Modular Perspective and Vermeer's Room

Tomás García-Salgado
Faculty of Architecture, Autonomous National University of México
tgsalgado@perspectivegeometry.com

Abstract

The room's dimensions of the Music Lesson (ML), as deduced in my first perspective analysis [1], corroborate that the projected image on its back wall approximates the real size of the painting, as Steadman first pointed out. It seems unlikely that the tiled floors in Vermeer's paintings were done at random. Instead, some of them seem to have a consistent image formation of about 90º of aperture of visual field, which speaks on behalf of the use of the camera obscura. Steadman based his consistency analysis of the underlying tiled floor grids of Vermeer's paintings in the inverse perspective method [2], finding that about six of them seem to depict the very same room. Following this idea, but instead of deducing the room's plan and elevation as he did, I will proceed directly in perspective with the aid of my *Modular Perspective* method. Thus overlaying the floor grid of the ML to another painting's floor grid, I will prove if they are consistent or not. In addition, if they are so, the real size of the second floor grid will be deduced. As far as I know, such a perspective proof has never been attempted before.

1. The Riddle of the Back Wall as Perspective Plane

Steadman sustains the hypothesis that Vermeer painted six of his works in the same studio [3]. His accurate architectural reconstructions show simultaneously the vantage points location of each one of them and how their projected images lie on the back wall. I, instead, displaced the perspective plane (PP) onto the back wall position to catch the painting's projected image on it. For this reason the term *perspective plane of the back wall* (PPbw) is introduced. The term *observer point* will also be used instead of the *camera vantage point* to avoid confusions onto which plane —the PP or the PPbw— the image is projected. The interchange of these planes aroused an unexpected riddle, which can hardly be visualized without the help of Figures *1a* and *1b*.

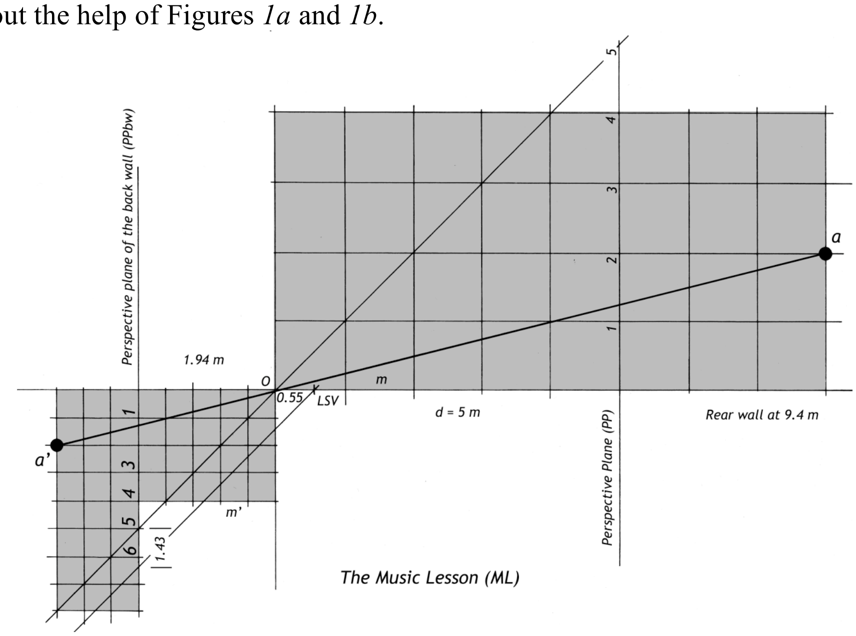


Figure 1a: *Relative positions, in the ML, of the PP and the PPbw from the observer.*

As it is evident in Fig. *1a*, the distance between the *observer point* and the PP is 5 *m* (modules), while being of about ≈ 2 *m* from the *observer point* to the PPbw. In other words, although both perspective planes have different modular distances, they remain proportional to one another. As we know, any given point within the observer's visual field relates to its identical within the camera's visual field. Notice in Fig. *1a*, how points *a* and *a'* have the same modulation in the PP and the PPbw respectively, while line *a-a'* encounters the visual of symmetry (*vs*) at the *observer point*.

