A Stitch in Time: Using Data Embroidery to Tell Australian Convict Stories

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Figure 1: Data embroideries of nineteenth century convict women Mary Sheriff and Mary Lambert. While the image itself is inspired by a particular event in the convict woman's life her life course data is integrated using one of the lines with the data point that inspired the image highlighted.

Abstract

The *Stitch in Time* project extends a traditional timeline visualisation of Australian convict women's lives by creating physical data embroideries drawing from the available historical data of individual women. The timelines visualise the individual life courses of over 13,600 nineteenth century Australian convict women according to the paper trail left behind in the Colonial Archives. In this project we created 18 embroideries of 21 convict women, based on sketches inspired by specific pieces of information in each woman's life. This novel approach illuminates the personal lives of individual subjects, of whom little imagery has survived. By exhibiting the embroideries in the Penitentiary Chapel in Hobart, Tasmania, we hope to arouse interest in the largely forgotten lives of this first coerced generation of European settlers. We use the unusual medium of embroidery on fabric because it is tightly connected to the daily experiences of convict women. By extending traditional data visualisation using this specific form of data physicalisation, *data embroidery*, we aim to create compelling access points to engage with individual Australian convict stories and therefore make this significant part of Australian history more approachable[1].

Index Terms: Human-centered computing—Visualization—Visualization application domains—Information Visualisation; Human-centered computing—Visualization—Visualization design and evaluation methods

1 Introduction

Between 1803 and 1853 over 13,600 female convicts were transported from mostly Ireland and England to then Van Diemen's Land, today's Tasmania. These are approximately half of the women transported to Australia in the late eighteenth and nineteenth century, out of around 168,000 convicts in total. For as long as these women were 'under servitude' the British Colonial bureaucracy recorded every aspect of their lives in minute detail in convict records like the conduct registers (see Fig. 2). Most of the convict records in Tasmania have survived and almost all female records have been transcribed into machine readable form by the Female Convicts Research Centre and subsequently cleaned and coded by Digital History Tasmania.

The extraordinary richness of the Tasmanian convict data is both a blessing and a curse. While truly unique in the amount of detail available on nineteenth century lives [2] and an exciting resource to work with, checking on the wide and varied records available for each convict (see Sect. 4) can get confusing very quickly. We therefore created the *Life Lines* visualisation (see Fig. 3), a browser-based interactive visualisation that shows a timeline of events for any convict woman, based on their recorded historical data. Since

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[1] https://www.stitchinti.me

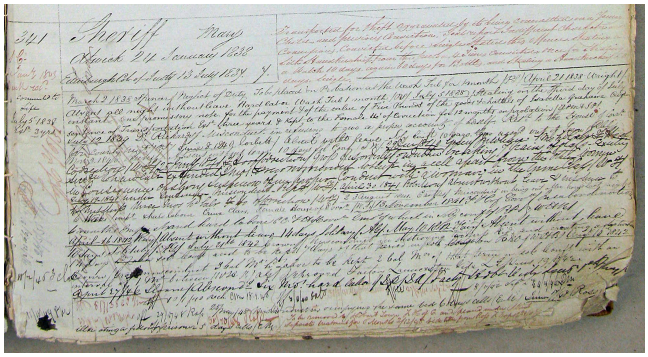

Figure 2: The conduct register entry for Mary Sheriff in the original nineteenth century ledger. Beneath some general information on top all of Mary's offences including date and resulting sentence in the colony were recorded.

the visualisation represents time as spatial distance it can create an immediate understanding of a person's life course, such as an impression of extended periods of incarceration. Similar visualisations have been used to make sense of life outcomes in the fields of criminology and social sciences [5, 6, 11]. The *Life Lines* visualisation proved interesting to history experts in the area, leading to insights such as the impact of giving birth on a convict woman's life.

However, it is fair to say that the lifelines, while informative, were not engaging for non-experts. We felt more could be done. While a timeline conveys a good initial overview into a convict life, on closer inspection what really stood out were slightly more telling pieces of information recorded in the registers. For example, Elizabeth Elemore being sentenced for hiding her pipe and a match in her shoe, or Mary Lambert being fined for keeping an unlicensed dog. These 'data titbits' arouse interest, personalise the abstract data, raise sympathy with the women, and often bridge the gap between the centuries to make convict women relatable. We saw an opportunity to tell the often completely forgotten stories of convict women in a compelling new way, by using a specific form of data physicalisation, a new technique which we call *data embroidery* – a medium which ties back to the daily lives of convict women (as explained in Sect. 3). Inspired by specific information – such as Mary Lambert's dog – we created hand-drawn sketches based on the historical records, into which we integrated the data points of their timelines, and turned them into embroideries.

