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DYES, PAINTS, AND INKS: AN OVERVIEW OF VISUAL COMPENSATION TECHNIQUES IN TEXTILE CONSERVATION

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ABSTRACT

Currently there is no single resource summarizing the different visual compensation methods used in textile conservation. Many techniques are shared through spoken communication, and there is a lack of literature documenting accepted options. The goal of this paper is to introduce common techniques, such as the use of dyes and paints, as well as a less common method, digital printing. The authors discuss when each option is appropriate, addressing their respective color-matching capabilities, workability, appearance when dry, and time and material requirements. Numerous case studies illustrating the use of these methods, with an emphasis on painted fills, are presented. The case studies represent a range of textile types, such as costume, needlework, historic and modern printed textiles, as well as a range of materials, including silk, cotton, and wool. Case studies include examples of visual compensation in areas of stains, patterns, and non-woven structures. The successes and limitations of each method are discussed.

Keywords
Visual compensation; textile paints; dyes; digital printing

1. INTRODUCTION

The use of custom-dyed fills for visual compensation in textile conservation is a widely accepted practice. However, a range of non-dye related materials are available to achieve different levels of integration, while working with a variety of collection types and treatment parameters. These materials range from printer ink to fabric paints and dyes, on substrates ranging from plain weave textiles to paper. The methods employed by textile conservators are primarily communicated orally. There is no literature source explaining the options, when each is appropriate, and their pros and cons. The lack of resources can create a discrepancy in the knowledge of acceptable practices of visual compensation methods. This text seeks to fill that need by introducing a range of methods, exploring when they might be used and why, and illustrating their use through a series of case studies. The authors are located in the United States and acknowledge the materials presented may not be available in other parts of the world.

2. VISUAL COMPENSATION TECHNIQUES IN TEXTILE CONSERVATION

The following is an overview of materials the authors have encountered as visual compensation methods in North American textile conservation labs.

2.1 Dyes

The use of custom-dyed fabrics is the most common form of visual compensation in textile conservation. Dyeing is performed when a specific color fabric is required as either an underlay for visual compensation or a sheer overlay for stabilization, and an Oddy-test-approved commercially dyed fabric (e.g. Kona® Cotton) cannot be found. It is also commonly used on conservation threads, such as hair silk. The dyes used are known and trusted for their colorfast, lightfast, washfast, wetfast, and crockfast natures. The dyes available to the authors are acid dyes such as Lanaset and PRO Sabraset, which are used for silk, nylon, and wool; fiber reactive dyes, such as Procion MX, used for cotton and linen; and Jacquard's Silk Colors, a modified fiber reactive dye.

2.2 Paints

Painted fabrics are a relatively new form of visual compensation in textile conservation. The authors are most familiar with PROfab Textile Paints, fluid acrylic paints [1], such as those sold by Golden, and Pébéo Setasilk Paints.

PROfab Textile Paint (PROfab) is a water-based pigment paint that can be used on all fiber types. It comes in both transparent and opaque varieties. The authors have primarily worked with the transparent paints, finding earth tones (e.g. "camel," "terracotta," "buttercream," and "earth brown") the most successful for matching aged, undyed cellulosic textiles. The consistency of the paint is thick and can be difficult to use for replicating patterns or detail. However, it can be diluted to create a watercolor-like paint that is easier to layer and minimally affects the textile hand. PROfab requires heat-setting with an iron for five minutes to make the paint washfast and colorfast. PROfab Opaque Fabric Paints have passed Oddy-testing. [2] Slight variations in color have also been observed after heat setting.

Golden Fluid Acrylic Paints (acrylic) are lightfast, low-viscosity paints with a high pigment load. They are used widely by conservators in many specialties in the United States. They are water-based and can be used on all fiber types. They dry quickly and do not require heat-setting to make them washfast and colorfast. They are easy to work with, come in a wide range of colors, and can be layered. However, they can produce a sheen, especially when trying to obtain a saturated color, and will result in the textile having a stiffer hand.

