



# **Artistic Data and Network Analysis**



Figure 1. Aby Warburg's Panel 45 with the color version of the images mapped over the black-and-white photographic reproductions.



# Images as Data: Cultural Analytics and Aby Warburg's *Mnemosyne*

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**Abstract:** In this paper, by extending the methodology of media archaeology to the praxis of Cultural Analytics/Media Visualization I ask how have we compared multitude of diverse images and what can we learn about the narratives that these comparisons allow? I turn to the work of Aby Warburg who attempted to organize close to two thousand images in his *Mnemosyne Atlas*. In comparing contemporary methods of image data visualization through cultural analytics method of remapping and the turn of the century methodology developed by Warburg under the working title of the “iconology of intervals,” I examine the shifts and continuities that have shaped informational aesthetics as well as data-driven narratives. Furthermore, in drawing parallels between contemporary Cultural Analytics/Media Visualization techniques, and Aby Warburg's *Atlas*, I argue that contextual and image color data knowledge should continue to be important for digital art history. More specifically, I take the case study of Warburg's Panel 45 in order to explore what we can learn through different visualization techniques about the role of color in the representation of violence and the promise of prosperous civil society.

**Keywords:** images as data, Aby Warburg, Cultural Analytics, color, visualization, violence, reconciliation

In their current state, the methods of Cultural Analytics and Digital Humanities provide two radically different ways of interpreting images. Cultural Analytics calls upon the understanding of images as objects with features, and more specifically as image-data in and of themselves. The potential of this computational method to digital art history was presented in detail in Manovich's essay “Data Science and Digital Art History.”<sup>1</sup> Digital Humanities methodologies on the other hand rarely analyze images per se. Instead, they tend to focus on the metadata: historical and cultural

information about the artifact. In this project, I take on a hybrid Digital Art Historical methodology that combines Cultural Analytics as articulated by Lev Manovich with Digital Humanities paradigms. I apply this method to the case study of Aby Warburg's *Mnemosyne Atlas* from 1924, and to Panel 45 more specifically. The twenty-four images in Panel 45, many of which were created by the Italian fresco painter Domenico Ghirlandaio, comprise the objects for this study. I selected Panel 45 because it grapples with the relationship between color and violence. Using Cultural Analytics, I

render Warburg's images as color-data. I argue that this color-data, situated in the theoretical framework provided by Christopher Johnson's 2013 Digital Humanities project about Warburg titled *Mnemosyne: Meandering through Aby Warburg's Atlas*<sup>2</sup> and in reference with traditional art historical texts about Domenico Ghirlandaio, speaks to the larger tropes of violence and civil reconciliation. I demonstrate that color-data becomes art historical knowledge through an in-depth conversation with digital humanities practices as well as with already established disciplinary knowledge.

## Warburg's *Mnemosyne*

Aby Warburg worked on the *Mnemosyne Atlas* project from 1924 until his death in 1929. The *Atlas* consisted of over two thousand black and white photographs of works of art arranged on "sixty-three wooden boards, measuring approximately 150x200cm, covered with black cloth."<sup>3</sup> According to Warburg, these arrangements of diverse types of images attempted to produce "first of all an inventory of pre-coined classical forms that impacted upon the stylistic development of the representation of life in motion in the age of the Renaissance."<sup>4</sup> It aimed to offer a "comparative analysis" of visual and cultural tropes spanning from Classic Antiquity to Renaissance, and engaged the early 20<sup>th</sup> century as well. This analysis was built upon

an understanding of not only of the formal elements of the images, but also of their cultural meaning.<sup>5</sup> While his panels contained no textual descriptions, Warburg kept notes that listed provisional titles as well as the overarching theme of each panel.

The black-and-white photographs of artworks were pinned either directly to the black fabric, or framed over a white mate. They varied in size, proportion of the depicted image, as well as distance from each other. Warburg sometimes photographed the work of art in its entirety. In other instances, he focused on a detail and included only a close-up. Through the use of the close up, he cropped and framed elements that can be then positioned as points of emphasis within the panels. The panels themselves have not survived and what we have left instead are black and white photographs of these panels instead.

## Panel 45

Christopher Johnson conducted an extensive study of Warburg's work. His research resulted in both a book manuscript titled *Memory, Metaphor, and Aby Warburg's Atlas of Images* and a Digital Humanities Project titled *Mnemosyne: Meandering through Aby Warburg's Atlas*. The book illuminates Warburg's use of the metaphor as a structuring element. Here Johnson argues that Panel 45 is a "study in contrasts."<sup>6</sup> As cited in Johnson book, Warburg's notes on this panel read:

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“ Superlatives of the language of gestures. Wantonness of self consciousness. Individual heroes emerging out of the typological grisaille. Loss of the ‘how’ of metaphor. At the center of the panel’s twenty-four images are two frescoes by Ghirlandaio from the Torenabouni Chapel, Massacre of the Innocents and Apparition of the Angel to Zechariah.”

