

Aberration analysis of the putative projector for Lorenzo Lotto's *Husband and wife*

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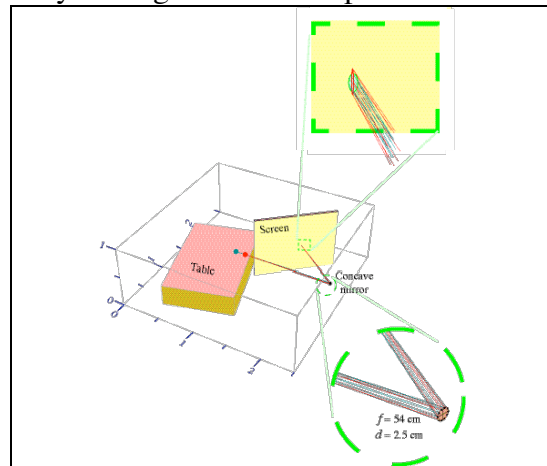
Abstract: The geometrical constraints upon Lorenzo Lotto's putative optical projector for *Husband and wife* imply that the projected image would reveal large off-axis aberrations. Such aberrations are roughly as severe as the defocus blur claimed to have led Lotto to refocus the projector to surmount its limited depth of field. This result and other facts undercut claims that Lotto used a projector when executing this painting.

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A recent theory claims that Renaissance master Lorenzo Lotto (1480-1556) used a concave mirror to project an inverted image of a tabletop carpet onto his canvas during the execution of *Husband and wife* (1645). Key evidence adduced for this claim includes perspective anomalies and changes in magnification ascribed to refocusing of the mirror to overcome limitations in depth of field [1]. Our ray tracing casts doubt upon this claim.

Figure 1: The putative optical projector employed by Lotto for tracing a real image of a tabletop carpet projected onto his canvas or screen (redrawn from Fig. 7 in [1]). The canvas size and geometry demanded by the mirror equation and concave mirror ($f = 54$ cm, $d = 2.5$ cm, inferred in [1]) tightly constrain the optical path and imply there would have been significant off-axis aberrations. The red and blue dots show the locations of putative refocusing, identified in [1]. The circular detail shows the concave projection mirror and the square detail the ray intersect diagram. Such ray intersections show there is never a sharp focus, nor a change in focus, of the sort assumed in [1]. (The less favored *lens*-based projector has a related set of drawbacks.)



We present further new evidence bearing upon the projection claim for this work: 1) several studies show that hand-knotted "Lotto carpets" were likely spatially asymmetric to a degree consistent with the painting having been executed without optics but inconsistent with geometric fits stated to three significant digits, 2) the numerous degrees of freedom in the optical fit of [1], 3) perspective anomalies in the painting that cannot be attributed to the use of optics, 4) geometric anomalies in other Lotto works that cannot be easily attributed to the use of optics [2], 5) severe illumination constraints that find support in neither the painting nor Lotto's working methods, and 6) the lack of documentary support for Lotto's use of projections, including his private notebook (*Libro di spese*). Finally, we question the claim Lotto executed a portion of the painting *blurry* to reconcile two sharp images projected separately under different focus conditions.

[1] David Hockney and Charles M. Falco, *Optics and Photonics News* **11**, 52 (2000)

[2] Christopher W. Tyler, *Leonardo*, **37**(5), 397-401 (2004)