In this paper, a collaboration between visualisation experts and historians, we present a case study that demonstrates a non-traditional approach to communicating historical data. With the embroideries we create tangible impressions of past lives, in a process driven by engaging with the data itself. We found this an effective approach when dealing with large amounts of highly qualitative data. By turning this data into actual physical, visually compelling objects, we aim to create new interest in a neglected aspect of Australian history, to be exhibited in their original context, the Penitentiary Chapel in Hobart, the historical building in which the conduct records were originally kept.

2 Related Work

Visual Story Telling Visual story telling has become increasingly more common since newspaper outlets like the *Guardian* or the *New York Times* introduced the use of dynamic graphics. Coining the term *narrative visualisation*, Segel and Heer [15] were the first to define a set of rules around visual story telling. Lee et al. [10] narrowed down the scope of what defines a data story and discussed the process of exploring data in order to create and then communicate a narrative. Brehmer et al. [1] focused specifically on timelines as a vehicle for story telling in regards to their effectiveness and expressiveness. All these works focus on browser-based, interactive visualisations, where the viewers themselves have a certain amount of agency in following the story. In our work we take the data visualisation of a timeline to a physical form embedded into an embroidery instead, thereby creating a considerably different experience.

Data Physicalisation Data physicalisation, an approach where data is encoded into physical artifacts [8] or sculptures [22], has emerged as a subtopic in data visualisation and design during the last 15 years. In 2013 Jansen and Dragicevic [7] extended the model of the 'infovis pipeline' to include a rendering process to create data physicalisations, and also stressed the perception of a physicalisation as part of the model. From the onset physicalisations were discussed as instruments to communicate information and engage an audience [8, 22]. They can also allow more artistic renderings that go beyond the mere representation of data [3], in which case they are often commissioned or exhibited by art galleries or museums, like the British Museum's 'Cradle to Grave' exhibition[2]. Exhibition was also a central concept of 'Slave Voyages', a work that comes thematically the closest to ours as it represents slave traffic from Africa to the American continent, albeit in aggregated form represented by beads on rings hanging from a ceiling [9].

Data Crafts and Embroidery Increasingly crafts like knitting, pottery or fashion design are used to create physical representations of data, often motivated by a desire to create meaningful objects that reflect on personal data [16, 18], or to communicate health data to diverse communities [13]. In this space Wannamaker et al. were the first to use machine embroidery to represent an exchange of text messages and discuss how specific machine embroidery techniques (like straight, satin or fill stitches) can be used to visually map data [20]. Inspiration for our work also comes from the art world, where (usually hand) embroidery has been rediscovered across the world as a form of creative and artistic expression [19]. Particularly inspirational is the beautiful yet accurate work of Meredith Woolnough, an Australian artist who uses free motion embroidery on water soluble stabilizer to recreate natural phenomena like leafs, shells, crustaceans in thread [21][3].

The work presented here builds on all these aspects, it steps beyond a classical data visualisation towards a physical representation, with the intent to communicate historical data to a broader audience beyond history academics. The artistic aspect lies in showing the data embedded into a motive inspired by an event or data point, hence representing the data in two ways (the event and the life course). The use of embroideries as a medium ties back to the historical day-to-day activities of many convict women, albeit in the modern version of machine embroidery. The physical and tactile realisation of the work, along with the linking of pictorial and data narratives sown into the material itself, makes for a unique but approachable medium for understanding convict history with a critical empathy.

3 Example and Motivation

Mary Sheriff Embroidery When Scottish-born convict woman Mary Sheriff arrived in Hobart on the Atwick in 1838 it was recorded in the description list that she had 4 dots tattooed on her left arm, probably indicating her membership in a criminal network back home in Edinburgh. We designed her embroidery so that her colonial track record continues her previous criminal career across her entire arm. In the embroidered timeline a gavel represents the trial, a ship the voyage to the colony, a heart a marriage, a baby a birth and a certificate the final Certificate of Freedom. Each circle is a committed offence, with the offence that inspired the sketch highlighted in color, and the compounded periods spent in secondary punishment (usually in a female factory in hard labour or solitary