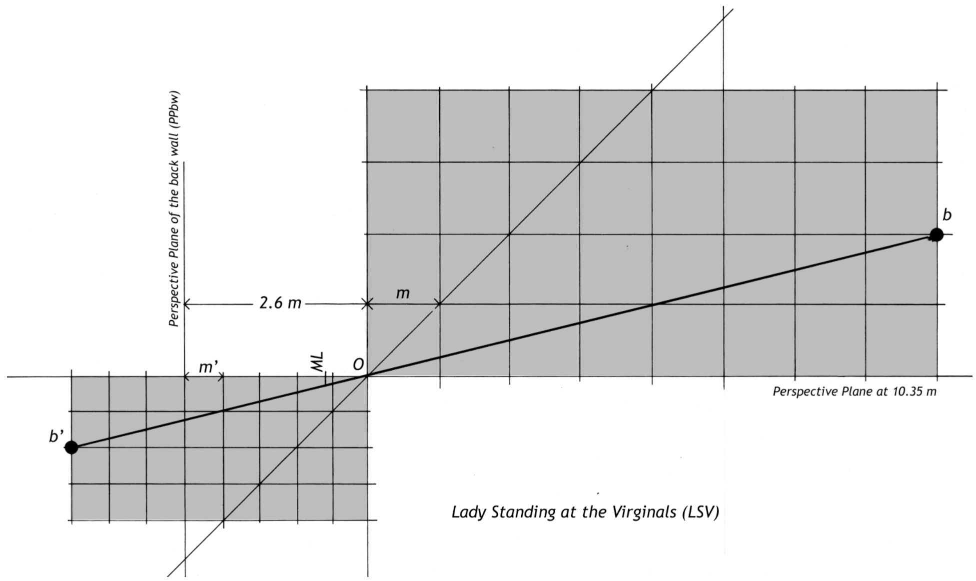


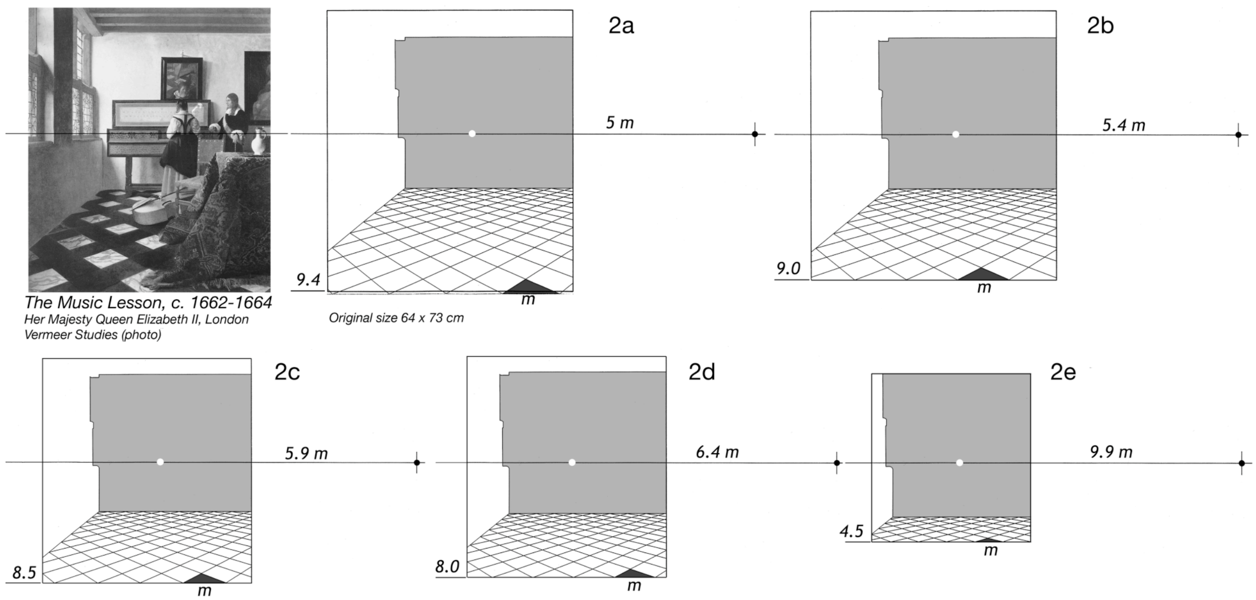
Figure 1b: *Relative positions, in LSV, of the PP and the PPbw from the observer.*

You may notice in Fig. *1b*, how the observer's distance increases in comparison to that of Fig. *1a*. Here, the distance between the PPbw and the *observer point* has changed to ≈ 2.5 *m*. When both figure *1a* and *1b* overlap at their correspondent PPbw, lines *a-a'* and *b-b'* run parallel one to another. On the contrary, when these figures overlap at their correspondent PP, then line *a-a'* and *b-b'* become as one. What these figures tell us is that the true size of the paintings corresponds to their projected image on the PPbw, whereas our perspective analysis takes place directly on the PP. Therefore, the riddle's mean is how the PPbw can be measured onto the PP.

2. Solving the Riddle

Based on the ML's real dimensions (≈ 64 x 73 cm), the size for other pictures will be deduced. A testing problem since the *observer point* is not common to all paintings. First, we need to prove that trimming a painting does not affect the absolute distance between *the vanishing point* (*vp*) and *the vanishing distance point* (*vdp*). Why should we do this? Because most of Vermeer's paintings show an asymmetric position of the *vp*, suggesting they were trimmed. For instance, Lady Standing at the Virginals (LSV) looks like a close up scene, emphasizing the female character without including completely the scene.