The Digital Humanities project *Mnemosyne* offers further insight into the specific images that constitute the panels.<sup>8</sup> Here the twenty-four black-and-white photographs of artworks that constitute Panel 45 are named and numbered. They are also linked to the color version of each artwork. Johnson’s interpretation of the panel reads:

“ A study in extremes, panel 45, builds on the sequence of panels 41, 41a, 42, 43, & 44. But it does so to signal a perilous ‘loss’ of metaphoric distance. Here frescos by Ghirlandaio emblemize the ‘afterlife’ of classical ‘expressive values’ in the Renaissance. Yet Ghirlandaio’s use of the *grisaille* technique is not able to fully moderate or mediate the intensity of the passions. Thus even as the *Massacre of the Innocents* metonymically yields to *The Blood of the Redeemer* (while also anticipating the Eucharistic

theme of panel 79), and even as the serving girl in *Birth of John the Baptist* heralds the all-important theme of the *nymph* whose ‘life in motion’ [*bewegtes Leben*] animates Warburg’s own thinking, the panel heightens the lethal threats (e.g., plague, tyranny, war) against the possibility of achieving psychological ‘balance’ [*Ausgleich*].”<sup>7</sup>

According to Johnson, this panel explores the tension between violence and passion on one hand and the aesthetic formal properties of *grisaille* – a technique that relies on varied in brightness gray palettes and desaturated colors – on the other.<sup>9</sup> Here Warburg explored the role of *grisaille* technique as well as color in conveying violence.

Building upon Johnson’s work, I argue that Panel 45 is indeed a comparative study of contrasts – contrasts that engage both visual and cultural tropes. Warburg explores violence and promise of civil reconciliation rather than passion; *grisaille* and brightly saturated color, Classic Antiquity and Renaissance. Warburg articulates these dyads by positioning images of rebirth on the left side of the panel – such as the *Birth of John the Baptist* by Domenico Ghirlandaio, and images of violence on the right – such as *Massacre of the Innocents* by Matteo di Giovanni. As the two frescoes represented in the center of Panel 45 show, the possibility of the social is rooted in a long-standing tradition of violence.

### Panel 45 in Color

The extensive documentation provided by the Digital Humanities *Mnemosyne* Project (2013) allows for the reconstitution of this panel in color (Figure 1). Cultural Analytics further confirms the importance of the question of color in Warburg's work. I argue that color is an important agent of meaning in Panel 45 not only because of its primacy as a feature for data extraction in Cultural Analytics, but also because it was the primary diving principle in the organization of Warburg's thought. Warburg questions the transience of violence and the promise of social rebirth in the Classic as well as Renaissance periods through an exploration of both color and *grisaille*. Although panel 45 consists of black and white photographs, I argue that he was working with and conceptualizing through works of art in color. The black-and-white effect is due to the photographic reproduction technology deployed in the constitution of the panels. The *Atlas* images for Warburg were pictures of intense color.

Digital Humanities projects, such as Johnsons's *Mnemosyne*, engage with the context in which Panel 45 with its images exists. They offer relevant information on the level of *metadata* about images such as: author, period, title, etc. Remapping visualization techniques allow for a closer look at the *data* that constitutes the images: namely brightness and saturation. Image visualization thus allows us to further analyze the relationship

between color and gray scale in relation to violence and possibility of civil reconciliation that Warburg positioned in first place as his motivation behind the composition of Panel 45.

### Cultural Analytics as a Methodology

Having translated Panel 45 into color, I turn to the methodology of Cultural Analytics in order to convert its images into color-data. Cultural Analytics is a methodology spearheaded by Lev Manovich and the Software Studies Initiative, which "allows the users to work with different kinds of data and media all shown together."<sup>10</sup> It adapted Information Visualization techniques used in STEM to the fields of Art History, Film and Media Studies, and Popular Culture, to name a few. Information visualization, as defined by Lev Manovich, is "a widely used as a tool for understanding data – i.e. discovering patterns, connections, and structure" and as such delivers "new knowledge about the world through systematic methods – such as experimentation, mathematical modeling, simulation." Furthermore, this new method is invested in design, as "it involves the visual presentation of data in a way that facilitates the perception of patterns."<sup>11</sup>

Deploying visual databases and graphic plotting software (*ImageJ*, which originally was developed by the National Institute for Health), the Cultural Analytics approach allows

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for the comparison of large sets of visual data through techniques previously deployed by STEM: namely “visualization, visual analytics, data mining, and information visualization.”<sup>11</sup> A prerequisite for the methodology of Cultural Analytics is an understanding of “culture as data” that can be “mined and visualized” – a move that distills visual culture into a set of data patterns.<sup>12</sup> In their seminal essay “How to Compare One Million Images?” Manovich, Douglass, and Zepel write that “having at our disposal very large cultural data sets which can be analyzed automatically with computers and explored using interactive interfaces and visualization” opens up new ways of understanding culture.<sup>13</sup> Tracing the grayscale, brightness, hue, and saturation of images on macro as well as micro scale allows for the articulation of trends across contemporary visual landscapes as well as across historical periods. In short, Cultural Analytics provides a computational algorithmic answer to the question: “How to Compare One Million [Diverse] Images?” It is important for new paradigm of exploring humanistic big data however to continue to emphasize the cultural context of this new visual landscape in order to offer a critical interpretation of the significance of this algorithmic knowledge.

