SARAH MAISEY*
Paintings Conservation Department
Tate Britain
London, United Kingdom
sarah.maisey@tate.org.uk
PATRICIA SMITHEN
Tate Britain
London, United Kingdom
patricia.smithen@tate.org.uk
ANNA VILARO SOLER
Transmedia Catalonia
Centre d'Accessibilitat i Intel·ligència
Ambiental de Catalunya (CAIAC)
Universitat Autònoma de Barcelona
anna.vilaro@uab.cat

TIM J. SMITH
Department of Psychological Sciences
Birkbeck, University of London
London, United Kingdom
tj.smith@bbk.ac.uk
www.bbk.ac.uk/psyc/staff/academic/tsmith
*Author for correspondence

RECOVERING FROM DESTRUCTION: THE CONSERVATION, REINTEGRATION AND PERCEPTUAL ANALYSIS OF A FLOOD-DAMAGED PAINTING BY JOHN MARTIN

Keywords: painting, John Martin, flood, Brandi, lacunae, perception, re-integration, eye tracking

ABSTRACT

This paper describes treatment issues surrounding John Martin's epic *Destruction of Pompeii and Herculaneum* (1821). The painting experienced such extensive structural damage following the 1928 Thames flood that it was considered destroyed. Despite major water damage affecting all layers of the painting and the loss of approximately one-fifth of the canvas, recent examination revealed the work to be in restorable condition. However, the extreme nature of the damages necessitates special ethical and technical considerations with regard to treatment, especially for the reintegration of the large missing portion. A consideration of viewer perception of the digitally simulated options for reintegration and their influence on viewer gaze behaviour, monitored via novel eye-tracking methods, was used to inform the treatment process.

RÉSUMÉ

Cet article décrit les problèmes liés au traitement de l'œuvre épique *Destruction of Pompeii and Herculaneum* (1821) de John Martin. Le tableau a subi des dommages structurels d'une telle ampleur suite à l'inondation de la Tamise en 1928, qu'il était considéré comme détruit. En dépit des dommages majeurs causés par l'eau sur l'ensemble des couches picturales, ainsi que la disparition d'un cinquième de la toile environ, un examen récent a montré que l'œuvre était dans un état permettant d'envisager sa restauration. Toutefois, la nature extrême des dommages engage une réflexion déontologique et technique particulière en ce qui concerne son traitement, notamment pour la réintégration de la vaste partie manquante. L'étude de la perception par le spectateur des différentes options de reconstitution, proposées par simulation nu-

CONTEXT OF THE PROJECT

Shortly after the Thames broke its banks in 7th January 1928, submerging the Tate's lower galleries, John Martin's *Destruction of Pompeii and Herculaeum* was declared irretrievably lost and de-accessioned from the collection. The remains of the large oil on canvas painting were faced with tissue and wax resin, rolled onto a tube and stored for several decades. Since being re-discovered in 1973, the painting had been examined periodically but due to the severity of the damage of the work (among other factors) conservation treatment was not considered feasible. This changed in 2009 when, in response to plans for a major exhibition of John Martin's work, this painting was re-assessed and a plan devised for its recovery.

Being the centre point of his 1822 solo retrospective at the Egyptian Hall, *The Destruction of Pompeii and Herculaeum* represents a pivotal work in John Martin's oeuvre. Martin was known as the master of the 'apocalyptic sublime', and this work is typically dramatic in terms of composition and subject matter. The painting illustrates the famous eruption of Vesuvius in AD79, which buried the cities of Pompeii and Herculaneum. Like many of Martin's works, the composition centres on a bright vortex of light encircled by luminous clouds and ashes which overwhelm the multitude of dark figures beneath.