As it is evident through Figs. *2a*-*2e*, the *vdp* increases whereas the visible floor tiles decrease in depth, which means that the absolute value between the *vd* and the *vdp* remains constant in all figures. Therefore, adding the distance *vd-vdp* and the visible floor tiles in each figure, we have: Fig. *2a* (5.0 *m* + 9.4 *m* = 14.4 *m*), Fig. *2b* (5.4 *m* + 9.0 *m* = 14.4 *m*), Fig. *2c* (5.9 *m* + 8.5 *m* = 14.4 *m*), Fig. *2d* (6.4 *m* + 8.0 *m* = 14.4 *m*), and Fig. *2e* (9.9 *m* + 4.5 *m* = 14.4 *m*). Which proves that the image formation of a painting does not change when it is trimmed; it remains constant in any case. The ML and LSV have different observer's positions. The former is at 14.4 *m*, as we already know, and the second is at 13.85 *m*. Hence, the difference between both positions is: 14.4 *m* – 13.85 *m* = 0.55 *m* (see Fig. *3b*).



Figures 2a-2e: *Four trimming stages of the Music Lesson.*

Let's return to Fig. *1a* to interpret it's meaning on the PPbw. Comparing the modular measures between the observer's visual field and that of the PPbw, it is found that 1.93 *m* of the ML fits with 5 *m* of LSV. That is, any given measure within the observer visual field has to be multiplied by the factor $f = 2.6$, for it to lie onto the PPbw. So we have: 0.55 *m* x 2.6 = 1.43 *m*. This value is useful in finding out the *vdp* of LSV on the PP, as follow: 1.43 *m* + ML*vdp* = LSV *vdp* (on the PP) = 1.43 *m* + 5 *m* = 6.43 *m*.

3. The Music Lesson and Lady Standing at the Virginals

Our geometrical analysis begins by outlining both the ML and LSV in perspective [4]. Then after, both drawings are superimposed at their *vp*, as it is shown in Figure *3a*. In order to deduce the *dvp*'s position in each drawing, the diagonal-tiles of the floor are counted along the bottom row as modules. Thus, by carrying them over the *vh* we have: *dvp* = 5 *m*, in the ML, and *dvp* = 10.35 *m*, in LSV.

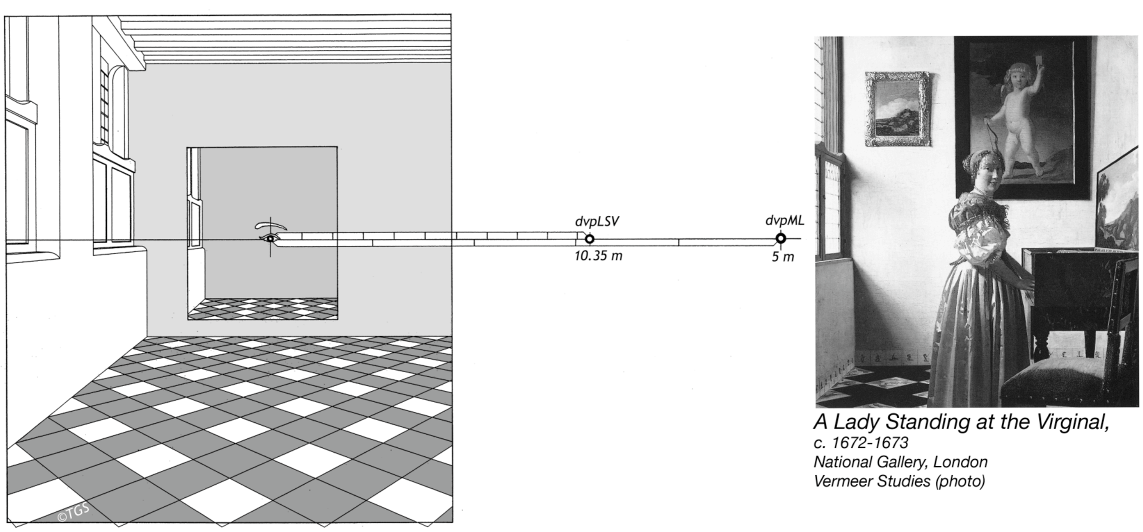


Figure 3a. *The ML and LSV overlapped at their vanishing points (vp).*

• Now, the *observer point* position for each painting is deduced as follows:
ML's *observer point*: 5 *m* (*dvp*) + 9.4 *m* (visible modules of the floor) =14.4*m*
LSV's *observer point*: 10.35 *m* (*dvp*) + 3.5 *m* (visible modules of the floor) = 13.85 *m*
• To find out the ML's true size, the distance from the *observer point* to the back wall should approximate 1.94 *m* (76 cm), which gives a diagonal-tile of 39.1 cm.
• The true size of LSV is deduced on the PP as follows: Locate point *c* by its modular perspective coordinates (X = 0, Y = -2.60 *m*, P = 0). This point lies exactly at the bottom of the visual field. Then drop the *c*-*vp* vertical visual ray by joining *c* with the *vp*. Next, mark on the *vh*: LSV2 *vdp* = 6.43 *m*, as deduced in section 2. This point lays on the PPbw, where the real image is projected. Therefore, sliding line *c*—LSV*dvp* until it meets point LSV2*vdp*, a new point *c'* is found where it crosses with line *c*-*vp*. This new point delimits the true size of LSV projected on the PPbw. Finally, after the drawing's visual field is completed, it can be attested that LSV measures ≈ 45 x 51 cm, as it is shown in Figure *3b*.
• Two points are required for the consistency proof: point *a* selected at random in LSV, and point *a'* deduced in the ML. The height (*vh*-floor) of point *a* needs to be adjusted from -2.60 *m* to -2.75 *m* to reach the ML's floor level, see Figure *3c*. This explains why point *a* appears lower than its actual position.

