

From copies to an original: the contribution of statistical methods

Amanda C. Murphy
Università Cattolica
Largo Gemelli 1, 20123 Milan
amanda.murphy@unicatt.it

Felicita Mornata
Independent scholar
mornata.felicita@gmail.com

Raffaella Zardoni
Independent scholar
raffaella.zardoni@me.com

Abstract

English. Despite the almost infinite number of existing copies, the exact appearance of the medieval veronica – the sudarium kept in Rome imprinted with the face of Christ – is not known. This paper illustrates an attempt to find the ‘true icon’, creating a sort of identikit by means of the statistical processing of 4500 works, with analysis of the concentration of the copies and their characteristics, together with multivariate analysis tools.

Italiano. Nonostante le infinite copie esistenti non è noto quale fosse l’aspetto della veronica medievale, il sudario con impresso il volto di Cristo conservato a Roma. Il documento dimostra il tentativo di ritrovare la “vera icona” creando una sorta di identikit attraverso un’elaborazione statistica di 4500 opere con analisi della concentrazione delle copie e delle loro caratteristiche, unitamente a strumenti di analisi multivariata.

1. Introduction

1.1. The missing original veronica

According to tradition, the veronica, the medieval relic conserved in St Peter’s, was the sudarium St Veronica offered Christ, on which his face was imprinted. Despite vast documentation from 1200 to 1500,¹ and the witness of pilgrims (such as Dante and Petrarch) visiting the relic in Rome, and countless extant copies, the exact aspect of the veronica is unknown.² There is great variance among its copies: e.g. Christ’s face can be transfigured, or show signs of suffering, be with/without the crown of thorns, with open/closed eyes.

The first systematic study of copies of the relic in order to find the original was the work of Karl Pearson in 1887.³ He compared literary and liturgical texts, and lined up images in chronological order, seeking reasons for the lack of continuity between representations. Scholars from literature, history, history of art, and theology have continued this research and the year 2000 saw a growth in interest in the topic;⁴ there is, however, still no definitive answer to the question of what the original medieval veronica looked like.

1.2. Veronica Route project

The Veronica Route project⁵ (VR) joined this field of research in 2010, with the creation of an open, expanding, interdisciplinary database of artistic and literary citations, ordering ‘the infinite copies’ of the image in an online catalogue. VR holds 4500+ tagged objects, particularly from the Middle Ages.⁶ The classifications

¹ In 1289 the Veronica was declared the most important relic in St Peter’s (Coll. Bull. SS. Eccl. Vat., I, 214).

² The image kept in St Peter’s Basilica shows indistinct markings and has not yet been studied. We can only be certain of the size of the medieval veronica (40 x 37 cm) thanks to the 14th century frame kept in the Vatican (Sturgis, 2000:75).

³ It is a curious coincidence that Pearson worked out the statistical index of correlation, a starting point for several statistical methods.

⁴ Belting (1990); G. Morello (1997); Hamburger (1998); Kessler, Wolf (1998); D’Onofrio (1999); Frugoni (1999); Morello, Wolf (2000); Di Blasio (2000); Burgio (2001); Di Fruscia (2013).

⁵ Veronica Route was presented at the conference ‘The European Fortune of the Roman Veronica’, Magdalene College, University of Cambridge, April 2016.

⁶ The works are signalled and sent in by volunteers together with the information found in loco: the sources are considered trustworthy, unless an error of attribution or dating is easily demonstrable. Many works recorded in Veronica Route do not yet have captions as complete as those in museum catalogues. Although the VR database covers all centuries, the richest and most relevant period for the present purpose is pre-1600.

were carried out manually, following a traditional methodological approach.⁷ The collected data was rendered available through tags marking iconographic characteristics, the dimensions of time (dating) and space (geographical positioning), with a visualisation function of the results allowing maps of veronicas to be manipulated.⁸ Thus classified according to >50 features, the images were turned into information. Data mining with appropriate statistic methodologies on a statistically significant number of images has yielded the definition of significant models and new interpretative hypotheses/research paths about the relic which ‘for three centuries, exerted such a great influence on the literary and artistic artefacts of our ancestors’.⁹

2. The variants of the iconographic subject and their geographical spread

To be able to identify the prototypes of the veronica, we used two different statistical tools, the index of transversality and multivariate analysis which juxtapose and aggregate the various tagged features.