Pébéo Setasilk Paint (Setasilk) is a water-based paint manufactured for use on silk and intended to mimic the appearance of dyeing. The paint needs to be heat-set with an iron for four minutes to obtain washfastness and colorfastness (with a 48-hour rest after heat-setting). [3] In the authors' experience, Setasilk paints yield bright colors with little to no effect on the textile's hand. They are not suitable for recreating details.

2.3 Digital Printing

Digital printing is the most recent development in visual compensation for textiles, having been successfully used in textile conservation since at least 2000. [4] Some institutions have contracted out the digital reproduction of fabric within their collection, such as the Metropolitan Museum of Art. [5] It is also possible to perform in-house digital reproductions. In-house printing can be performed using an inkjet printer and a prepared fabric, such as Crafter's Images PhotoFabric (PhotoFabric) or a fabric pre-treated with a resin or coating, such as C. Jenkin's Company Bubble Jet Set 2000 (Bubble Jet Set). The long-term suitability of digitally printed reproduction fabrics is unknown. One of the authors, Kris Cnossen, is in the process of testing the washfast, colorfast, and chemical stability of digitally printed reproduction fabrics.

2.4 Comparing the Options

Each of these options poses unique challenges and advantages. Often the use of more than one technique may be necessary to achieve successful visual compensation. Factors to consider when choosing a compensation method include material compatibility, workability, time and budget constraints, health and safety, and final appearance and hand.

Dyeing fabric for loss compensation is most useful when a medium-to-large amount of fabric is needed, when a specific color of thread is needed, or for toning a sheer overlay fabric, such as nylon net. Some negatives of dyeing are that is takes substantial time (1-2 days), color matching can be difficult and time consuming, and there are health hazards associated with the dyes. Dyeing also requires specific equipment, such as a scale, heat source, and pipettes.

Paints are most useful when creating small fills or when trying to replicate non-repeating patterns or mottled surfaces. Painting is significantly faster than the other compensation methods presented, but it is most likely to affect a textile's drape, making it unsuitable for larger amounts of fabric. Paints are also useful when recreating a pattern, layering designs, or matching wear, stains, or general signs of degradation. The paints presented in this article additionally pose little to no health hazards, and the material requirements are minimal (a variety of brushes and a palette; an iron for PROfab and Setasilk).

Digital printing, if available, is the best option for reproducing complicated designs that cannot be realistically or easily recreated through other means. The amount of fabric printed is limited by the size of the printer, however. While the health hazards of this technique are minimal, there are significant and costly material needs. In order to create a digitally printed reproduction of a historic fabric, high quality photographic and a photo editing software such as Photoshop is necessary, in addition to an inkjet printer. A pre-treated fabric (e.g. PhotoFabric) or a fabric treated with a coating (e.g. Bubble Jet Set) is also recommended. While some commercial printers will perform certain steps in the process, such as photo processing, this can be expensive.

When to use or combine any of these three visual compensation options—dyeing, painting, and printing— must be decided on a case-by-case basis, depending on the parameters of each treatment. It is also important to note that other media and substrates may be appropriate for replicating unique surfaces or patterns, as will be demonstrated in the following case studies.

3. CASE STUDIES

The following six case studies have been chosen to illustrate the range of results one can achieve using painted and printed fills. All of the conservation treatments were completed under the supervision of Laura Mina and Kate Sahmel at the Winterthur Museum, Garden and Library between 2019 and 2021. The case studies involving painted fills were carried out by Annabelle Camp as both an undergraduate and graduate student in conservation. They represent a diversity of not only compensation techniques, but also material and collection types. The case studies presented here include the successful use of acrylic and PROfab paints, watercolor pencil, and archival ink pen on substrates including plain weave cotton, silk habotai, Asian paper, silk net, and needle felted wool.

The digitally printed case study was carried out by Kris Cnossen as part of their graduate studies in conservation and demonstrates success in an understudied area of textile compensation techniques.