CONDITION

Prior to the flood, the painting was purportedly '…in a disgracefully neglected condition' (Pendered 1923, 266). Once unrolled in 2009, it was evident that it also carried all the hallmarks of a flood damaged work (Figure 1). This included extensive flaking, tenting and paint loss brought about by cohesive failure of the ground and shrinkage of the canvas support; a thick, encrusted and oily dirt layer originating from the Thames water; multiple tears and creases in the support and substantial mildew on the reverse. Moreover, cross-section examination revealed five layers of severely darkened natural resin varnish. Together with the residual wax left over from the facing, this rendered the image virtually unreadable. Most crucially, however, approximately one-fifth of the canvas was lost, obliterating the focal point of the image – the heart of the volcano, along with some details of Pompeii.

mérique, ainsi que leur influence sur le regard du spectateur, contrôlé par de nouvelles méthodes d'oculométrie, ont été utilisées pour informer le processus du traitement.

RESUMEN

Este artículo describe los problemas del tratamiento que rodea a la obra épica de John Martin *Destruction of Pompeii and Herculaneum* (1821). La pintura sufrió un daño estructural tan grave después de la inundación del Támesis de 1928 que se dio por destruida. A pesar del gran daño causado por el agua, que afectó a todas las capas del cuadro y a la pérdida de aproximadamente una quinta parte del lienzo, estudios recientes revelaron que la obra está en condiciones de poder restaurarse. Sin embargo, debido a la naturaleza extrema de los daños es necesario tener en cuenta ciertos aspectos éticos y técnicos con relación al tratamiento, en especial para reintegrar la gran sección faltante. Con el objetivo de obtener información para el proceso de tratamiento, se utilizó un estudio relacionado con la percepción del observador ante distintas simulaciones digitales para la reintegración, así como la influencia de dichas simulaciones en el comportamiento de la mirada del observador, y se hizo un seguimiento a través de métodos novedosos para seguir el movimiento del ojo.

Figure 1
John Martin's *The Destruction of Pompeii and Herculaneum*. Photographed before treatment in March 2010

Fortunately, despite being declared a 'lost' work immediately after the flood, recent inspection revealed that much of what remained was in salvageable condition. In particular the areas encompassing the bulk of the more complex and detailed renderings of the major figure groups, sea and landscapes remain remarkably well intact. Moreover for the large area that was lost there is substantial evidence from other sources of the imagery. This includes a poor quality black and white photograph of the work before the flood;[1] a schematic mezzotint print labelling the principal figures and features;[2] and a later, smaller version of the work, also by Martin, from the collection of Tabley House in Cheshire. The latter constitutes the most significant piece of evidence since it is, with the exception of a few minor details, very similar in composition.

STABILISATION AND CLEANING

After the facing was removed and verso cleaned the consolidation process presented the first major challenge. Complex problems were identified which were caused by the extended immersion in water. There were relatively large paint and ground losses, areas of tenting, crumbling of the ground and tiny but widespread pinprick losses. The required consolidant(s) therefore had to have enough strength to secure larger flakes and be able to penetrate throughout the structure of the paint and ground layers. Local consolidation with variable concentrations of Aquazol 200[3] worked well. This enabled concurrent removal of the wax resin layer using xylene to be undertaken with minimal risk of further paint loss. In areas where the local consolidant was not able to infiltrate, an application from the reverse of the highly penetrative consolidant, Plexisol P550,[4] provided additional security.

Whilst removal of the dirt and wax resin layers improved the clarity of the picture, the multiple discoloured layers of thick, dark varnish made many

passages exceptionally difficult to read. Moreover, it was distorting the intentionally lurid colours of the scene to the extent that it was severely undermining the artist's intention to provide a sublime image. The colour was a striking factor when the painting was first executed and was commented on by many of the contemporary viewers who reviewed the original 1822 Egyptian Hall exhibition. Note was made on the '…excess of the brilliant hues of the Artist's palette' (European Magazine, April 1822) and the '…too palpable an obtrusion of colour' (London Magazine, May 1822). The visual benefits of cleaning were clear in re-establishing the dramatic palette and mood of the work (Figure 2). However, the process was not without its risks. Original resinous glazes applied in certain areas presented complications, especially given that non-original glazes (seemingly applied to mask damages that had occurred prior to the flood) were also present. Widespread cross-section examination enabled the identification of original and non-original glazes which informed the cleaning process.