2.1. Index of transversality

The recurrent iconographic characteristics, the subjects (St. Veronica, angels, sudarium, etc.), the various transversal themes (Roman relic, Strozzii, St. Spirit, etc.) and the supports (painting, miniature, sculpture), available for each veronica in the Veronica Route database, are all dichotomic variables (0-1 presence/absence).

The frequencies of the dichotomic variables to be compared through the centuries have to be normalised in order to make the data homogeneous. For this reason we identified the index of transversality in time, which was calculated as follows:

$$I_{KS} = \frac{(Freq_{KS}/Freq_{K\Sigma S})}{(Freq_S/Freq_{\Sigma S})} \quad K = characteristic, \quad S = century$$

Figure 1 shows that the graphic representation of some indices clearly show the strong coupling of DOUBLE-POINTED BEARD-OPEN EYES and the late appearance of the feature CLOSED EYES.

⁷ With time, it will be interesting to be able to adopt automatic face analysis tools, which are not yet appropriate for the recognition of iconographic characteristics, although they already work well in estimations of eye, nose and mouth positions, the degrees of different emotional expressions, etc. as shown in the Selfiecity project, classified as one of the most significant examples of “distant viewing”.

⁸ Software developed by Giacomo Aletti, professor of Probability and Statistical Mathematics, Dipartimento di Scienze e Politiche Ambientali, Università degli Studi di Milano.

⁹ ‘In this age when scholars attempt to trace the journey of a saga from India to Iceland, I hope that a description of the origin and development of a legend which has exercised such a huge influence on the literary and figurative works of our forebears over the centuries will not be considered superfluous.’ (Karl Pearson, *Die Fronica*, p. 94, our translation)

