

## **Mona Lisa's smiles in Leonardo's drawings**

SORANZO, Alessandro <<http://orcid.org/0000-0002-4445-1968>>, DANYEKO, Olga and ZAVAGNO, Daniele

Available from Sheffield Hallam University Research Archive (SHURA) at:

<https://shura.shu.ac.uk/17314/>

---

This document is the Accepted Version [AM]

**Citation:**

SORANZO, Alessandro, DANYEKO, Olga and ZAVAGNO, Daniele (2017). Mona Lisa's smiles in Leonardo's drawings. *Art and Perception*, 5 (5), p. 410. [Article]

---

**Copyright and re-use policy**

See <http://shura.shu.ac.uk/information.html>

# Mona Lisa's smiles in Leonardo's drawings

Soranzo, A., Danyeko O. and Zavago D. -- a.soranzo@shu.ac.uk

## INTRODUCTION

Emotions play a fundamental role in everyday life; every thought, attitude or action has an emotional counterpart. This project investigates the emotions expressed in Leonardo da Vinci (1452-1519)'s work. The adherence to visual realism expressed by Renaissance and post-Renaissance artists is an asset to the study of emotional expression. Visual arts, in general, are an ideal archive where every aspect of the visual world has been represented. Artists have included visual illusions in their works long before scientists understood the mechanisms behind them. This is particularly true of Leonardo who was interested not only in the analysis of physical phenomena but also in our perceptions of these phenomena (Kemp, 2011). The past few years have witnessed a growing interest in the understanding of emotions through micro-expressions, which are contractions of facial muscles tied to underlying emotions. Interestingly, five centuries ago, Leonardo pioneered the study of micro-expressions by introducing the concepts of "moti mentali" and 'accidenti mentali' which can be translated as the representation of transient, dynamic mental states, thoughts and emotions. Paintings can effectively communicate emotions in a dynamic way as shown by Actis-Grosso & Zavago (2015). The Mona Lisa (1503-6) is probably the best example of how ambiguous micro-expressions can generate a dynamic mental and emotional state in the portrayed subject.

In her account of the *Mona Lisa*, Livingstone (2002) provides a basis for the ambiguous nature of the smile by pointing out that "Perhaps it is the difference in her [the *Mona Lisa*'s] expression carried by high and low spatial frequency ranges [...] that helps produce her smile's elusive quality" (Livingstone, 2000; p. 1299). Similarly, Kemp & Cotte (2010) noted that the emotional expression of another portrait attributed to Leonardo - *La Bella Principessa* (1495-6) - is also ambiguous and "subtle to an inexpressible degree" (p. 26).



Figure 1: La Bella Principessa. Leonardo da Vinci (late 15th Century)

### The 'uncatchable' smile

Soranzo & Newberry (2015;2016) found that, similarly to the *Mona Lisa*, the *Bella Principessa* presents a spatial frequency dependent illusion that they termed the 'uncatchable smile' because when the *Principessa*'s face is viewed from far away, the mouth is perceived as slanting upward in a smile-like fashion, but as the face is viewed from close-up, it appears to take a downward turn, making the *Principessa*'s smile impossible to catch. At its turn, this uncatchable smile alters *Principessa* level's of contentment. In addition, authors found that increasing the level of Gaussian blur, i.e. reducing the spatial frequency, leads to an increase in the perceived level of contentment (figure 2).



Figure 2: Increasing the level of Gaussian Blur increases the perceived level of Contentment

It seems that the area around the *Principessa*'s mouth is the main responsible for the 'uncatchable smile' illusion (figure 3).



Figure 3: The area around the mouth is responsible of the 'uncatchable smile' illusion

## EXPERIMENT

The perceptual change of expression in both *Mona Lisa* and *Bella Principessa* might arise from a masterly use of the *sfumato* technique. *Sfumato* can be described in terms of smoothly graded passages from one colour to another, from one tonality to another, from one brightness to another, or even the combination of the aforementioned cases. Leonardo himself defined *sfumato* as "without lines or borders, in the manner of smoke or beyond the focus plane", thus trying to convey the idea of visually indistinguishable passages from one colour to another. Both *Mona Lisa* and *Bella Principessa* include extensive areas of *sfumato* and they were both made using oil.