Figure 2
The painting after varnish removal

RE-INTEGRATION

Theory and perception

Losses on this scale are rarely encountered by easel paintings conservators. The decision of how to re-integrate the lacuna presented the most substantial ethical question in treatment. The dilemma revolved around preserving the dual function of the painting as both an historical artefact and an aesthetic image. The considerable body of evidence to indicate what went into the missing area meant that an illusionistic reintegration could be largely achieved without resorting to hypothesis. However, given the extent of the loss, it was felt that this approach would unacceptably compromise the integrity of the work. A proposal was put forth to re-integrate the missing portion to the extent that, from a distance, it would blend with the rest of the painting yet leave the reconstructed area clearly distinguishable on close inspection.

In considering how to achieve this, it is useful to refer to classical theories of conservation that underpin contemporary conservation ethics. In 1963, Cesare Brandi published his *Theory of Restoration* that drew on the principles of *Gestalt* psychology to explain the disruptive effect of lacunae. Brandi discussed the issue in terms of the 'potential unity' of the artwork (Brandi 1963). He stated that, in perceptual terms, a lacuna would become an 'interesting figure' causing the rest of the artwork to recede into the background. He therefore stated that 'any intervention should be easily recognisable, but without interfering with the unity that one is trying to establish' (Brandi 1963, 341). His aim for re-integration therefore was to allow the damages to recede into the background so as to enable the remainder of the image to come forward as one, unified whole. In the wake of Brandi's theory, a range of re-integration techniques were developed by his followers, including the hatched pure colour lines of the *trattegio* and *selezione chromatica* techniques employed for the re-integration of small losses; and the use of flat 'neutral' colours and *astrazione chromatica* for larger ones.

Brandi set the standard for drawing on the findings of perception psychology to help solve the problems posed by lacunae in artworks. However, since his time the field of visual cognition has made considerable advances in understanding how we attend to and perceive complex visual scenes such as paintings. Moreover, modern eye tracking equipment can now allow us to empirically test precisely how people view such images. Both these factors have implications for the way in which we might treat lacunae in works of art.

Brandi worked on the assumption that viewers could actually perceive a work as one unified whole. However, this impression is an illusion constructed from a sequence of partial views as a person shifts their attention around the work. In fact, only the details of a painting on which the viewer fixates their eyes will be perceived and encoded into memory. Various factors influence where a viewer will fixate whilst looking at a painting. Image factors such as points of high luminance contrast or colour may involuntarily capture viewer attention (Koch and Ullman 1985). Cognitive factors such as the expertise of the viewer or their knowledge of the depicted scene may override the influence of image features (Henderson et al. 2007). However, highly salient image features such as the lacunae in the Martin may involuntarily capture attention if the high-contrast edge of the loss is not carefully obscured. Such involuntary control of viewer attention would shift attention away from the remaining focal features of the painting, potentially decreasing the viewer's comprehension of the depicted scene and aesthetic appreciation of the work.

Viewer testing

To understand how certain features of different re-integration methods affected viewer perception, and to ensure that the proposed methods of reintegration did not create undesirable influences over attention, the

impact of various reintegration options on viewer attention was tested in a controlled empirical study. Simply asking viewers which version they preferred would not suffice as viewers have only partial insight into their attentional behaviour and cannot reflect on how the image features influence this behaviour.

Digital versions intended to broadly simulate four possible reintegration solutions were created in Photoshop as follows:

1. The illusionistic infill: this was used as the control and intended to appear close to how the painting would originally have looked. To create this, an image of the corresponding area of the Tabley House version of the painting was modified and inserted into the gap. Features were matched by making minor adjustments to scale and to some placements. Cross referencing with the original black and white photo and the mezzotint schematic ensured any details or forms in the Tabley House version that were not in the original were identified and removed. Colours were adjusted to match the original and the insert's edges contain cloned material from the original to make the boundary between the two appear seamless.