3.1 Painted Fills: Pair of Handkerchiefs

Compensation materials used: PROfab on plain weave cotton; Acrylic on plain weave cotton

During the 2020-2021 academic year, an uncut pair of handkerchiefs commemorating the death of George Washington from the collection of Historical Society of Haddonfield, New Jersey served as a student treatment project at the Winterthur/University of Delaware Program in Art Conservation.

The rectangular textile (19 ⅛"H × 42 ¼"W) is a plain weave cotton, copperplate printed using an iron-mordanted dye; it dates to 1800, the year following Washington's death. The proper right print is titled "THE DEATH of GENERAL WASHINGTON," while that on the proper left is titled "THE TEARS of AMERICA." On each print, there is a central circular scene surrounded by boxes of text. The two prints are separated by a ¼" unprinted area where they were likely meant to be cut.

Few extant examples of both prints represented on this piece can be located, and no other example of the two together have been found. This piece provides an important insight into how copperplate-printed handkerchiefs were produced in the 1800s and are key examples of American mourning art in its inception. However, the textile was in poor structural condition due to acidic degradation caused by poor housing and dye degradation. This had led to significant tears and losses, overall weakening of the fibers, and discoloration. The conservation treatment aimed to improve the physical and chemical stability of the object while also improving its aesthetic condition by reducing the overall discoloration and stains, stabilizing all existing tears, and compensating for losses.

The textile underwent a phytate treatment [6], an accepted antioxidant treatment used by paper conservators to slow the autocatalytic degradation of iron-based inks and dyes, which in this textile had resulted in significant "fall-out" of the print areas [7]. The textile was then lined with silk crepeline precoated with a 4% solution of Klucel G. While these steps stabilized the textile, the significant losses were distracting, so it was deemed appropriate to fill the majority of them using plain weave cotton of a similar weave and thread count to the original textile.

This textile required over 50 individual fills, and because the majority of losses were in areas of the printed design, they each needed to be hand painted. Initial test fills were made using PROfab, but the need to customize each fill required multiple modifications, and the repeated heat-setting of the PROfab took significant time.

Following testing of different tracing, stenciling, and painting methods, the following protocol was deemed to have the best and fastest results:

1. Plain weave cotton was toned with PROfab to achieve the appropriate background color and heat set.
2. The fill was cut to shape based on a Mylar tracing of the loss.
3. It was placed in position with a Mylar barrier between the fill and textile, and acrylic paints were then used to paint the design in situ.
4. Once dry, the fill was adhered to the crepeline lining by reactivating the 4% Klucel G with ethanol vapors.

The use of acrylic paints for areas of the printed design allowed for more immediate verification of color matching (as PROfab can slightly shift in color upon drying), faster production (as no heat setting is required), and finer line quality.

However, the hesitancy among textile conservators to use acrylics is their tendency to be plasticky and shiny. This was a problem in two areas of loss where a saturated purple black was required. Achieving such a saturated color with acrylic did result in the fill having a distracting, plasticky sheen. Therefore, in these areas, PROfab alone was used.

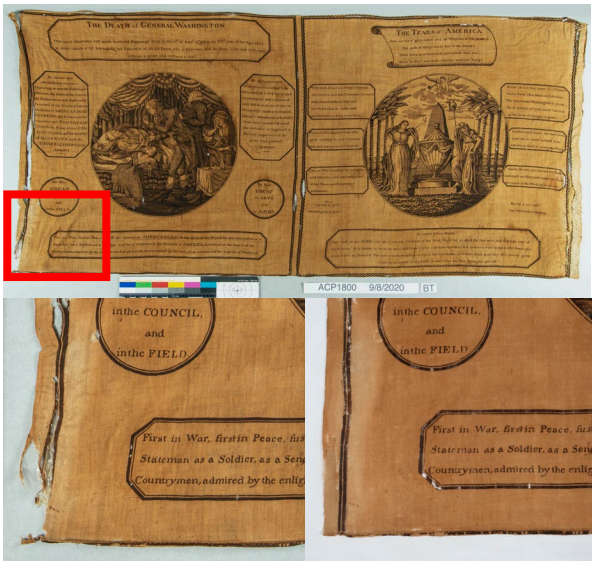

Figure 1 – The textile before treatment (top) with a detail of the bottom left corner before (lower left) and after (lower right) treatment. The Historical Society of Haddonfield, New Jersey 1921-104.