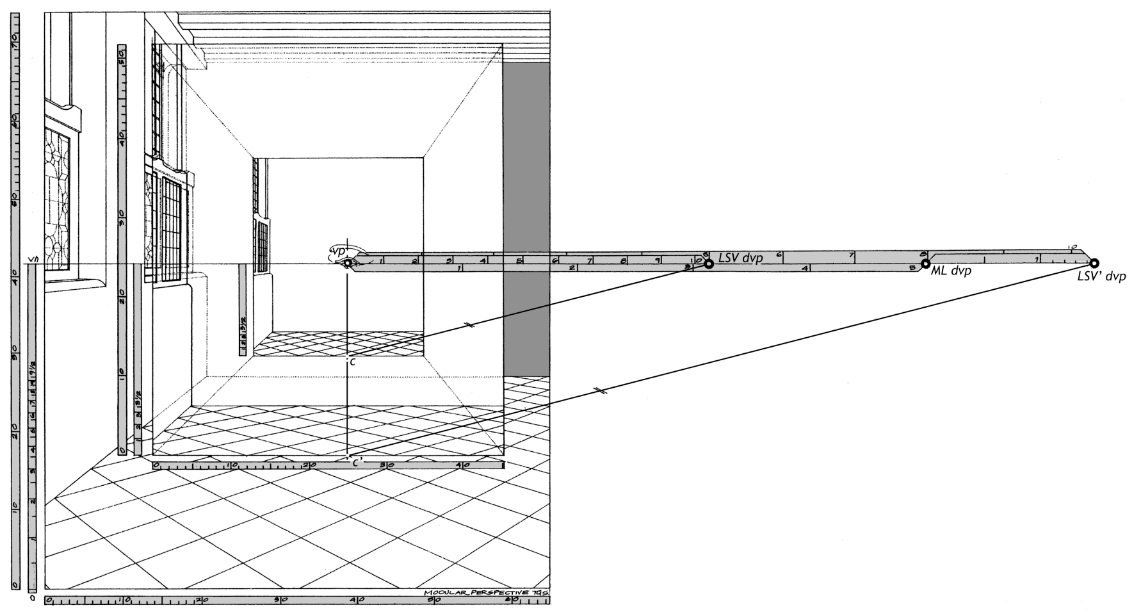


Figure 3b. *LSV measures, of ≈ 45 x 51 cm, were deduced.*

• By diminishing from the rear wall 0.55 *m*, in the ML, point *a'* is found along the visual ray *a*-*vp* [5]. Thus, we can assure that both points *a* and *a'* occupy identical positions in the visual space. Finally, when line *a*-*dvp*LSV2 slides down until it meets line *a'*-*dvp*ML, it should result in them running parallel to each other, proving that points *a* and *a'* perfectly match point-to-point. By repeating the test for other pairs of points, the same result was obtained.
• The windows of LSV and the ML are of different types and the height of their sills also differ. This can be proven by carrying out a 45º diagonal line from each windowsill to the floor, having as a result 2.5 *m* in the ML, and 2.3 *m* in LSV.
• Despite both rooms seem to have the same dimensions and floor tiles, their windows do not match. It is unlikely that Vermeer intentionally decided to change both the windows' lead pattern and the sill's height, just for aesthetical reasons. His mindfully executed still life scenes rather manifest a pictorial realism. Whether the room depicted in LSV is that of the ML or not, they still seem to be of the same dimensions.