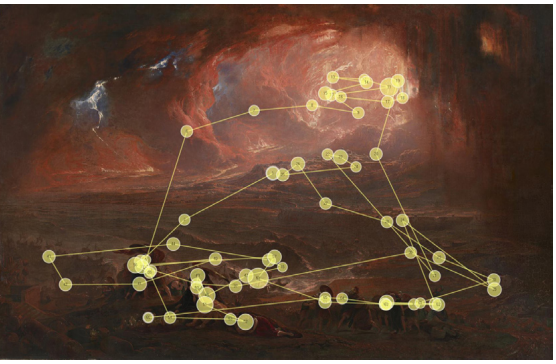
2. The neutral infill: this was intended to simulate a 'neutral retouching'. No reconstruction was attempted but a single colour, composed of a tonal mixture of all the colours surrounding the lacunae, was inserted into the gap.

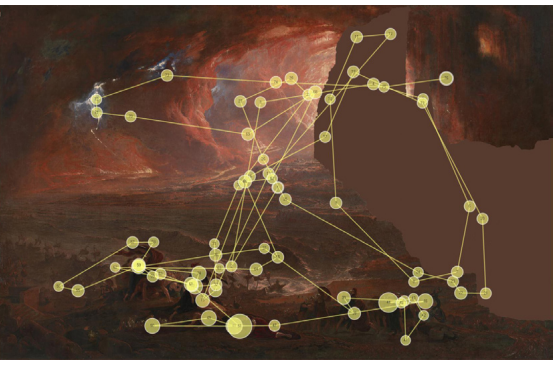
3. The muted infill: this constituted a version of the illusionistic infill in which the colours had been toned down by de-saturation, the theory being that such tones would discourage the viewer from attending to that area, allowing greater attention to be paid to the original.

4. The abstracted infill: this was based on the illusionistic infill. Although the colours were not altered significantly, the image was placed through a filter in Photoshop that removed some of the sharp edges and fine detail.

The only digital alterations made to other areas of the original painting were to fill in the smaller paint losses, simulating the standard illusionistic retouching that would be applied to these areas.

The four versions were presented to twenty naïve viewers within a longer series of stylistically similar paintings. Each viewer only saw one of the versions. Each painting was presented on a 21 inch LCD monitor at a viewing distance of about 60cm for 20 seconds. Although in reality viewers would be able to alter how close to and where they were in relation to the artwork, it was not possible to simulate this in a controlled manner in the experiment. The viewing distance selected reasonably approximated the normal, overall viewing distance that a person would have in relation to the work. During each presentation period, viewer eye movements were monitored with an eye tracker capable of locating and tracking their pupils.[5] By comparing which parts of the painting were fixated by different viewers





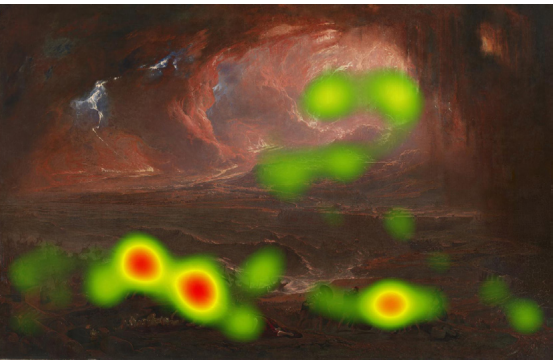


Figure 3
Eye movement scanpath during viewing of illusionistic version of John Martin's *The Destruction of Pompeii and Herculaeum*. Each circle denotes a fixation with the diameter of the circle representing the duration. Lines denote saccadic eye movements

Figure 4
Eye movement scanpath during viewing of *neutral* version of John Martin's *The Destruction of Pompeii and Herculaeum*. Each circle denotes a fixation with the diameter of the circle representing the duration. Lines denote saccades

Figure 5
Gaze 'heatmap' for the illusionistic version representing the distribution of fixations for all viewers in that test group. Hotter colours (red/orange) represent more time spent in that region

we can identify how each reintegration method influenced the viewer's experience of the painting.