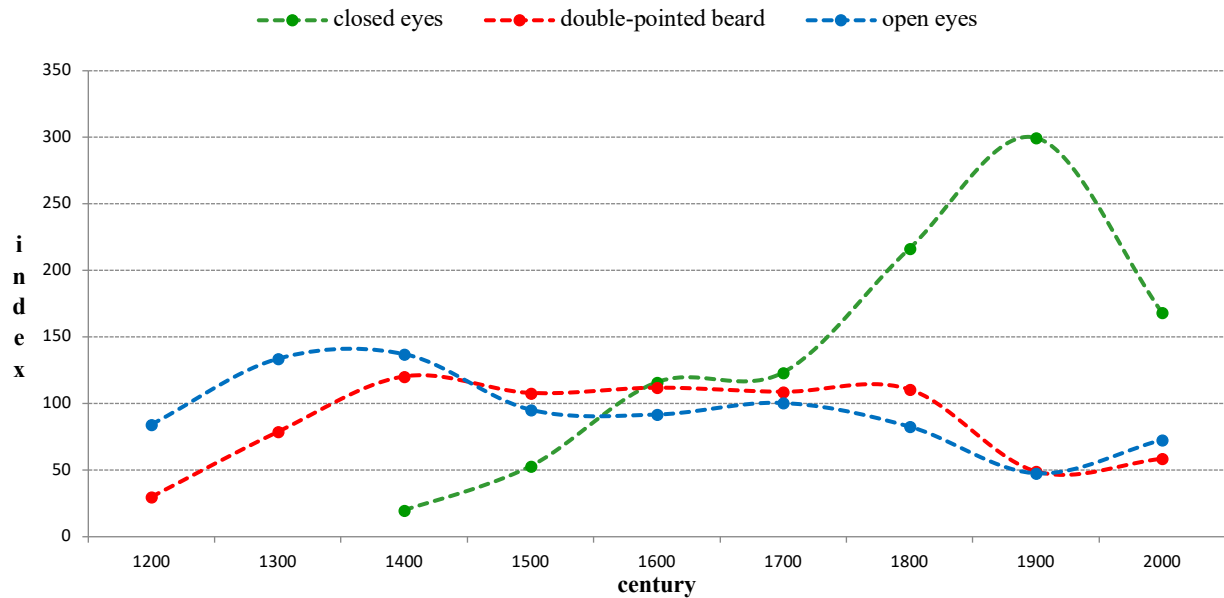


Figure 1. Index of transversality

2.2. Multivariate analysis: K-Means Cluster Analysis

From 1300 on, the considerable number of veronicas makes multivariate analyses on the available data meaningful. Another fruitful approach to investigating the correlations between the features is to aggregate veronicas from the same time frame into homogeneous groups, using the methodology K-means Cluster.¹⁰ This algorithm considers each veronica like a point in a space of N dimensions (N = the available fields for each record). The value of each field is interpreted as distance from the origin along the corresponding spatial axis. In the K-means methods the original choice of a value for K determines the number of clusters that will be found. The analyst experiments with different values of K and each set of clusters is then evaluated: the one which shows the clearest interpretation of the data is chosen. It is an iterative process, which begins by identifying K points as seeds, and continues by aggregating all the other records, assigning each record to the closest centroid cluster. After this process the new cluster centroids are calculated, and, according to the proximity rule, the cluster to which each point belongs is recalculated. This iterative process ends when the cluster boundaries stabilize. Once the clusters have been defined, the results can be interpreted.

In order to describe the elements shared by the veronicas belonging to the same cluster, the matrix of the "final centroids" must be analysed, which, being dichotomous variables, quantifies the influence of each variable within the cluster. Therefore, Final Cluster Center $\rightarrow 1$ corresponds to the predominance of that variable in that particular cluster, and vice versa.

The fourteenth century

	1	2	3
without crown	0,937	0,922	0,897
open eyes	0,984	0,882	0,759
transfigured	0,921	0,745	0,655
St. Veronica	0,000	0,725	0,000
cruciform halo	0,556	0,667	0,379
double-pointed beard	0,444	0,353	0,448
head of Christ	0,032	0,196	0,000
cut out	0,492	0,039	0,138
sudarium	0,508	0,020	0,000

¹⁰ Implemented in the software SPSS Statistics (Analyze / Classify / K-Means Cluster procedure).

dark face	0,048	0,020	0,000
fleury cross	0,032	0,020	0,034
arma Christi	0,032	0,020	0,000
suffering	0,000	0,020	0,069
transparent veil	0,000	0,020	0,000
ascent to Calvary/Calvary	0,000	0,020	0,000
open mouth/visible teeth	0,063	0,000	0,069
dark veil	0,048	0,000	0,000
Sts.Peter and Paul	0,048	0,000	0,000
imago pietatis	0,048	0,000	0,000
green crown	0,016	0,000	0,000
crown of thorns	0,000	0,000	0,069
blank veil	0,000	0,000	0,000
triple veil	0,000	0,000	0,000
folds	0,000	0,000	0,000
monochrome	0,000	0,000	0,000
angel/s	0,000	0,000	0,862
Mass of Saint Gregory	0,000	0,000	0,000
way of the Cross	0,000	0,000	0,000
Frequency of veronicas (143)	63	51	29

Figure 2. Clusters in the fourteenth century

The works in the 1300s tagged with ROMAN VERONICA¹¹ can be analysed in three clusters (excluding those with the tags BADGE and TEXT). In Figure 2, the predominant characteristics are in yellow, the absent ones in green. In this period all the veronicas are characterised, homogeneously, by the serene face of Christ, without a trace of suffering. Differences are found in the subjects showing the veronica: cluster 1 includes almost all the cases of the sudarium alone (with the tags CUT OUT and DARK FACE); cluster 2 aggregates the figure of St Veronica (particularly in Lombardy where we can find one of the first pictorial representations of the saint);¹² cluster 3 aggregates angels holding up the sudarium, positioned throughout eastern and central Europe.

The Fifteenth century

The 1400s are the most popular century for the image¹³ (with 1122 works compared to 264 in the 1300s); in the second half of the century, veronicas appear with Christ's face bearing signs of suffering and drops of blood, and with the iconographic subject of the ascent to Calvary¹⁴. The considerable number of works and their variations in this century determined the choice to analyse the data in four clusters, in the interest of the best interpretation of the dominant characteristics in the variants. The 709 works tagged with ROMAN VERONICA, (excluding those tagged BADGE and TEXT) were thus aggregated: in Cluster 1 (234 veronicas, coloured in light blue in Figure 3) we find the transfigured face of Christ; in Cluster 2 (139 veronicas, dark blue) St Veronica; in Cluster 3 (166 veronicas, red) the new features of the Passion; and Cluster 4 (170 veronicas, orange) the sudarium.