In comparing images, whose origin lie in user-generated media, television, film, as well as photography, and art broadly defined, Lev Manovich proposes three major strategies: (1)

Collection Montage – or the creation of image-grids where images are arranged in neat rows and columns with uniform size and spacing through the Montage function of the *ImageJ* software; (2) Temporal and Spatial Sampling in which the archive of images is sampled either based on the date of the image (temporally) or based on the selection of portions of images (spatially); (3) Remapping – the plotting of images in order to identify patterns across temporal media artifacts or series of artifacts. Thus, Cultural Analytics, with its methodology for media visualization, “is based on three operations: zooming out to see the whole collection (image montage), temporal and spatial sampling, and remapping (re-arranging the samples of media in new configurations).”<sup>14</sup> In this project, I am particularly interested in the possibilities for shaping digital art historical methodologies centered on color that Remapping offers, as it allows for a wide range of visual landscapes to be drafted.

## Remapping Panel 45

In the context of Cultural Analytics, **I**color becomes one of the key feature components through which analysis is conducted and data attained. Coupled with art historical knowledge, it provides a crucial look at the role of color in the articulation of violence as well as the possibility of civility (Figure 2). In remapping Panel 45, I worked with the



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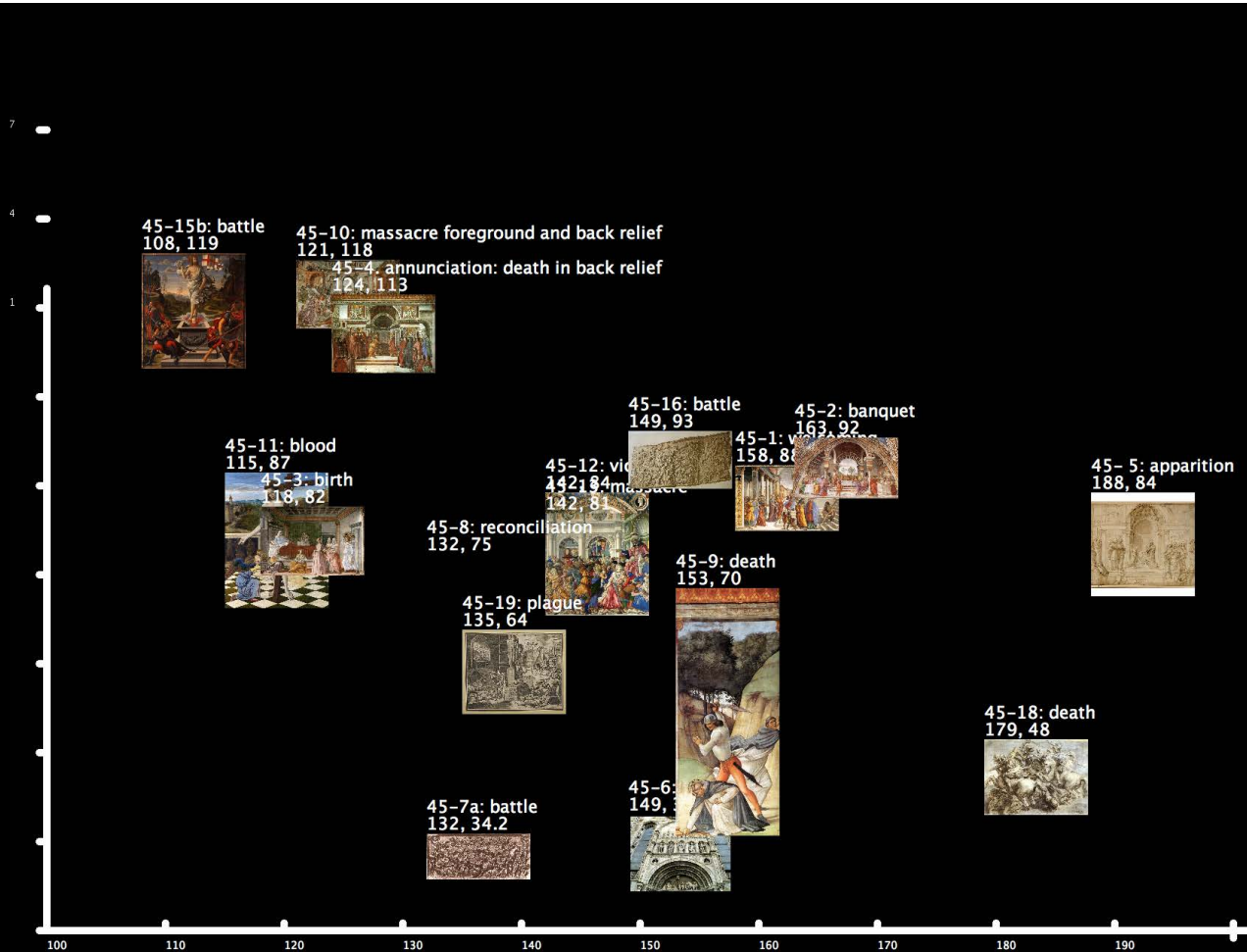