The scanpath of one viewer for the illusionistic version of the painting can be seen in Figure 3. What is immediately apparent from the viewer's fixation locations is that only a few strong focal points, such as the heart of the volcano and foreground figures, receive most attention with other background regions such as the swirling clouds of volcanic ash receiving no fixations.

Qualitative comparison of the scanpath of one participant for the neutral version (Figure 4) to the illusionistic version suggests that viewer attention is focussed much more to the part of the painting occupied by the edge of the lacunae. To quantify this difference, the painting was divided into Regions of Interest and the eye movements to these regions analysed. Viewers who looked at the illusionistic version, spent most of the viewing time attending to the foreground figures and the heart of the volcano. This distribution of fixations is clearly visible when the time viewers collectively spent fixating each region of the painting is visualised as a 'heatmap' (Figure 5) in which hotter colours such as yellow, orange and red represent more gaze fixation time in a particular region. The heatmap demonstrates that attention is largely focussed on the most visually striking or thematically interesting features (e.g. upsurges of lava, fine detail of the distant cities, cowering foreground figures). By comparison, viewers of the neutral (Figure 6) and the muted (Figure 7) versions of the painting seem to be initially distracted by the lacunae, fixating the area occupied by the edge of the lacunae earlier and more often than in either the illusionistic or the abstracted (Figure 8) versions. This suggests that viewers were more aware of the loss in these versions than in the abstracted version. However, after viewers shift their attention away from the lacunae in all versions, they were able to attend to the remaining focal features of the painting.

Although the analysis of gaze behaviour does not address the more ethical question of how much viewers would like to see the work presented in an authentic state, this was investigated through a separate, short questionnaire. Viewers were asked to rank each reintegrated version of the painting (plus images of the work before treatment and after cleaning but before any retouching) in terms of how much they would like to see each of them displayed in a gallery given how the painting looked before treatment. Despite most being aware of issues of authenticity, the overwhelming majority nevertheless rated the illusionistic version as the one they would most like to see displayed, followed by the versions that were re-integrated to some extent. Moreover, viewers rated the abstracted version as the next most preferred followed by the muted and neutral versions. This ordering reflects the evidence from the gaze behaviour: gaze behaviour in the 'abstracted' version was closest to the illusionistic than any other version.

Practical application

Knowledge of visual perception and the results of eye tracking tests and viewer ratings with the simulated reconstructions will be used to help determine the appearance of the reconstruction applied to the actual work. It is hoped that the actual appearance of the physical reconstruction will simulate something between the abstracted and illusionistic versions created in Photoshop. Details, particularly around the buildings and areas of high luminance (e.g. the upsurges of lava), will be subtly played down so as to discourage prolonged fixation on features in the non-original area. Although at reasonably close inspection the re-integration will be visible, the edges will blend sufficiently to avoid drawing particular attention.

To achieve this, oil-primed canvas will be inserted into the missing section. Filling and retouching will begin with integration of the smallest losses in the existing canvas. For the reconstruction, it is hoped that Paraloid B72 gels will effectively mimic the texture and appearance of the original oil paint.

To confirm the impact of the physical reintegration at various viewing distances, plans are in place to conduct a real-world eye-tracking study in the gallery after completion.[6] This study will examine whether naïve viewers attend to the reintegrated painting in an unconstrained manner at a distance but freely detect the loss up close.