The textile is now visually cohesive with the printed text and imagery legible (Fig. 1).

3.2 Painted Fills: Miniature Pillow Sham

Compensation materials used: PROfab on plain weave cotton; Acrylic on silk net; Liquitex Matte Medium

Similar to the pair of mourning handkerchiefs, the 2019 treatment of a miniature pillow sham from the collection of Winterthur Museum, Garden and Library required the use of both acrylic and PROfab for visual compensation. The miniature cotton pillow sham (4 ⅜" H × 6 ⅜" W) and associated insert were likely made in the museum's former sewing rooms in the 20th century for display on a miniature bed in the Attic Corner period room of the house museum.

The pillow and sham came to the textile conservation lab for treatment due to damages caused by silverfish, which were likely attracted to a stain previously documented on the sham. Grazing had resulted in a loss measuring 11/16" × 3/16" on the front of the sham. Additional losses were present in the cotton bobbin lace edging around the perimeter, although the cause of these losses is unknown.

To compensate for the central loss in the sham body, the following procedure was conducted:

1. A plain weave cotton of similar thread count and weight was chosen and cut to shape using a scalpel following a Mylar tracing of the loss.
2. The fill was painted to match the original textile using PROfab "Buttercream" color and heat set.
3. The fill was stitched in place using hair silk and supported with a nylon net underlay.

While this procedure was successful in visually compensating for the loss in the body of the sham, it made losses in the lace edging more prominent and distracting. To compensate for these:

1. A lace silk net with similar mesh size and shape to the lace was found, painted using "Buttercream" color PROfab fabric paint and heat set.
2. The net was stitched in place as an underlay using hair silk.
3. In the largest area of loss in the lace, the repeating circular pattern was built up on the fill using Golden Fluid Acrylic paint bulked with Liquitex Matte Medium. Once dried, the pattern was made further matte by stippling the acrylic surface with a pin.

The combined result of these two compensation techniques is a visually cohesive sham (Fig. 2).

Figure 2 – The pillowcase before and after treatment. Winterthur Museum, Garden and Library 1964. 2197.001. Image courtesy of Jim Schneck.

3.3 Painted Fills: Patchwork Dog

Compensation materials used: Acrylic and Pigma Micron Archival Pen on plain weave cotton; PROfab on felted wool; Lanaset dyes; Kona® Cotton

During the 2020-2021 academic year, a stuffed animal dog with patchwork covering owned by a private individual served as a student treatment project for the Winterthur/University of Delaware Program in Art Conservation. The

plush hound (11.5”H × 12.0”W × 22.5”L), named “Leonardo,” was purchased at a craft fair in 1973. It is made of printed cotton patchwork over cotton muslin and stuffed with green synthetic filling, estimated to be modacrylic. Additionally, it has felted wool eyes and a copper alloy leash.

The dog had been well-loved. In addition to severe structural damage, such as tears in the tail and back left leg and the loss of interior stuffing, the patchwork exterior had significant losses, with nearly complete losses in patches on the tail and feet. 14 different floral prints were used to create the patchwork pattern, and 38 of the 59 patches required aesthetic compensation.

While the large tears required structural stabilization, the majority of this treatment focused on the restoration of the printed patchwork. The owner preferred a full aesthetic restoration, which allowing for significant experimentation with acrylic-painted fills.

Due to the three-dimensionality of the dog, image capture for digitally printed reproduction fabric would be difficult. Different patches also were unevenly faded. However, it was deemed appropriate to restore the fully printed appearance. Thus, the only option was to hand paint each fill. Acrylic paint was selected due to the wide range of colors available, the ability to layer colors, and their rapid drying time.