Figure 2. Remapping the images of Panel 45, using the ImageMeasure and ImagePlot modules of the ImageJ Software.

color versions of the images. Using the ImageJ's module ImagePlot, developed by the Software Studies Institute at UCSD and CUNY Graduate School, I first ran analytics on the following features: Grayscale, Brightness, Saturation, and Hue. Exceptions were made in the case of image 17, which I was unable to locate in color, and image

14, which included too much black or white negative space around the actual round-shaped image and thus escaped accurate numerical representation. This data was then mapped onto a black canvas with the same size as the photographs of Warburg's panel – namely 650x847 pixels (the canvas size is a combination of the plotting

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area of 550x747 pixels and 50px border space). Next, whereas Warburg had the ability to choose images with different size and scale, ImagePlot's insists on a uniform image size. I calculated the size of the images in the photograph of Warburg's panel and then reduced that size in half for legibility purposes. I arrived at the average width of 65 pixels for the size of all images in the remapping. The X-axis was used for the distribution of the brightness via *brightness\_median* (average of grey scale values for the pixels in an image) while the Y-axis was used to display the saturation via *saturation\_median* (average of saturation, i.e. purity of color for each pixel in an image). Even though *brightness\_median* and *saturation\_median* range between the values of 0 and 255 according to the standard RGB schema, where as 255 designates highest brightness or white and purest saturation, I chose a smaller range that reflected the subset of color available in Panel 45. I limited the X-axis brightness range to 100-200 and the Y-axis saturation range to 20-150. This restriction indicates that all images included fall in the mid range in terms of brightness and in the lower to mid-range of saturation, given the overall digital RGB color spectrum. In prefacing my argument about the need of art historical context for understanding image-data, I included to additional variables. First, I added a parameter indicating whether the title of the artwork signals associations with violence or civility and reconciliation. Second, I included the image numbers in the plotting of the data in order to keep reference to the title and author

of the works. The image number and metadata correlation can be found in the Appendix to this article.

The remapping plane became a landscape of color in which the images coming closest to a *grisaille* technique lie in its lower right corner, while the images with highest brightness and saturation lie in its upper left corner. Thus *grisaille* images occupied the space of the lower Y-axis, while images with bright colors clustered around the upper Y-axis. As described earlier in the article, the *grisaille* technique attempted to subdue color by decreasing saturation to a point of gray monochrome composition and by working within varied attributes of brightness within this single shade in order to express meaning. In other words *grisaille* artwork can exhibit black, white, as well as shades of gray as colors and thus tends to stay altogether in the low spectrum of the saturation range –hence on the lower Y-axis. *Grisaille* images at the same time vary in brightness and thus span along the horizontal X-axis. The images coming closest to a *grisaille* technique on the remapped canvas lie in the lower level of the Y-axis. In this case they are 45-7a – color image of a bronze fresco, 45-6 – color image of sculpture, 45-18 – color image of an engraving, and 45-19 – color image of copperplate engraving. These images lie on the outer rim, while 45-4 and 45-10 take the central stage.

Surprisingly, the two images with highest saturation and brightness

levels are positioned adjacent to each other both at Warburg's Panel 45 as well as in the Remapping of the panel. Images 45-10 (*Massacre of the Innocents*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel Santa Maria Novella) and 45-4 – same as 4a and 4b – (*Annunciation to Zacharias*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel, Santa Maria Novella) lie at the heart of the Warburg's Panel 45. They are positioned in the vertical and horizontal center of the panel. These two images are of the same size. And both are larger, thus more prominent than the rest of the images included in Warburg's panel (See Figure 1). In the remapped canvas, they are positioned together at the top left corner. This positioning indicates that they carry the highest brightness and saturation values of all images included in Warburg's original canvas. One image represents violence, the other – civil reconciliation.

## Art Historical Account of Ghirlandaio's frescoes

*Massacre of the Innocents* and *Annunciation to Zacharias* are among the six frescoes coming out of Tornabuoni Chapel, Santa Maria Novella in Florence, Italy. Both were created by Domenico Ghirlandaio and his

helpers in 1485. As Art Historian Steffi Roettgen writes,

“Iconographically, the *Massacre of the Innocents* forms an antithetical counterpart of the *Adoration of the Kings*, the one constituting one of the seven joys of the Virgin, the other one of her seven sorrows....In the Bible narrative of the massacre of the children in Bethlehem... it took place a year after the magi had returned home and Joseph and Mary had fled to Egypt. Herod, having heard that a king of the Jews had been born in Bethlehem, had all of the year-old male infants of the city killed – among them, unwittingly, his own son, who had been entrusted to a nurse.<sup>15</sup>”

This dramatic fresco portrays the massacre both in the foreground through the main scene as well as on the background as part of the architectural relief included in the scene. Taking a closer look at this artwork demonstrates that Ghirlandaio deploys *grisaille technique* in both planes. In the background plane *grisaille* is associated with architecture. In the foreground plane *grisaille* comes to represent the living dead: both people and animals appear through desaturation pale and bloodless. In the foreground plane, in contrast to the *grisaille* of flesh, dress appears to be in bold colors such as gold, blue, purple, and crimson flow across the image.