Figure 3 displays the distribution of the works across Europe: we see a dominance of the figure of St Veronica with the transfigured face of Christ in France, where St Veronica is considered the evangeliser of the

¹¹ The tag ROMAN VERONICA is used when the veronica is the only subject or the main subject, and not when the veronica is part of another work, such as Arma Christi, Madonna of the Seven Sorrows, and such like.

¹² Stefano Candiani, The iconography of Veronica in the Lombardy region, late XIII-early XV centuries, in A. Murphy et al. Ed., The European Fortune of the Roman Veronica in the Middle Ages, Convivium Supplementum 2017, Turnhout: Brepols. p. 264.

¹³ "From the 14th century, wherever the Roman Church went, the veronica would go with it" (Neil MacGregor and Erika Langmuir, 2000, p.92)

¹⁴ The moment in which the veil was imprinted was not initially linked to the ascent to Calvary, but to Jesus' public life.

region,¹⁵ and in Flanders (where she is the patron saint of linen and cloth merchants); the first veronicas with signs of suffering appear in all European countries, and it becomes slightly prevalent as a characteristic in Germany, while in England there is a prevalence of the sudarium as the iconographic subject.

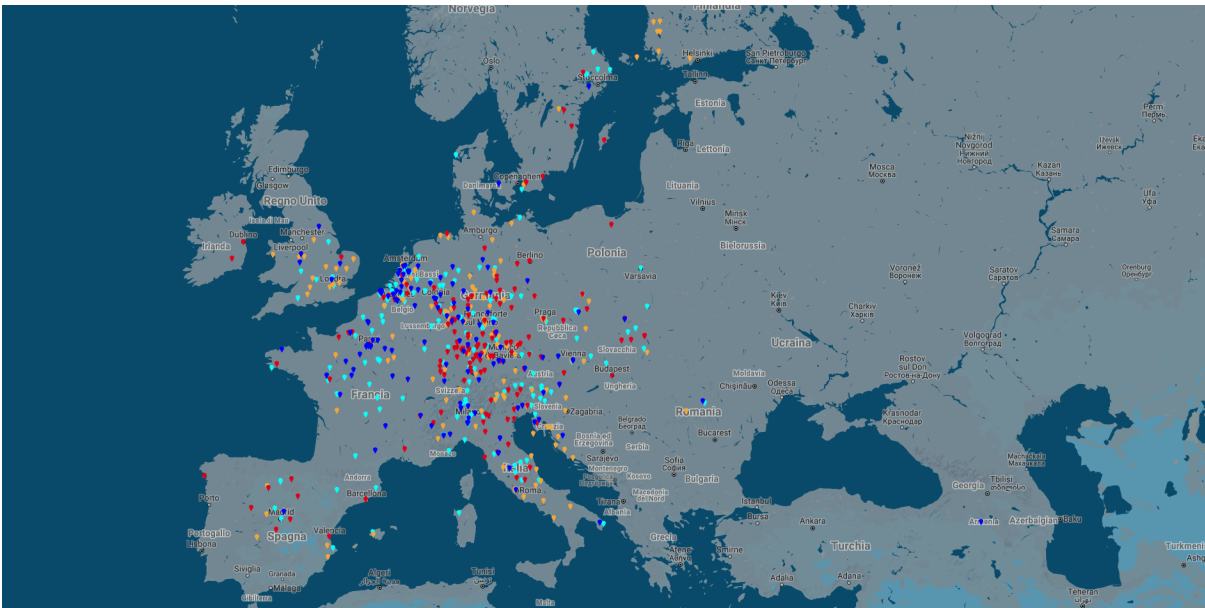


Figure 3. 1400s - distribution of the clusters

The Sixteenth century

There are 1075 works from the 1500s in Veronica Route. In a 4-cluster analysis of the 948 works, we find the SUDARIUM in cluster 1 (165 veronicas, including those characterised by DARK FACE and CUT OUT); cluster 2, SAINT VERONICA (always dominant in France), 295 veronicas; cluster 3, 281, SIGNS OF SUFFERING (a feature which becomes dominant in Italy); and in cluster 4, with 207 veronicas, the ASCENT TO CALVARY and BLANK VEIL. This feature, meaning that the face of Christ imprinted on the cloth is no longer visible, seems to shift attention away from the relic kept in Rome and onto the woman's pious gesture. In actual fact, the Protestant Reform and the Sack of Rome of 1527 interrupted – for various reasons – the history of the Roman relic.