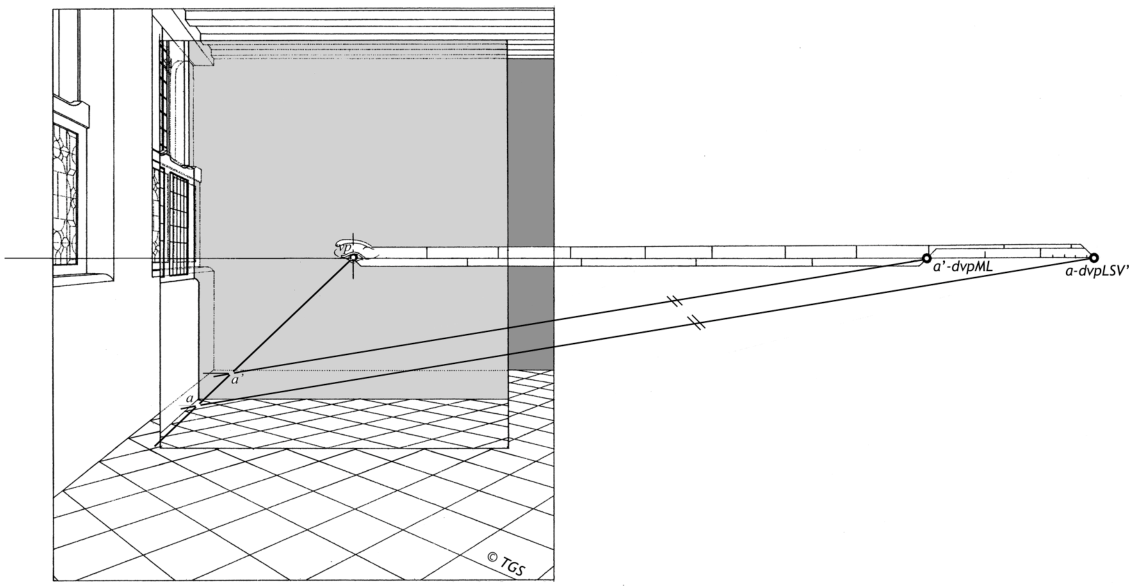


Figure 3c. *The consistency prove, point-to-point, between the ML and LSV.*

By 1672, when Vermeer painted LSV —after ten years the ML was painted—, it probably was not in the same room that the ML was, but most likely another room whose back wall approximates to it.

4. The Music Lesson and The Concert

It is impossible to make any assumption about the Concert's room identity since it has no windows. Once again, the tiled floor becomes the only reliable geometrical element available for the consistency proof.

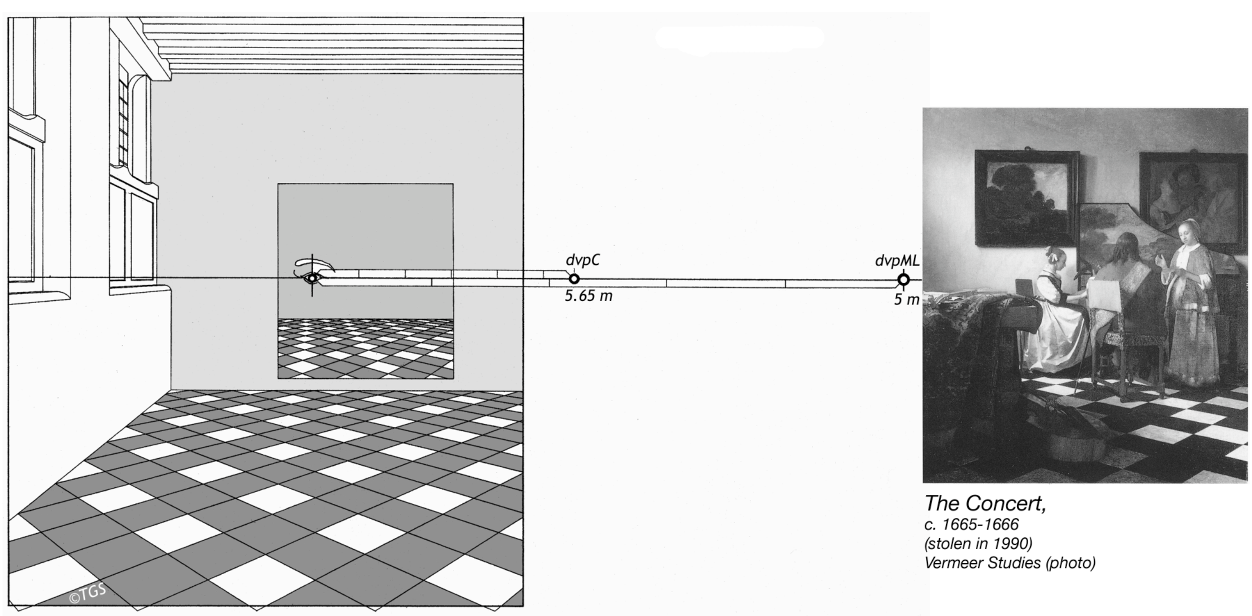


Figure 4a. *The ML and the Concert overlap to one another at their vanishing points (vp).*

• In Figure *4a*, both perspectives of the ML and the Concert overlay to one another at their *vp*. Each *dvp* was measured in modules at its correspondent limit of visual field, and carried over to the *vh*, as follows: *dvp* = 5 *m*, in the ML, and *dvp* = 5.65 *m*, in the Concert.

• Thus the *observer point* position for each painting is deduced as follows:
ML's *observer point*: 5 *m* (*dvp*) + 9.4 *m* (visible modules of the floor) =14.4 *m*.
The Concert's *observer point*: 5.65 *m* (*dvp*) + 8.20 *m* (visible modules of the floor) = 13.85 *m*.
• The real size of the Concert on the PP is deduced as follows: Locate point *c* by its modular perspective coordinates (X = 0, Y = -2.17, P = 0). This point lays exactly at the inferior limit of the visual field. Then drop a vertical visual ray *c*-*vp* by joining *c* with the *vp*.