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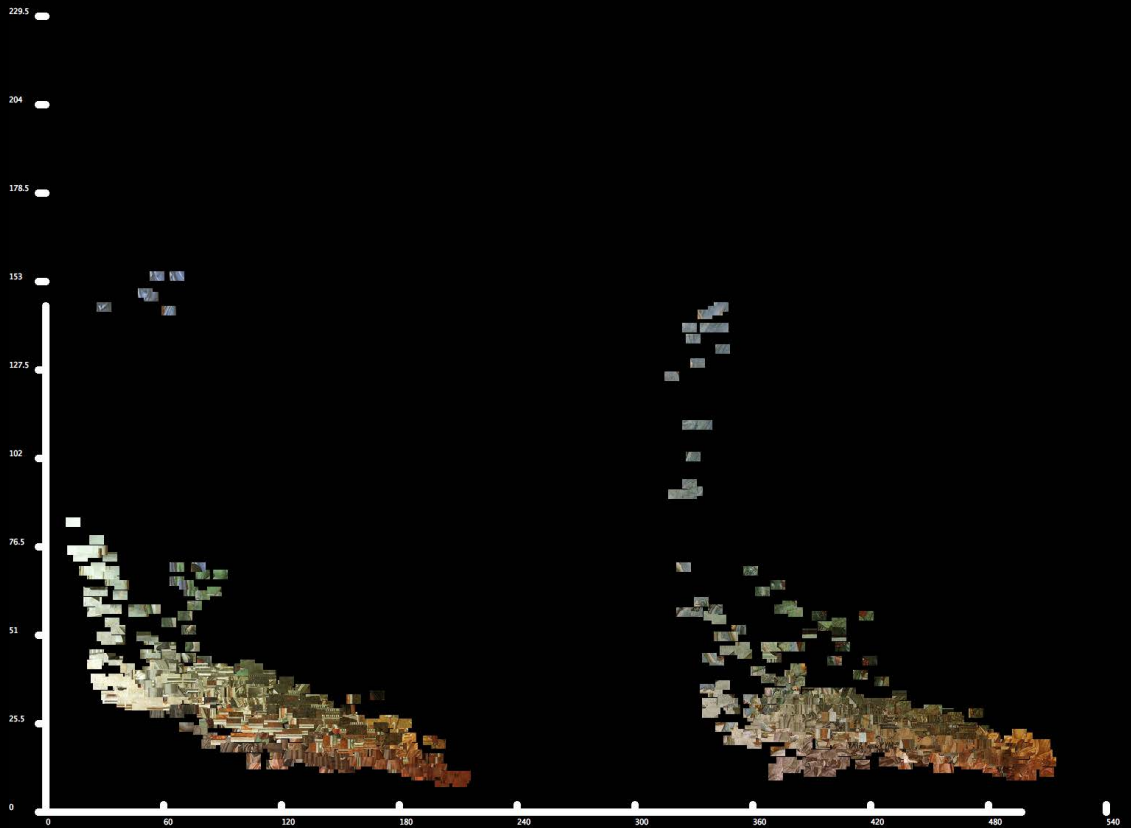


Figure 3. Visualization the hue and saturation in images 45-4 (*Annunciation*) on the left and 45-10 (*Massacre*) on the right

Where as the *Massacre* is a fresco representing totalizing violence, *Annunciation to Zacharias* signals the beginning of salvation and the possibility of civil reconciliation. This fresco, featuring the portraits of “several generations of the Tornabuoni family” as representatives of Florence, celebrates the prosperity of 1490’s

Florence as well as the assurance that with God’s will salvation will come.<sup>16</sup> According to the story of Zacharias, here, the *promise of salvation* lies in prophesy of his unborn son. Warburg included three versions of this image – one of which presents a tightly cropped version of the fresco to exclude the architectural framework of the chapel,

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and another, which under the name Angel Appearing to Zacharias presents a drawing which was presented to the patron by the painter for approval, before beginning to paint.<sup>17</sup>

Yet the prosperity of the city and the promise of salvation is founded upon death and violence. This triumph is evident in the inscription on the background architectural detail of the city wall, which reads: “In the year 1490, when the most beautiful cities, owing its wealth, its conquests, its undertakings and buildings, enjoyed prosperity and peace”.<sup>18</sup> Florence perceived itself as the new Rome and in order to assert its prominence and legitimacy, sought to situate itself within the Classical tradition. Warburg hints at this tie as well by positioning Ghirlandaio’s fresco of *Brutus, Scaevola, Camillus*, which signals precisely the establishment of Rome, immediately to the right of the *Annunciation* in Panel 45. The Classical tradition, portrayed in the background architectural details through *grisaille*, includes violent scenes of triumph in keeping up with the legends of the establishment of Rome. The civility and prosperity of Florence as the new Rome is thus secured first through the legitimacy of the violet triumph in Classical Tradition, thus contemporaneously, as well as simultaneously through the destruction of the enemy as seen in the *Massacre of the Innocents* fresco.