3. Research on the Roman relic: validation

The last investigation concerns the relic kept in St Peter's, of which there are no photographic reproductions and which has never been an object of study.

In Veronica Route the tag ROMAN RELIC is assigned when the historical sources of the work refer directly to the relic. This feature is present only in 3.4% of the 1081 veronicas that are catalogued up to the end of the 1400s (excluding the veronicas with the tags TEXT and BADGE). These are decidedly small numbers for making a predictive analysis of the characteristics of the ROMAN RELIC.

The investigation therefore proceeded by evaluating the concentrations of the tag ROMAN RELIC in the other features and ordering them according to decreasing values. In the graph, the average concentration of 2% - index 100 – is indicated by the blue line and the characteristics with a higher index are those that correspond most to the ROMAN RELIC; the clear emergence of the features CUT OUT and DARK FACE can be seen, whereas the features DOUBLE-POINTED BEARD - CROWN OF THORNS - SUFFERING, positioned underneath the blue line are clearly separate from the Roman relic.

¹⁵ Her tomb is still preserved at Saint Seurin (Bordeaux), on the pilgrims' way to Santiago di Compostela.

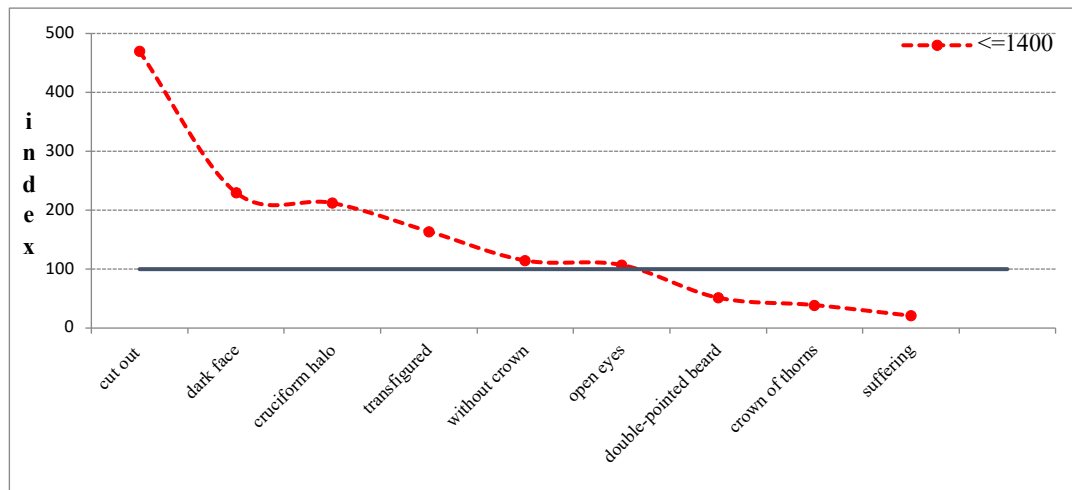


Figure 4. Concentration of the ROMAN RELIC

CUT OUT and DARK FACE are the features characterising the Mandylion in the Vatican (Figure 5),¹⁶ a work likened to the medieval relic.¹⁷ Identifying the Vatican Mandylion with the medieval Veronica would not be contradicted by the data, but the proportion of works tagged as CUT OUT and DARK FACE compared to the total works in the database (5 in 1200, 3 in 1300, 53 in 1400) and the late spread of the iconography, suggest the need for further research on this.



Figure 5. Left, the *Vatican Mandylion*, Lipsanoteca of the Pontifical Palaces, Vatican, next to works tagged CUT OUT and DARK FACE: *Veronica d'oro*, 1368 ca. Prague, Cathedral Treasury; *Santa Veronica col velo tra i SS. Pietro e Paolo*, 1430, altar Santa Maria del Monastero, Manta.