Deducing the difference between both scenes' *observer point* we have: 14.4 – 13.85 = 0.55 *m*, thus the factor we are looking for is: 0.55 x 2.6 = 1.43 *m*. Now, carrying the PPbw's measures into the PP we have: 1.43 *m* + ML*vdp* = 1.43 + 5 = 6.43 *m* = C *vdp*. This point lays on the PPbw where its real image is projected. Sliding a parallel line from *c* – C *dvp* until it meets point C2 *vdp*, a new point *c'* is found where it crosses the vertical *c* – *vp*. This new point delimits the real size of the Concert projected on the PPbw. Finally, the whole visual field is completed by carrying visual rays from the *vp*, having as a result that the Concert measures ≈ 64.5 x 72.5 cm, as it is attested in Figure *4b*.

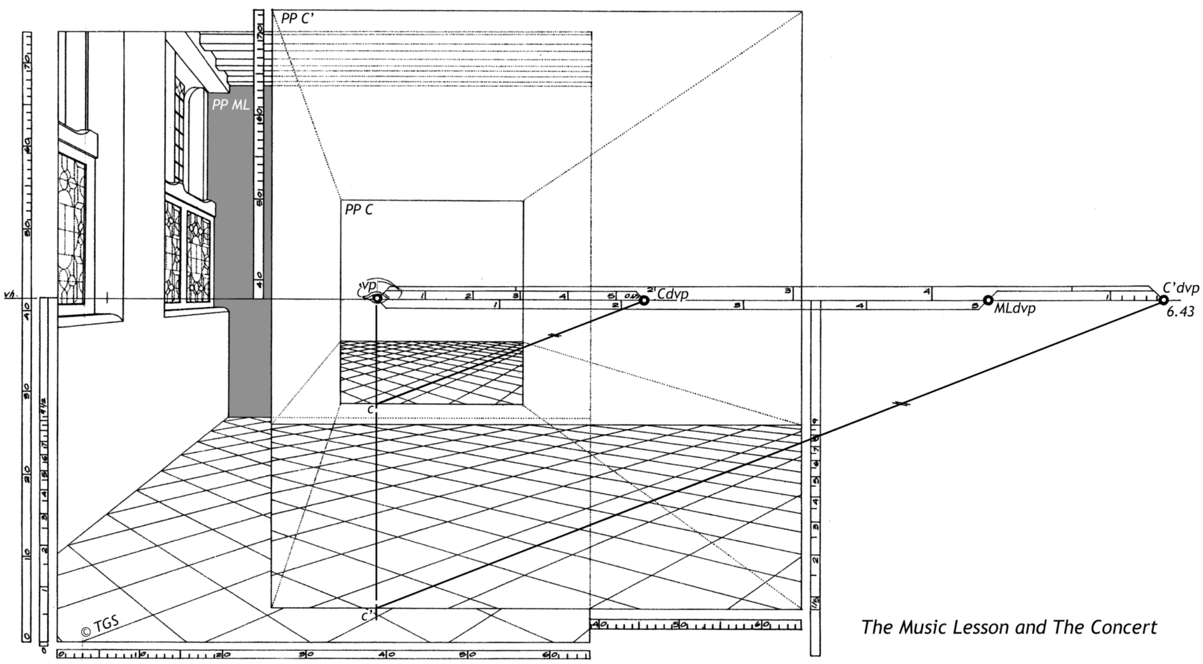


Figure 4b. *The Concert's measures, of ≈ 64.5 x 72.5 cm, were deduced.*

5. The Music Lesson and The Girl with a Wineglass

Based on Steadman's theory, of a ceramic tile been one-half of the marble's [6], the underlying floor grids of the ML and The Girl with a Wineglass (TGW) failed to match, since the aforementioned margin of error goes beyond of an acceptable tolerance. The Glass of Wine (GW) is also included here because it seems to depict the very same room of TGW, given that both appear to have the same window's leaden glass-pattern and floor tiles. To prove this, the missing part of the window was reconstructed in TGW, and then verifying its position with that of the GW.

As it can be seen in Figures *5a* and *5b*, the interval of the central window was found between the ≈ 10.4 *m* – 18 *m* rows for both grids [7], proving that they have the same embrasure span, while in Steadman's axonometric views this embrasure span commences at 9.5 *m* in GW and at 11.5 *m* in TGW.