Ghirlandaio’s frescoes *Massacre of the Innocents* and *Annunciation to Zacharias* lie at the heart of Warburg’s

panel as well, with fragments of the *Annunciation* repeated and scaled three times. The centrality of these two works in Warburg’s panel as well as their positioning in relation color, thus *grisaille* in the Remapping, articulate violence and civility/prosperity, not violence and passion as Johnson argues as the major tropes of this panel. Where as Johnson argues that “Ghirlandaio’s use of the *grisaille* technique is not able to fully moderate or mediate the intensity of the passions,” I argue based on the data provided by the Remapping, that Ghirlandaio, deployed similar techniques in the portrayal of both sorrow and joy, death and rebirth. While these observations are meaningful, taking a closer look at the art historical background provided by Warburg of both of Ghirlandaio’s frescoes: *Massacre of the Innocents* and *Annunciation to Zacharias*, reveals a powerful critique of both the institution and visual representation of civil society founded upon violence, waged by Aby Warburg.

Situated in the context of art history, the image-data produced through the remapping of Panel 45 demonstrates that images representing violence as well as civility/prosperity used color in similar fashion. The proximity of *Massacre of the Innocents* and *Annunciation to Zacharias* confirms Warburg’s inquiry into the value of color in representing violence. Reading these two images as image-data prompts a budding observation: in the age of Renaissance, death and civil reconciliation do appear to be



portrayed with similar color footprint. Were we to expect grisaille being more present in images of death or destruction, reserving color for the heroes that emerge out of total violence? The remapping of Panel 45 illustrates one of Warburg's central concerns: "Individual heroes emerging out of the typological grisaille." And further, imbricates this concern in the aesthetics of color and the tropes of violence and civil reconciliation.

## Color-Data in Art History

Traditional art historical accounts allows us to understand the techniques and material basis of the colors, while Cultural Analytics provides an indispensable overview of the quantity or amassment of hues used. In painting the chapel, Ghirlandaio used *all of the colors available*: "di pingere facere et exornare cum omnibus coloribus ut vulgariter dicitur posti in fresco."<sup>19</sup> As Julia DeLancey argues, the artist used "a palette of fully saturated, pure hues, employing few pastel or dark colour and generally only white in order to create relief, lending the cycle a vibrant and legible appearance."<sup>20</sup> It is interesting that Ghirlandaio's work in Tornabuoni Chapel is notable in terms of its pure hues and bright saturations. Yet two of Ghirlandaio's brightly colored frescos were chosen by Warburg in a discussion about *grisaille* – hence grayness and desaturation. Cultural Analytics sheds additional light into this paradox.

In translating Ghirlandaio's *Massacre of the Innocents* and *Annunciation to Zacharias* into color-data in and of themselves, patterns of similarities between the two images are revealed. I created a second remapping that focused on the color visualization of these two images, based on the features of hue and saturation. I first resized them to the same width of 800 pixels. I then divided each image into 1024 pieces (each piece containing 25 pixels of color data, both images amounting to 2048 pieces). These 2048 segments became the objects of the second remapping that I conducted. The color-data in each segment was measured and mapped accordingly: Y-axis represented hue (*hue\_median*) on the scale of 0 to 255, while the X-axis showed the saturation (*saturation\_median*).

Both Ghirlandaio's *Massacre of the Innocents* (representing total violence) and *Annunciation to Zacharias* (depicting the possibility of civil reconciliation) exhibit similar hue/saturation distributions (Figure 3). Their color blueprints signal dominance of red, orange, and green highly saturated hues, as well as green-blue highly desaturated elements. This color-data gains significance when interpreted through the framework of art history. The color footprints demonstrate not only articulations of the tropes of violence and the promise of civil rebirth in terms of foreground and background planes, but also in terms of temporal dissonance: Renaissance and Classic Antiquity in

Renaissance thought respectively. Our movement across the horizontal X-axis thus becomes movement through time. Desaturated *grisaille*, almost white chips come to signal the perception of the Classic Antiquity in the late 1400s and the deeper reds and oranges represent the full saturation hues of the Renaissance. This visualization illuminates comparatively the way color has come to structure violence and the possibility of reconstruction across two different temporal periods (Figure 3).