Conclusions

Firstly, the Veronica Route project intends to continue investigating the origins of the medieval relic's iconography. Secondly, we intend to break up the temporal arches (linked so far to centuries) so as to align them better with historical events, such as the Holy Years, in order to investigate the origins and development of the relic variations more precisely. Lastly, an exploration of the features which do not seem to derive from the Roman relic, but which have nevertheless become highly famous, would be an interesting new direction.

¹⁶ The Mandylion was once considered the most ancient reproduction of the Face of Christ, even though it is documented in Rome only from 1517. Until 1870 it was kept in the Church of St Sylvester the First (San Silvestro in Capite), and is now kept in the Vatican.

¹⁷ G. Morello (2012) p. 78.

References

- Hans Belting. 1990. *Bild und Kult: eine Geschichte des Bildes vor dem Zeitalter der Kunst*, Beck, Munchen.
- Michael J. A. Berry and Gordon S. Linoff. 1999. *Mastering Data Mining*, Wiley, Oxford.
- Eugenio Burgio. 2001. Veronica e il volto di Cristo: Testi e immagini di una 'Legenda' tardomedioevale, in *Testo e immagine nel medioevo Germanico*, (Ed. Maria Grazia Saibene and Marina Buzzoni). Istituto Editoriale Universitario, Cisalpino, pp. 65-102.
- Mario D'Onofrio (ed.). 1999. *Romei e Giubilei. Il pellegrinaggio medievale a San Pietro (350-1350)*, Electa, Milano.
- Tiziana Maria Di Blasio. 2000. *Veronica, il Mistero del Volto*, Città Nuova, Roma.
- Chiara Di Fruscia. 2014. Roma come Gerusalemme? Reliquie e memorie di Cristo nell'Urbe, in *Come a Gerusalemme. Evocazioni, riproduzioni, imitazioni dei luoghi santi tra Medioevo ed Età Moderna*, Benvenuti, A. and Piatti, P. Sismel, Firenze.
- Arsenio Frugoni. 1999. *Pellegrini a Roma nel 1300, Cronache del primo Giubileo*, PIEMME, Casale Monferrato.
- Giacomo Grimaldi. *Opusculum de sacrosancto veronicae sudario*, Biblioteca apostolica vaticana, Archivio Capitolo San Pietro H3, Città del Vaticano.
- Jeffrey F. Hamburger. 1998. *The Visual and the Visionary*, ZoneBook, New York.
- Herbert L. Kessler, Gerhard Wolf. (eds.) 1998. *The Holy Face and the Paradox of Representation, Papers from a Colloquium held at the Bibliotheca Hertziana*, Rome and the Villa Spelman, Florence.
- Neil McGregor, Erika Langmuir. 2000. *Seeing Salvation. Images of Christ in Art*, Yale University Press, Newhaven.
- Giovanni Morello. 2012. "Or fu sì fatta la sembianza vostra?" La Veronica di San Pietro: storia ed immagine, in Giovanni Morello. *La Basilica di San Pietro*, Gangemi Editore, Roma, pp. 39-80.
- Giovanni Morello. 1997. "La Veronica nostra". In *La Storia dei Giubilei*, edited by Gloria Fossi, Giunti - Bnl Edizioni, Roma.
- Giovanni Morello, Gerhard Wolf. 2000. *Il volto di Cristo, Catalogue of the Exhibition*. Electa, Milano.
- Karl Pearson. 1887. *Die Fronica, Ein Beitrag zur Geschichte des Christusbildes im Mittelalter*, Strasbourg.
- Alexander Sturgis. 2000. "The True Likeness", in Gabriele Finaldi (ed.), *Image of Christ*, The National Gallery, London.
- Nicola Barbuti, Stefano Ferilli, Tommaso Caldarola. 2018. *Un innovativo Graphing Matching System per la ricerca in database di manoscritti antichi. Umanistica Digitale*, No 3. <https://umanisticadigitale.unibo.it/article/view/8144>
- Alise Tifentale, Lev Manovich. 2015. *Selfiecity: Exploring Photography and Self-Fashioning in Social Media*. In Berry D.M., Dieter M. (eds.) *Postdigital Aesthetics*. Palgrave Macmillan, London.