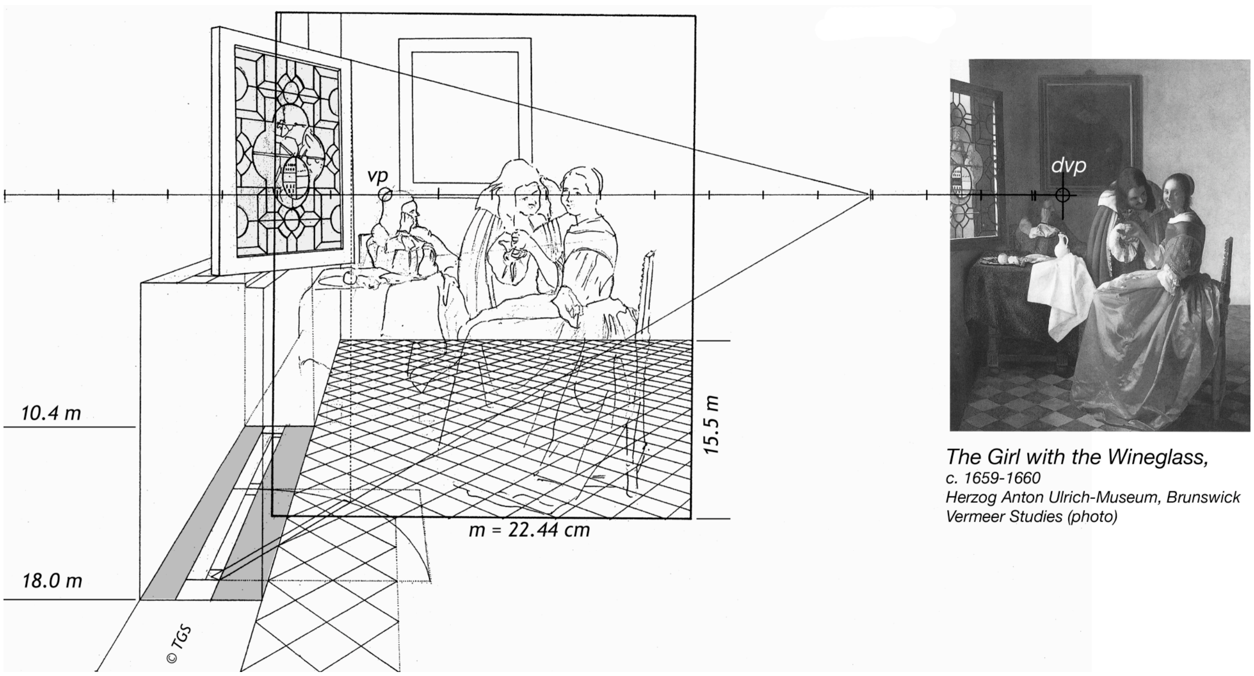


Figure 5a. *The Girl with a Wineglass reconstructed by TGS.*

If Steadman's assumptions were true, then the expected modular position for both windows must lay between the 12 *m* – 20.8 *m*, in accordance with the ML, which lies between the ≈ 6 *m* – 10.4 *m*. In addition, the window's height does not match: 2.60 *m* ≠ 2.25 *m* (the ML Vs. both TGW and WG respectively). Not only Steadman's measures are incompatible with the ML but also mine's. This discrepancy suggests that both floor tilling were not in 0.50:1 proportion. They instead seems to be in ≈ 0.575:1 proportion, as deduced through Figs. *5a* and *5b*, as follows:

TGW & GW window's embrasure: 10.4 *m* – 18 *m* = (6 x 1.74 – 10.4 x 1.74) ≈ 10.4 *m* – 18.1 *m*.

TGW & GW window's height: 4.5 *m* ≈ (4.5/1.74) ≈ 2.59 *m* ≈ ML window's height ≈ 2.60 *m*.