[2] http://www.pharmacopoeia-art.net/articles/in-sickness-and-in-health/

[3] https://meredithwoolnough.com.au

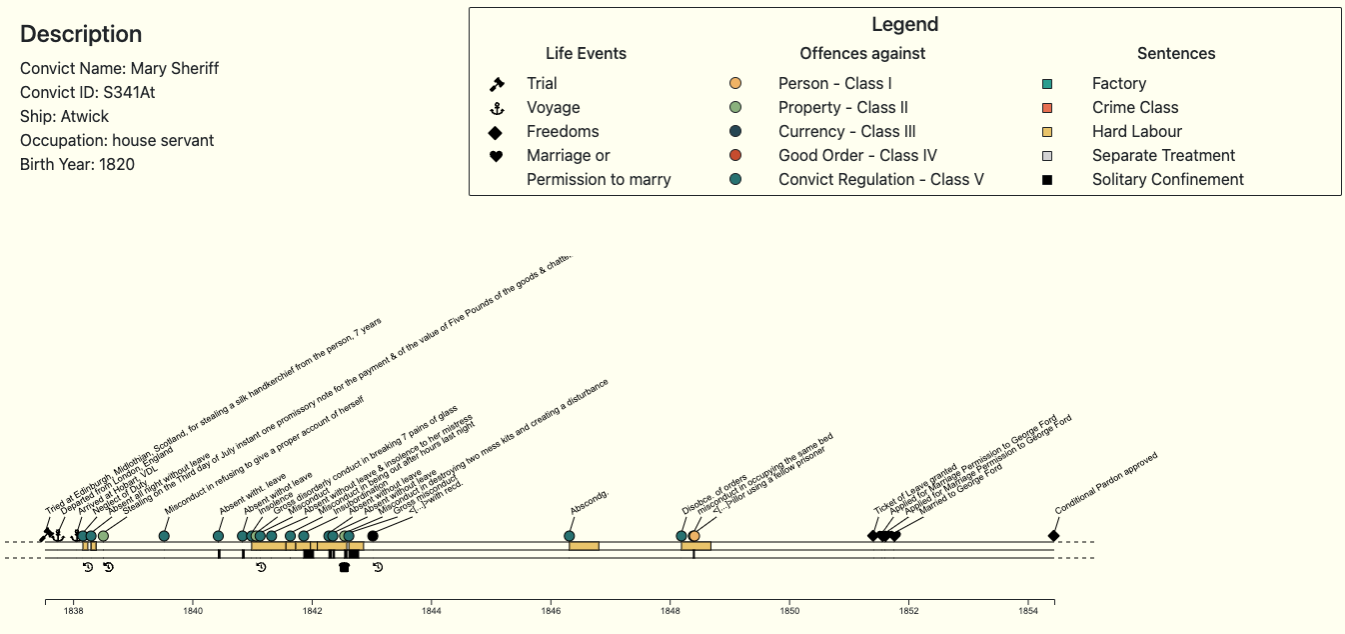

Figure 3: The timeline visualisation showing Mary Sheriff's lifeline, based on the transcribed conduct register and other sources.

confinement) are indicated by a grey satin stitch running next to the line.

In October 1842 Mary, confined to the Launceston Female Factory at the time, attacked the surgeon of the institution, stabbing him several times and cutting down to the bone next to his right eye. The violent outbreak probably came after the victim of the attack had refused to declare her too sick to spend another three weeks in solitary confinement, a brutal form of corporal punishment spent in darkness. Mary's life illustrates one of the caveats when working with a historical dataset, the fact that an empty period in the timeline might be mistaken for event-less when in truth there is a gap in the records. Mary served a three-year prison sentence for the attack [4], but since she was sentenced in the quarter sessions and these records are yet to be imaged and transcribed the *Life Lines* visualisation does not indicate this period. Creating the embroideries included checking and adding missing information from other sources.

Motivation The majority of convict women sent to Australia were, like Mary Sheriff, sentenced to 7 years transportation for petty theft (and unlike Mary Lambert, who was sentenced to 14 years for forgery). Yet even after the women had finished their time under servitude they usually still had no permission to return home or they lacked the funds to do so. Transportation was the initial vehicle to provide a coerced workforce for Australia's colonisation, but effectively this workforce also became a large part of the first generations of European settlers. Yet despite the extraordinary richness of records very little is known about the female convict women. The *Stitch in Time* project aims to entice interest in these convict women, by creating visually engaging access points to then delve deeper into their personal stories. In the exhibition this is achieved in two ways: each embroidery is accompanied with a textual summary of the woman's life which illustrates why she is shown in this way and also includes key dates (instead of disturbing the embroideries' aesthetic with them). Visitors of the exhibition are also provided with a flyer containing a key to understand the integrated timelines. While the timelines do not explain every detail of a woman's life they give condensed impressions, which can communicate different life trajectories between convict women. For example, they show the difference between Mary Sheriff's extended factory period caused by a dense string of offences and Mary Lambert's offence free period during which she gave birth to three children after her marriage (Fig. 1).