The aim of the current project is to test the hypothesis that Leonardo included a similar illusion of direction in other artworks type, even where oil was not used, in particular in his drawings.

We considered: *La Scapigliata* (1508) and another Female Head (1470-76). These two drawings were chosen because the position of the represented head is slightly different: Side view for the *Scapigliata* and Front view for the Female Head. The experimental conditions intended to examine if the viewing distance affects the ratings of how happy the portrayed subjects appear.

### Participants

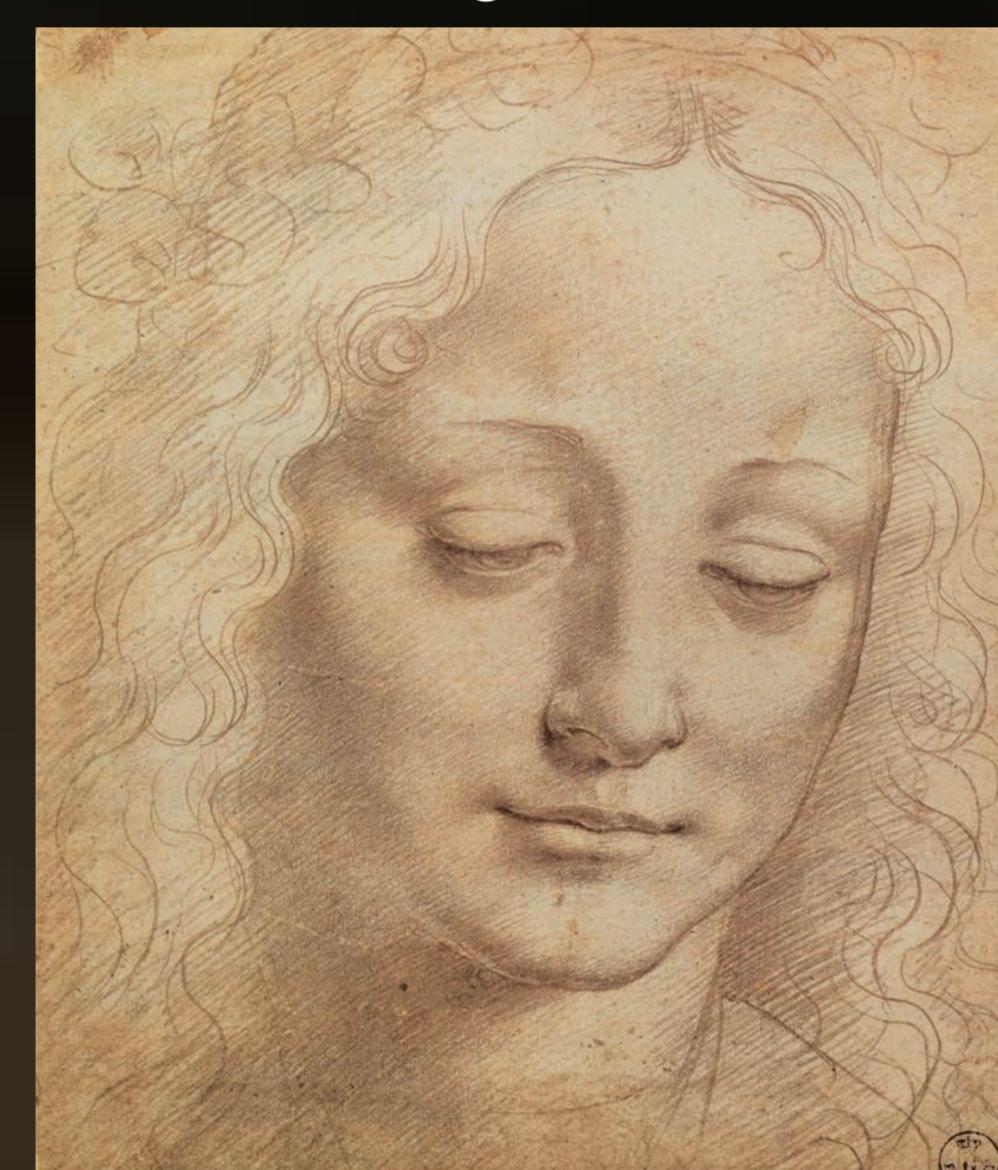
Thirty-two participants took part in the experiment, 16 for each distance condition. All had normal or corrected-to-normal acuity and were naïve with regard to the experimental design. Furthermore, participants were not familiar with the portrait.

