of
pre-perspectoidal medieval space, or of non-European art and modern art such as cubism with its deliberate collage of viewpoints.

In the quest to reunify art and science, it is fashionable to claim for the computer a status as the territory for the foundation of a new 'renaissance'. However, it is not as a work of art in its own right, with an inherent cultural 'message', but rather as a powerful research tool with special rules and limitations that the computer can be most effectively used and applied to traditional art historical inquiry.

References