Further motivation for this project came from the fact that barely any imagery of convict women exists. Although some women had a photograph taken[4], they are usually from later stages of their lives. By contrast the majority of the data comes from their time under servitude, when the women were in their late teens or early twenties. So the embroideries show younger women, deliberately using the abstractness of line drawings converted into stitches, creating an impression rather than an actual picture. Some elements in the embroidery, like the hair color or tattoos, come from the descriptions recorded on arrival. From an artistic perspective, the sketches were often drawn with an intent to return a woman's dignity, giving back control or sometimes just some peace.

Using embroidery as a medium made sense with the realisation that convict women were intrinsically connected with fabric, thread and needle work. Amongst the specific occupations of convict women recorded on arrival were those of needle women, dressmakers, stay makers, washer women, laundry maids and others [12], in total almost 20%, and often women with specific skills were employed in these professions again. Needle skills were valuable in the colony, so much so that they were specifically recorded in the description lists made on arrival, e.g. Sarah Wilkinson, a house maid, had the remark added that she 'could work well on her needle'. It can be assumed that the work generally required in colonial households included looking after and mending clothes. There were even attempts to build up embroidery skills amongst the women before their arrival, to be seen in the quilt made by convict women on board of the Rajah, the ship that brought them to the colony[5]. Lastly, in the female factories a certain amount of needlework, spinning and weaving was also done. Hard labour consisted mostly of washing, with the women often specifically sentenced to the wash tub [17].

[4]https://www.femaleconvicts.org.au/about-convict-lives/gallery
[5]https://nga.gov.au/stories-ideas/the-rajah-quilt-1841/