### Stimuli

A printed version of the *La Scapigliata* and Female Head both (width = 20.3 cm and length 29.9 cm) were placed in the centre of an A1 paper pad resting on an easel stuck down with glue.



La Scapigliata (1508)  
Side view



La Scapigliata (1508)  
Frontal View

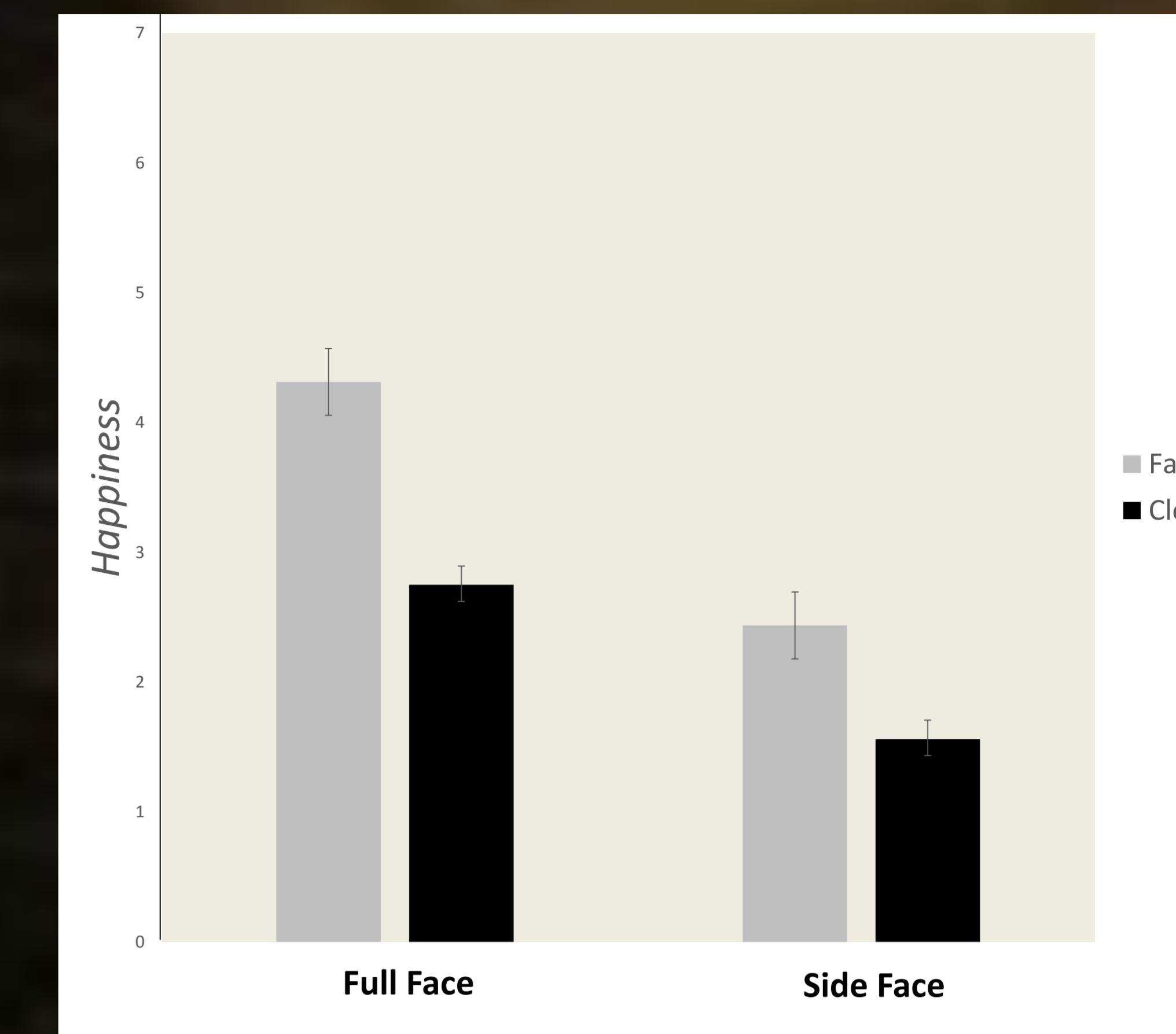
Figure 4:

### Procedure

In a mixed measure design, each participant viewed both the drawings from either 0.5 cm or from 8 meters away.

The participants were asked to stand in front of the covered drawings. Prior to the unveiling of the drawings, the participants were shown 4 magnitudes of estimation modules. These modules would represent what was meant by a rating happiness in a scale from 1 to 7. For a rating of 1 the participants were shown an unhappy face and were told that this represented that the drawing was not smiling at all and were then shown a rating of 7 which was represented by a very happy smiley face. After this the drawings were unveiled and the participants were asked to rate from 1 to 7 the level of happiness

## RESULTS AND DISCUSSION



A mixed two-ways ANOVA highlighted a significant difference between both Distance and View independent variables [ $F_{(1, 30)} = 26.19, p < 0.001, np^2 = 0.47$ ; and  $F_{(1, 37.5)} = 53.36, p < 0.001 np^2 = .64$ ; respectively]. The interaction between the two variables was not significant ( $p = 0.11$ ). Figure 5 plots of the results.

The results confirm the presence of the illusion of happiness in these Leonardo's drawings: from far away the portrayed subjects appeared significantly happier than from close up. Furthermore, it seems that the effect is stronger in the Full Face condition.

The results support the hypothesis that Leonardo trained this illusory effect before representing it in the most famous *Mona Lisa* and that it is present also in artworks adopting artistic techniques different from *sfumato*. of how viewing angle positioning has a similar effect to low spatial frequencies. As

The question remains whether Leonardo da Vinci intended this illusion. Either way it can be argued that the ambiguity created adds to the portrait's allure. It is possible that the front facing *Mona Lisa* may have been developed from techniques which Leonardo da Vinci used when creating drawings.

### References

- Actis-Grosso, R. & Zavago D. (2015). E-motions. *Art & Perception* 3.1: 53-66.
- Kemp M. & Cotte P. (2010). *La Bella Principessa. The Story of the New Masterpiece by Leonardo da Vinci*. Hodder and Stoughton, London.
- Kemp, M. (2011). *Leonardo*. Oxford: Oxford University Press.
- Livingstone, M. (2002). *Vision and Art: the Biology of Seeing*. New York: Abrahams.
- Soranzo, A. & Newberry, M. (2015). The Uncatchable Smile in Leonardo da Vinci's *La Bella Principessa* Portrait. *Vision Research*. 113, 78–86. <http://dx.doi.org/10.1016/j.visres.2015.05.014>
- Soranzo, A. & Newberry, M. (2016). Investigating the 'Uncatchable Smile' in Leonardo da Vinci's *La Bella Principessa*: A Comparison with the *Mona Lisa* and Pollaiuolo's Portrait of a Girl. *Journal of Visualized Experiments*. (116), e54248, doi:10.3791/54248.