The two frescoes indeed feature *grisaille* architectural elements that operate as backdrop to the scenes that mirror both in content as well as technique sculptures or engravings of violence. The backdrop of both frescoes projects Classic Antiquity into the age of Renaissance. In representing “classical motifs and inscriptions, battles, cavalcades and warriors,” these frescoes allow for an investigation of the contemporaneity of *grisaille*.<sup>21</sup> This dualism is theorized by Christopher Johnson. He articulates tension between form and content is manifested in the image itself where “the slaughter colorfully depicted in the foreground is repeated monochromatically in the scenes portrayed on the triumphal arch in the background.”<sup>22</sup> Through repetition of visual motifs both within the image as well as within the panel - a close up fragment of this same image was pinned on the panel as well, Warburg illustrates how “the Renaissance language of gestures is prefigured in classic antiquity.”<sup>23</sup>

Cultural Analytics further extends this argument to mirroring by providing a comparative framework of the images as color-data.

## Color, Violence, and the Promise of Rebirth of Civil Society

Moving both literary as well as symbolically back and forth between *grisaille* representations of violence in the Classical tradition and pure saturated colors in the Renaissance, Warburg’s Panel 45 poses important question about the role of color in articulating memory and history as well as distance from the past in which contemplation about the present and belief in the future can take place. As Giorgio Agamben has argued, for Warburg “just as the creation and enjoyment of art require the fusion of two psychic attitudes that exclude each other (‘a passionate surrender to the self leading to a complete identification with the present – and a cool and detached serenity which belongs to the categorizing contemplation of things]).”<sup>24</sup> The examination of *grisaille* in relation to color through projects informed by Digital Humanities and Cultural Analytics techniques prompts us to further ask questions: what is the role of color in allowing for or precluding contemplation; how are we to understand contemporary acts of totalizing violence; how do we

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represent hope for the possibility of social and well as spiritual humanistic reconstruction?

The oscillation between identification and contemplation that Warburg proposes structures the comparative methodology that accounts for both form and content: hence both *data* and *metadata* associated are imbricated in a framework of duality. It is in this movement within images as well as in-between images, in other words in the intervals within and in-between the visual, that critical thinking can be provoked. In the context of Cultural Analytics, this space of contemplation too is visible in the movement in-between bits of visual data. But as much as we try to break down images into unique molecules, into the smallest units of information possible, even those miniscule units are complex, multilayered, and dynamic, thus not stable and self-evident. This is particularly relevant to the study of visual media, as even a single pixel is invested in color and every color carries within itself complex historical and theoretical implications.<sup>25</sup> Relational visual knowledge is thus manifested not only in the *edges* (lines in-between

plotted data) that connect the *nodes* (the dots that plot data) in practices of information/media/visualization, but within the images that constitute these nodes in and of themselves.

## Contextual Visual Knowledge

In articulating Digital Art History through methodologies that analyzes data and metadata, I attempted to integrate cultural and historical knowledge with data science. While adapting Big Data quantitative paradigms to the study of art, media, and popular culture allows for important new ways of seeing the still and moving image, I argue that this mode of visualization is always and already imbricated in a complex network: one that is not purely algorithmic, but also socio-economic, political, and last but not least historical. I argue that Digital Art History should continue its investment in contextual visual knowledge by combining quantitative image-data paradigms with traditional art history in order to foster critical interpretations of visual culture.

## Appendix

*Panel 45. Image 1. Mary enters the Temple*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel, Santa Maria Novella.

*Panel 45. Image 2. Herod's Banquet*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel, Santa Maria Novella.

*Panel 45. Image 3. Birth of John the Baptist*, Domenico Ghirlandaio, fresco, 1485-90;

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Florence, Tornabuoni Chapel, Santa Maria Novella.

*Panel 45. Image 4a&b. An Angel appears to Zacharias*, [Annunciation to Zacharias] Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel, Santa Maria Novella.

*Panel 45. Image 5. Angel appears to Zacharias*, Domenico Ghirlandaio, preparatory sketch, ca.1485; Vienna, Albertina Museum.

*Panel 45. Image 6. Offering in the Temple with a Hercules Relief (?) on the Altar*, Jacopo and Tommaso Rodari, sculpture, 1491-1509; Como, Como Cathedral.

*Panel 45. Image 7.a. Battle (with Hercules)*, Bertoldo di Giovanni, bronze sculpture, ca. 1478; Florence, Museo Nazionale del Bargello.

*Panel 45. Image 7.b. Battle (with Hercules)*, Bertoldo di Giovanni, bronze sculpture, ca. 1478; Florence, Museo Nazionale del Bargello.

*Panel 45. Image 8. Reconciliation of the Romans and Sabines*, Bartolomeo di Giovanni, spalliera painting, late 15th cent.; Rome, Galleria Colonna.

*Panel 45. Image 9. Death of Peter Martyr (Saint Peter of Verona)*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel, Santa Maria Novella

*Panel 45. Image 10. Massacre of the Innocents*, Domenico Ghirlandaio, fresco, 1485-90; Florence, Tornabuoni Chapel Santa Maria Novella.