The plain weave cotton fills were prepared using the following procedure:

1. An overall background color or tone was achieved using washes or direct applications of Fluid Golden Acrylic paint. For patterns with a black background, the pattern was painted onto black Kona® Cotton, as achieving a saturated black with acrylic alone resulted in a highly stiff textile.
2. Once dry, the patterns were painted on top using acrylic. As necessary, these patterns were replicated using Mylar tracings of the original.
3. Additional patterning was added where necessary using a Pigma Micron Archival black pen and heat set using an iron for five minutes, preferably before acrylic was applied to prevent melting or altering the surface of the paint layer.
4. All fills were stitched in place using hair silk dyed with Lanaset dyes.

Additionally, losses in the dog’s left felted wool eye were aesthetically compensated for using needle felted wool fills toned with PROfab fabric paint, heat set using an iron for five minutes, and stitched in place with cotton thread.

Figure 3 – The patchwork dog “Leonardo” before and after treatment.

While incredibly time consuming, the fill painting process was highly successful in visually integrating the many losses (Fig. 3). Such a level of integration could not have been achieved with other methods available.

3.4 Dyed, Painted, and Penciled Fills: Silkwork Picture

Compensation materials used: Lanaset dye and PROfab on silk habotai; Aquarelle pencil on Gampi tissue

Unlike the other treatments presented, which primarily include cotton fills, the 2020 treatment

of a painted silkwork picture from the collection of the Winterthur Museum, Garden and Library required fills of both silk and Asian paper.

This rectangular silkwork picture (19.5”H × 23.5”W) consists of a plain weave silk ground with cotton support. It depicts a reclining woman beneath trees and a bower in the foreground with a house in the background. The imagery is depicted using silk embroidery, the majority of which is enhanced with paint. Both the sky and the woman’s head and arms are executed completely in paint. The artist used both dry brush and wet techniques. There is an embroidered inscription along the bottom which attributes the piece to Natchez, Mississippi, 1811.

It is a significant piece within the Winterthur collection, as it is a beautifully executed early American embroidery. However, due to its many condition concerns, the piece could not be exhibited. Overall, it was in poor structural condition due to the highly fragile and damaged silk and associated losses and tears, as well as the stained and brittle lining. It was in poor aesthetic condition with distracting staining on the bottom edge and proper left.

Much of this treatment focused on stabilizing structural damages and reducing tidelines and staining. Tear repair was completed using silk crepeline underlays coated with 15% 1:1 Lascaux 360HV:498HV, and tidelines and staining were reduced using a variety of gels and chelator solutions. Once stabilized, the compensation of large areas of loss was deemed necessary for the legibility of the picture.

Losses around the perimeter of the silk were filled in the following way:

1. The losses were traced using Mylar and cut to shape using a scalpel.
2. Fills were cut from silk habotai pre-dyed with Lanaset and further altered or mottled using PROfab to match the remaining stains. The paint also helped diminish the natural sheen of the silk habotai so that it more closely matched the light reflecting properties of the silkwork. All painted fills were ironed following the PROfab guidelines.
3. Fills were adhered to the crepeline underlays already in position from tear repair, and the adhesive was reactivated with an ethanol vapor chamber.

There were also losses in the painted woman’s arm and forehead, which were inaccessible from the back due to the surrounding embroidery. These were filled in the following way:

1. The losses were traced using Mylar and cut to shape using a scalpel.
2. Fills were cut from Gampi tissue and colored with Museum Aquarelle Watercolour Pencils.
3. Where crepeline underlays were possible, the tissue fills were adhered directly to them.
4. Where crepeline underlays were not possible due to the surrounding embroidery, the tissue fills were applied as overlays. Once the appropriate color was achieved with Aquarelle, they were coated with 30% 1:1 Lascaux 360HV:498HV, and once in position, the adhesive was reactivated using an ethanol vapor chamber.

