The 'uncatchable smile' illusion in Da Vinci's Bella Principessa depends on the viewing angle

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INTRODUCTION

In 1998, a little known picture catalogued as a 19th century imitation of an Italian Renaissance prototype by an unnamed German Romantic artist was sold for a modest sum in a New York gallery. Later, it was sold to a buyer who suspected that the picture's origin was much more prestigious than originally thought. Following subsequent examination by experts and extensive research by the Oxford art historian Martin Kemp, the portrait (Figure 1) was held to be a once in a lifetime discovery and it was attributed to Leonardo Da Vinci (Kemp & Cotte, 2010).

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

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Further evidence supporting the provenance of the picture and identification of La Principessa came to light in 2011 (Silverman, 2012) which showed that the portrait had been removed from the Warsaw Sforziad, a hand illuminated book associated with the family of Ludovico Sforza, the ruler of Milan in the 1490's and patron of Leonardo (Kemp, 2011). La Principessa was identified as Bianca, the illegitimate daughter of Ludovico who at around 13 years of age was to be married to a commander of the Duke's Milanese forces. Leonardo's connection with the Duke of Milan is well known as he painted other portraits associated with his family and court as can be seen in Kemp's chronology (2011).

The picture, showing a young girl in her early teens, was executed by Leonardo on vellum using pen ink and a combination of coloured chalk (Kemp & Cotte, 2010). The pen and brown ink combine with the underlying yellow vellum background to create a mellow range of colours and skin tones. The girl's dress and hairstyle indicate that she was a member of the court of Milan during the late fifteenth century. Her expression shown in profile is ambiguous and has been described as "subtle to an inexpressible degree" (Kemp & Cotte, 2010; page 26).

The 'uncatchable' smile

In La Bella Principessa's portrait, the princess's smile can be seen to have an enigmatic quality, described by Kemp as "poised but pensive, the look of someone growing up too fast" (O'Neil, 2012).

Pickard & Soranzo (2012) found a spatial frequency dependent illusion that they termed the 'uncatchable smile' because when the Principessa's face is viewed indirectly, the mouth is perceived as slanting distinctly upward in a smile-like fashion, but as the face is viewed directly 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 particular, 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

In addition, authors found that the area around the Principessa's mouth is responsible for the 'uncatchable smile' illusion (figure 3).

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

EXPERIMENT

The spatial-frequency-dependent 'uncatchable' smile illusion in La Bella Principessa is, in some way, similar to that identified in the *Mona Lisa*. Bohrn et al. (2009) demonstrate that spatial frequency can influence the perception of the Mona Lisa's smile.

As a difference from the Mona Lisa, however, the Bella Principessa is facing left, in profile viewing. In the present research we tested weather the magnitude of the "uncatchable smile" effect depends on the viewing position.

The experimental conditions intended to examine if the viewing angle position seen in foveal effects the ratings of how Content La Bella Principessa appears. According to Bayle et al. 2011, the detection of emotional states from facial expressions is effective in periphery vision up to 40. Therefore, the viewing angle positions of the experiment differed of 40° (-40° , 0° , and +40).

Participants

Twenty-four participants took part in the experiment, eight for viewing angle condition. All had normal or corrected-to-normal acuity and were naive with regard to the experimental design. Furthermore, participants were not familiar with the portrait.

Stimuli

A portrait of La Bella Principessa (width = 20.3 cm and length 29.9 cm) was placed in the centre of an A1 paper pad resting on an easel stuck down with glue (figure 4.

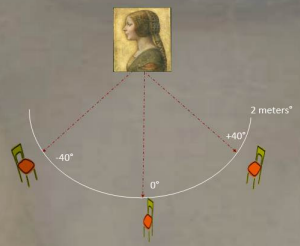

Figure 4: Experimental setting

Procedure

The portrait was veiled before each participants entered to the room. A chair was placed with its left forward leg on top of the marker (piece of black coloured tape) which represented each position of the three conditions. The participants were asked to sit up straight with their back resting on the back of the chair. Prior to the unveiling of the portrait the participants were shown 4 magnitudes of estimation modules. These modules would represent what was meant by a rating of 1 and 7. For a rating of 1 the participants were shown an unhappy smiley face and were told that this represented that the portrait was not smirking at all and were then shown a rating of 7 which was represented by a very happy smiley face. After this the portrait was unveiled and the participants were asked to rate from 1 to 7 the level of Contentment in La Bella Principessa.

RESULTS AND DISCUSSION

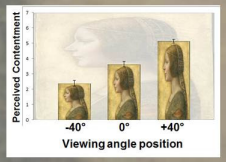

Figure 5: Experimental reults

A one way between participants ANOVA highlighted a significant difference between viewing angles positions and the rating of La Bella's level of Contentment [$F_{(2, 21)} = 68.86$, $p < 0.001$]. Effect size $\eta p^2 = .87$, this is regarded as a very large effect size. Figure 5 show the plot of the results.

The results confirm the presence of the 'uncatchable smile' illusion identified by Pickard and Soranzo (2012).

In addition, the results support the idea of how viewing angle positioning has a similar effect to low spatial frequencies. As Livingstone (2002) and Bohrn et al., (2010) proposed peripheral vision is recruited during facial expression perception. Additionally, Vuilleumier et al. (2003) and Bayle et al. (2011) further suggested that emotional expressions in facial perception are processed in low spatial frequencies. It seems that viewing La Bella Principessa 40 degrees from the right has a similar effect of reducing the spatial frequency.

Finally, results suggest a viewing directional effect of this visual illusion in relation to the portrait of La Bella Principessa. Perhaps, this directional effect occurs because the lady in the portrait is left facing. This assumption would account for how La Bella's smile appears to be less apparent in the left peripheral viewing position as evident by the lowest ratings given, in comparison to the highest ratings given within the far right peripheral viewing condition.

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 painting La Bella Principessa in profile view.

References

Bayle J.D, Schoendoff B., Henaf M-A., and Krolak-Salmon P. (2011). Emotional Facial Expression Detection in the Peripheral Visual Field.PlosOne. DOI: 10.1371/journal.pone.0021584

Bohrn, I. Carbon, C. & Hutzler, F. (2009). Mona Lisa's Smile - Perception or Deception? Psychological Science 21, 3, 378–380.

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.

O'Neil, T. (Feb. 2012). Lady with a secret. National Geographic. [on line} Available at: attp://ngm.nationalgeographic.com/2012/02/lost-da-vinci/o-neill-text [accessed 29th Nov 2012].

Pickard M. and Soranzo A. (2012) "Da Vinci's La Bella Principessa and the Uncatchable Smile" 1st Visual Science of Art Conference | 1-2 September 2012, Alghero, Italy.

Silverman, P. (2012). Leonardo's Lost Princess. Wiley and Son, Inc., Hoboken, New Jersey.

Vuilleumier P., Armony J., Driver J. and Dolan R. (2003). Distinct spatial frequency sensitivities for processing faces and emotional expressions. Nature Neuroscience 6, 624 - 631