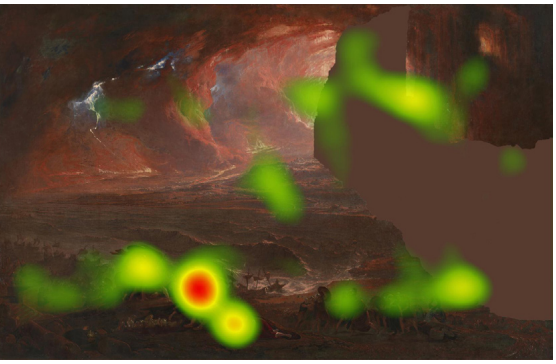


Figure 6
Gaze 'heatmap' for the neutral version

Figure 7
Gaze 'heatmap' for the muted version

Figure 8
Gaze 'heatmap' for the abstracted version

CONCLUSION

The extent of the damage and degradation to *The Destruction of Pompeii and Herculaeum* necessitated dramatic conservation interventions, raising significant ethical questions. Whilst in its damaged state, the painting authentically embodies material evidence of the 1928 flood, this key work from John Martin's oeuvre was never intended to operate as an historic artefact. Its ability to perform its original function as a dramatic and striking example of Martin's 'apocalyptic sublime' aesthetic was almost entirely lost in its pre-restored state. The aim in treatment was therefore not only to stabilise the work, but also to enable the painting to regain much of this visual impact through cleaning, retouching and reconstruction of the missing portion. The latter presented the greatest challenge in attempting to balance the aesthetic whole whilst acknowledging the extent of non-original paint. An understanding of visual cognition and the use of simulated eye-tracking tests not only indicated the most effective way of doing this, but also provided valuable insight into the way aspects of the reconstructed area could be played down in order to subtly discourage prolonged viewer fixation. The applicability of this research to other areas of conservation where visual interventions are made has great potential for informing treatments and levels of intervention.

ACKNOWLEDGEMENTS

The authors would like to thank Martin Myrone and Anna Austen for their curatorial input; Simone Wernitznig, Katey-Mary Twitchett, Tim Green, Mark Coombs and Rosie Gleave for their assistance in treatment; Rod Tidnam and David Clarke for their assistance with Photoshop and Tobii Technology for the loan of their TX300 eyetracker.

NOTES

[1] The image is published in Pendered (1924, 106 facing page). The original photograph could not be located.

[2] The image is published in John Martin's 1822 Egyptian Hall exhibition catalogue.

[3] Aquazol 200 was applied in 5 percent, 10 percent and 20 percent w/v solutions as necessary, dissolved in a 3:1 mix of xylene: propan-2-ol.

[4] Plexisol P550 was dissolved 5 percent w/v in Stoddards solvent.

[5] The eyetracker used was a Tobii TX300. This device uses high-speed infra-red cameras to locate and track the viewer's pupils. The eyetracker is hidden within the display monitor and after a brief calibration period the viewers are free to move their heads and view the paintings as normal without concern for the eyetracking.

[6] A real-world eyetracker uses head mounted infrared cameras to record the viewer's eye movements and superimpose their gaze on to a video of the view in front of them. Real-world eyetrackers allow monitoring of gaze behaviour during unconstrained, real-world tasks such as exploring a gallery.

REFERENCES

BRANDI, C. 1963. Theory of restoration. Translated by G. Ponti and A.M. Vaccarro. In *Historical and philosophical issues in the conservation of cultural heritage. Readings in Conservation*, 1996, eds. N. Stanley Price, M.K. Talley Jr., and A.M. Vaccaro, 339–342. Los Angeles: The Getty Conservation Institute.

EUROPEAN MAGAZINE. April 1822. Mr Martin's Pictures, 81: 370.

Henderson, J.M. 2007. Regarding scenes. *Current Directions in Psychological Science* 16: 219–222.

KOCH, C., and S. ULLMAN. 1985. Shifts in selective visual attention – towards the underlying neural circuitry. *Human Neurobiology* 4(4): 219–227.

London Magazine. May 1822. 5: 29.

MARTIN, J. 1822. A descriptive catalogue of the *Destruction of Pompeii and Herculaneum.* With other pictures painted by John Martin. London: Plummer and Brewis.

PENDERED, M.L. 1924. *John Martin, painter: his life and times*. New York: E.P. Dutton and Company.

MATERIALS LIST

Aquazol 200 (Oxazole, 2-ethyl-4,5-dihydro-, homopolymer)
Kremer Pigmente
http://kremer-pigmente.de

Plexisol P550-40 (A poly butylmethacrylate acrylic homopolymer solution)
Kremer Pigmente
http://kremer-pigmente.de