*Panel 45. Image 11. The Blood of the Redeemer*, Giovanni Bellini, oil on wood, ca. 1460-65; London, National Gallery.

*Panel 45. Image 12. Brutus, Scaevola, Camillus*, Domenico Ghirlandaio, fresco, 1481-85; Florence, Sala dei Gigli in the Palazzo Vecchio.

*Panel 45. Image 13. Massacre of the Innocents*, Matteo di Giovanni, tempera on panel, 1482; Naples, Museo Nazionale di Capodimonte.

*Panel 45. Image 14.1. Mehmed II*, Bertoldo di Giovanni, bronze medal, 1482. Helsinki, National Museum of Finland.

*Panel 45. Image 14.2. Mehmed II*, Bertoldo di Giovanni, bronze medal, 1482. Helsinki, National Museum of Finland.

*Panel 45. Image 15.a. Resurrection of Christ*, Domenico Ghirlandaio (design), with Davide and Benedetto Ghirlandaio Gemäldegalerie, tempera on wood, ca.1494; Berlin, Gemäldegalerie.

*Panel 45. Image 15.b. Resurrection of Christ*, Domenico Ghirlandaio (design), with Davide and Benedetto Ghirlandaio Gemäldegalerie, tempera on wood, ca.1494; Berlin, Gemäldegalerie.

*Panel 45. Image 16.a. Drawings of scenes from a relief on Trajan's Column*, Workshop

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of Domenico Ghirlandaio [both scenes depict the flight of the Dacians], ca. 1490; from a sketchbook, *Codice Escurialensis*, 28-II-12, fol. 63.

*Panel 45. Image 17.* A prisoner is led before the emperor, Maso di Bartolomeo, relief sculpture, 1452; Florence, Palazzo Medici-Riccardi.

*Panel 45. Image 18. The Battle at Anghiari*, Lorenzo Zacchia, (after Leonardo), engraving, 1558.

*Panel 45. Image 19. The Phrygian Plague (Il Morbetto)*, Marcantonio Raimondi (after Raphael), copperplate engraving, ca. 1520.

## Notes

- 1 Lev Manovich "Data Science and Digital Art History" *International Journal for Digital Art History*. Vol 1. No. 1. 2015. p. 12-35.
- 2 Christopher Johnson *Mnemosyne*. 2013. <http://warburg.library.cornell.edu/>
- 3 Christopher Johnson. *Memory*. P.9
- 4 Aby Warburg. "The Absorption of the Expressive Values of the Past." Trans. Matthew Rampley. *Art In Translation* 1.2 (July 2009). P. 227-8.
- 5 Ibid.
- 6 Johnson, p. 98
- 7 Ibid.
- 8 Christopher Johnson *Mnemosyne*. 2013. <http://warburg.library.cornell.edu/http://warburg.library.cornell.edu>
- 9 Grisaille, is a technique of monochrome painting in grey or greyish color that Renaissance painters used for effects of sculpture. See Irene Earls. *Renaissance Art: A Topical Dictionary*. Greenwood Press, New York (1987) p. 130
- 10 Lev Manovich, "Cultural Analytics: Analysis and Visualization of Large Cultural Data Sets" [2008]. [www.manovich.net/cultural\\_analytics.pdf](http://www.manovich.net/cultural_analytics.pdf) (accessed September 1, 2014).
- 11 Manovich "Cultural Analytics" 2008.
- 12 Ibid.
- 13 Manovich et al. "How to Compare One Million Images?" [2011] <http://manovich.net/index.php/projects/how-to-compare> (accessed September 1, 2014).
- 14 Lev Manovich. "Media Visualization: Visual Techniques for Exploring Large Media Collections" *Media Studies Futures*, ed. Kelly Gates. (Blackwell, 2012).
- 15 Steffi Roettgen. *Italian Frescoes: The Flowering of the Renaissance, 1470-1510*. (New York, London, Paris: Abbeville Press Publishers, 1997), p. 174.
- 16 Ibid.
- 17 Jean K Cadogan. *Domenico Ghirlandaio: Artist and Artisan* (New York and London: Yale University Press, 2000), p. 46.
- 18 Roettgen 1997, 174.
- 19 Roettgen 1997, 166.
- 20 Julia DeLancey. "Before Michelangelo: Colour usage in Domenico Ghirlandaio and Filippino Lippi" *Apollo* 145 (1997), p. 18.
- 21 Micheletti 1990, 48
- 22 Emma Micheletti, *Domenico Ghirlandaio* Florence. Italy: SCALA, 1990). P. 48.
- 23 Ibid.
- 24 Giorgio Agamben. "Aby Warburg and the Nameless Science." *Potentialities: Collected Essays in Philosophy*. Trans. Daniel Heller-Roazen. (Stanford: Stanford University Press, 1999), P. 94.
- 25 The complex history of color is evident in the works of Manlio Brusatin, Philip Ball, and Micheal Pastureau to name a few color historians.



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## Images as Data

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