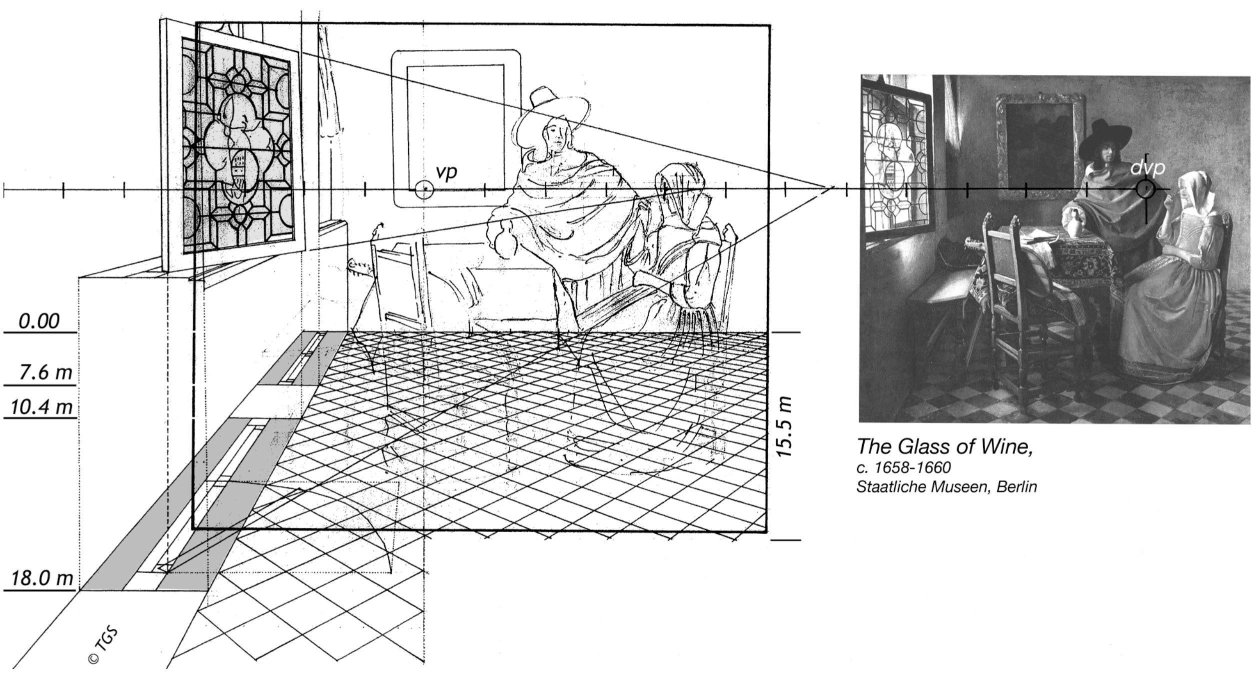


Figure 5b. *The Glass of Wine as reconstructed by TGS.*

So the awkward questions should be: how the ceramic floor grid could possible has served as a reference to deduce the marble floor under unmatched proportions? What if the marble flooring was in place at the time TGW was painted? At this point, we might conclude that the ceramic floor was captured at its current size by the camera, and then when it was renovated to the marble it was captured in the same way.

In both drawings, TGW and GW, the windows hold the clue to deduce where the *observer point* stands. In the TGW, the *observer point* is at: 12.2 *m* (*dvp*) + 15.5 *m* (visible modules of the floor) = 27.7 *m*. See Figs. *5a* and *5c*. Its position lays behind of the ML's but not too much to throw away the idea of it being the same room, since its real dimensions are not yet conclusive. If visual ray (*vr1*) were carrying out from the *observer point*, passing by tangentially to the left column, it would hit on the second column's lateral-face, as in the painting itself. Repeating the same proof for the visual ray (*vr2*), from Steadman's *observer point* estimation, it would fall outside of the window. This is the bottom question about the ceramic and marble floor's tile proportion. The same proof, as described for TGW, throw identical results for GW. Thus, my estimation of the room's width for both TGW and GW is about 7.63 m, instead of 6.46 m. This is why the consistency proofs between TGW and the ML's underlying grids is not practicable, since they seem to have different back wall positions, or even relate to different rooms.

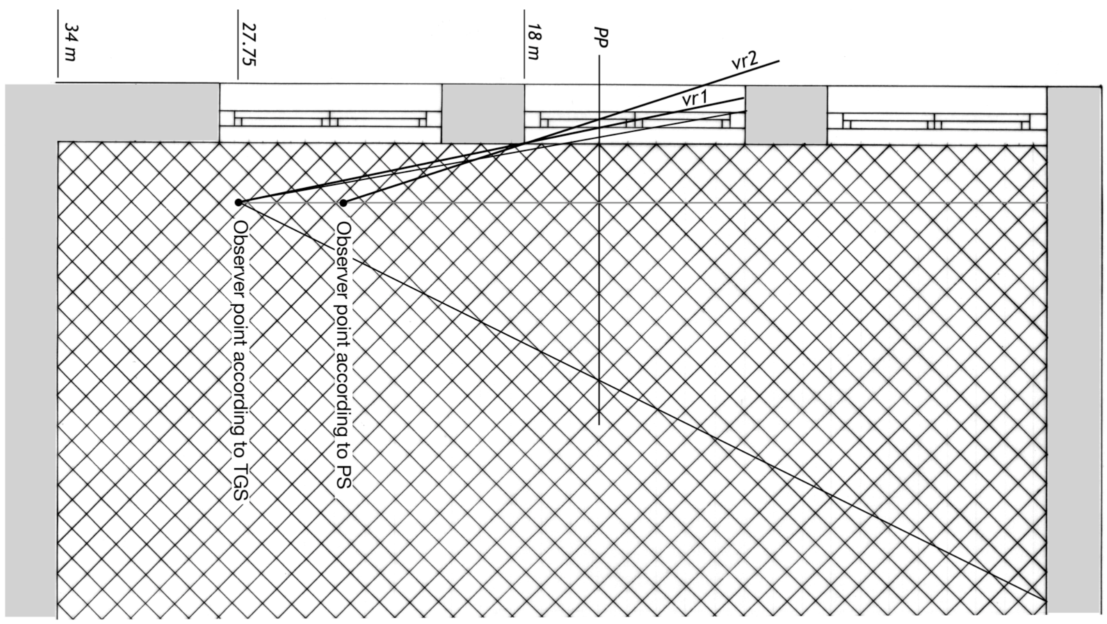


Figure 5c. *Comparison between the visual rays, vr1 and vr2.*

Notes and References

[1] Tomás García-Salgado, *"Some Perspective Considerations on Vermeer's The Music Lesson"*, *perspectivegeometry.com* e-journal, Number 1 (2003).
[2] Philip Steadman, *Vermeer's Camera, Uncovering the Truth Behind the Masterpieces* (UK: Oxford University Press, 2002), p. 73.
[3] Steadman [2], pp. 102-103.
[4] A margin of error of about ± 2 percent must be estimated since the photographs were not in true size.
[5] This value represents the difference between both observers in the room.
[6] Steadman [2], pp. 101, 114-115.
[7] Considering the diagonal of a ceramic tile as one *module* ($m \approx 31.7$ cm); counting from back to front.
Photo credits, as indicated in foot captions, are from: *Vermeer Studies*, Ivan Gaskell and Michiel Jonker, Eds. National Gallery of Art, Washington, 1998.