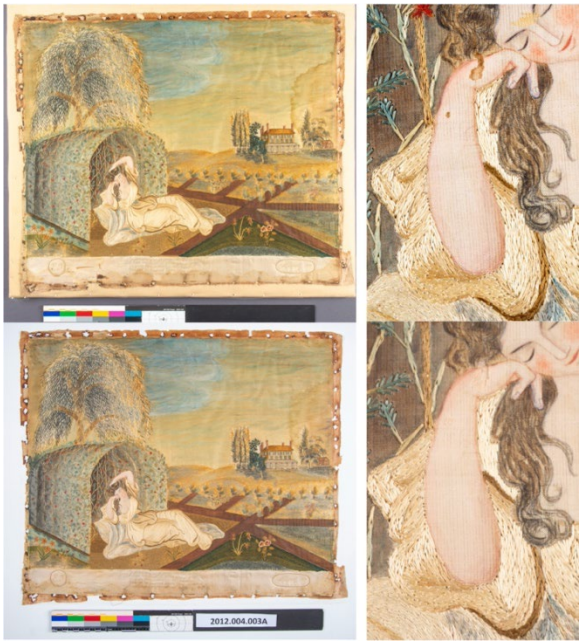

Figure 4 – The silkwork before and after treatment (left) and a detail of the woman’s arm before and after the Gampi tissue fill (right). Winterthur Museum, Garden and Library 2012.0004.003A.

The use of these two different fill materials was necessary to match both the structural and aesthetic needs of this complex textile (Fig. 4). The use of Aquarelle was found to be the most appropriate texture to match the painted face of the figure, while paints and dyes were necessary to compensate for the other areas of the work. This demonstrates the successful marriage of numerous compensation methods in one conservation treatment.

3.5 Digitally Printed Fills: Green Dress

Compensation materials used: Crafter's Images PhotoFabric, C. Jenkin's Company Bubble Jet Set 2000, Epson Sure Color P600 UltraChrome HD pigment ink printer and inks

During the 2020-2021 academic year, an early 19th-century green dress (52" collar to hem; 27" waist circumference; 32" chest circumference; 98.5" hem circumference) with a blue feather print in the collection of Winterthur Museum, Garden and Library served as a graduate student treatment project. The dress had some tears and multiple campaigns of previous repairs. A large and visually distracting repair patch on the proper right sleeve of the dress prompted an investigation into digitally printed reproduction fabric.

The fabric was woven in an alternating opaque and sheer stripe pattern that was dyed with a compound green and printed with a blue feather pattern (Fig. 5). The intricately dyed and woven nature of this fabric made it nearly impossible to replicate due to time, money, and skill constraints.

Due to other cost and time constraints— as well as a belief that developing an in-house printing methodology was needed for conservators— it was decided to digitally print the reproduction fabric in-house. After performing a literature review of in-house digitally printed textiles used in conservation, it was unclear if digital printing would be able to capture the complex nature of the original print, especially the opaque-and-sheer stripes. The saturation and clarity of line were also a concern [8].

Figure 5 – The dress before treatment and with printed fill options for sleeve. Winterthur Museum, Garden and Library 1965.2368. Lower image courtesy of Evan Krape.

The investigation into digital printing began by taking a high-quality image of a pattern repeat and using Photoshop to color correct and ensure the image was to size. Next, two pre-treated textile options were identified: PhotoFabric from a local fabric store and cotton coated with Bubble Jet Set. The Bubble Jet Set allows for more fabric options than the PhotoFabric, so long as the fabric is cotton. The downside to Bubble Jet Set-coated fabric is that it must be attached to a rigid surface in order to go through a printer. The instructions suggest that the coated fabric be ironed to freezer paper, but this repeatedly jammed the printer.

Instead, it was discovered that the Bubble Jet Set-coated fabric could be ironed to the used backing paper from the PhotoFabric. This makes the Bubble Jet Set option less easy to use than PhotoFabric. The primary downside to the PhotoFabric is that it only comes in one fabric choice: cotton poplin.

Using the PhotoFabric and Bubble Jet Set-coated fabric, 4" × 4" samples of the reproduction fabric, or strike-offs, were printed to test the color, drape, and hand. It was found that the PhotoFabric was easier to use than the Bubble Jet Set-coated fabrics and created a successful visual match to the original fabric, even though the PhotoFabric is cotton poplin, a thicker, more opaque fabric than the original sheer and opaque striped fabric.

Based on this success of finding a visually appropriate fabric digitally printed in-house, Kris Cnossen is currently researching the suitability of four different digitally printed fabric options: two contract (Spoonflower and Dyenamix) and two in-house (PhotoFabric and Bubble Jet Set-coated). The suitability is being assessed via washfast, crockfast, and Oddy tests, as well as solid-phase microextraction followed by gas chromatography-mass spectrometry method (SPME-GCMS). The results of this research will be published in collaboration with Miriam Murphy, Textile Conservator at the St. Louis Art Museum, in an upcoming issue of the Journal of the American Institute of Conservation.

4. CONCLUSION

This article presents a handful of successful cases using painted and printed fills in textile conservation. These techniques have been proven to yield a wider variety of results, often in less time than accepted custom dyeing practices, especially when used in combination with other techniques, such as paper, archival ink, and pencil. They are materials and methods that should be added to every textile conservator's toolkit.

However, this area is ripe for further testing and experimentation. Although current research suggests textile paints are safe, [9] [10] further aging tests of textile paints and printing inks should be conducted to confirm these findings and better understand their long-term compatibility with objects.

Additionally, many of the materials used in these case studies are taken from other conservation specialties, such as Golden Fluid Acrylics, Gampi tissue, and Aquarelle pencils. It is possible that there are other materials suitable for the aesthetic compensation of textiles utilized by other specialties that are yet to be explored by textile conservators.

Moving forward, the authors will continue to expand on the materials and methods presented here to properly meet the visual compensation needs of each textile treatment as they arise.

MATERIALS LIST

C. Jenkin's Company Bubble Jet Set 2000: Proprietary fabric coating applied to silk and cotton to make them suitable for inkjet printing.

Crafter's Images PhotoFabric Cotton poplin fabric with paper backing for at-home inkjet printing.

Epson Sure Color P600 UltraChrome HD pigment ink printer and inks: Professional-quality photographic printer and associated pigment-based printing inks.

Golden Fluid Acrylic Paints: Lightfast, low-viscosity acrylic paints with a high pigment load. Manufactured by Golden Artist Colors.

Hair Silk: Fine silk thread.

Klucel G: Non-ionic thermoplastic adhesive (hydroxypropylcellulose), soluble in ethanol and water.

Kona® Cotton: Plain weave, solid color cotton. Manufactured by Robert Kaufman.

Lascaux 360HV: Thermoplastic acrylic resin composed of water-based dispersion of butyl acrylate and methylmethacrylate thickened with acrylic butylester. Dry film is slightly tacky and can be used as a weak pressure-sensitive adhesive or reactivated with acetone, ethanol, glycol esters, toluene, or heat (50–55°C). This is no longer available and has been replaced by Lascaux 303HV. Manufactured by Alois K. Diethelm, Switzerland.

Lascaux 498HV: Thermoplastic acrylic resin composed of water-based emulsion containing butyl acrylate thickened with methacrylic acid (40% solids). It can be thinned with water; the dry film is insoluble in water but soluble in acetone, ethanol, glycol esters, toluene. Manufactured by Alois K. Diethelm, Switzerland.

Liquitex Matte Medium: Acrylic paint additive. Manufactured by Liquitex

Mylar: Clear, colorless thermoplastic film of polyethylene terephthalate. Produced by DuPont.

Nylon Net: Lightweight nylon netting with hexagonal meshes.

Pébéo Setasilk Paint: Thin, flowable, water-based paint designed for use on silk. Manufactured by Pébéo.

PROfab Textile Paint: Water-based pigment paint manufactured for use on textiles.
Manufactured by PRO Chemical and Dye.

Silk Crepeline: Sheer, lightweight, plain weave silk
Silk Net: Lightweight silk netting with diamond meshes.

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