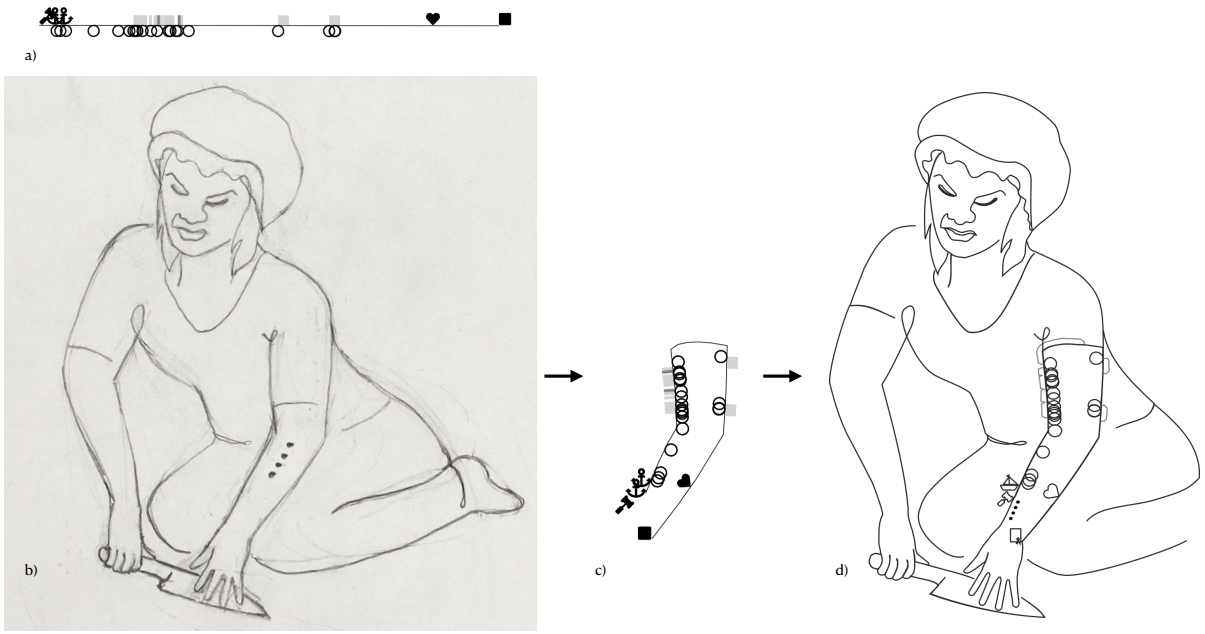

Figure 4: The work process of creating a data embroidery. a) A simplified version of Mary Sheriff's timeline where some less important information (her applications for marriage permission and a grant for a ticket of leave) is removed. b) The original sketch for Mary Sheriff's embroidery. In Mary's case the sketch was inspired by the information that she, while confined in the Launceston Female Factory attacked the factory surgeon with a sharpened knife stolen from the canteen. c) The data points of Mary's timeline in the shape of her left arm following the idea that her colonial track record continues the four dots she had tatooed on her left arm (as recorded on arrival). During this process the sleeves became a bit shorter to create more space for the timeline. d) The timeline data integrated into the image. During this step the anchors marking the exact departure and arrival date of the transport ship where replaced with the easier to understand single ship symbol representing the voyage. Also the attack on the factory surgeon resulted in three years imprisonment for Mary, which are not shown in the timeline since the court records have not yet been transcribed. Since this information was known to the authors this period is included in the final embroidery (the difference is visible in on the sleeve).

4 Work Process

Data Preparation The visualisation was built from multiple data sets from the *Digital History Tasmania* database and includes data from the conduct registers, permission to marry registers, marriage registers, birth registers as well as information about freedoms, the ship voyage and trial records [2]. The diversity of these sources required initial complex data wrangling to combine them into one common data set, including unifying, checking, and if possible correcting the date format (usually for errors introduced during the transcription). Since the conduct records include the start date and length of sentences in the female factories, the end date of sentences could be calculated and the beginning of a sentence moved to the end of a previous sentence period in cases of sentence overlap. R scripts were used for this step.

Life Lines Visualisation The *Life Lines*[6] are a browser-based visualisation created in JavaScript using the Vue framework[7] and d3.js[8]. They show, on a timeline, which we also call life line, the life course events for any of over 13,600 convict women (Fig. 3 shows an example). Above the actual life line is a description giving the name, convict id, ship name, occupation, birth and (if known) death year of the convict, as well as a legend for the symbols used in the visualisation. The life line itself shows all data points for one convict woman on a horizontal line. Above the line sit the life course events, usually starting with the day of the trial and departure and arrival day of the ship, often ending with the day a woman received her conditional pardon or certificate of freedom. The most frequent symbol on the line are circles, representing offences committed under servitude, color-coded by offence category. Above the events is a description of the event, connected by a line. For better readability these descriptions have been spaced out evenly, and set out on an angle. Recorded below the top line are periods of secondary punishment in a female factory, and separated out below the second line periods in solitary confinement, again color-coded. Below the bottom line, additional information about the sentences is represented by a left-rotating clock for an extension to the original sentence or a slice of bread in case solitary confinement included a diet of bread and water. To avoid the legend from getting disproportionately large these symbols are explained through tool-tips. Hovering over sentence periods also shows the duration in days, hovering over symbols displays a horizontal version of the descriptions for increased readability.

Hovering over a life line allows further interactive exploration. For example, hovering over one of the anchor symbols will enlarge them indicating interactivity. Clicking on an anchor will show the life lines of all women who arrived on that ship. There is similar interactivity built in for permission to marry applications or marriages to the same man, and collective offences committed by multiple women. This interactivity allows users to explore connections in the data more easily – something historians find very useful.

A Stitch in Time To create the 18 embroideries of 21 convict women the first author browsed the life course events in the *Life Lines* visualisation and the conduct registers for inspiration and then sketched the basic image for an embroidery using pencil and paper

[6] https://github.com/monalena/vue-lifelines
[7] https://vuejs.org
[8] https://d3js.org

(see Fig. 4). The final sketch was then converted into svg format using *Inkscape*[9], and the path from the line selected to show the life line copied into the *Life Lines* application so that it could be integrated back into the svg image with the life events correctly positioned on the line. While the life line is usually integrated using an outline of the woman's body (like Mary Lambert's back) some offences allowed more creativity: for example the embroideries show Mary Ann McGilligan, who was sentenced for writing a letter out of the factory without permission, writing her life line onto a letter. Or the life line of Elizabeth Elemore, sentenced for hiding a pipe and a match in her boot, as a trail of smoke while she is lighting her pipe.

The svg image was then converted into an embroidery stitch plan using specialised software, *Embrilliance*[10]. In this step additional background color stitches, either tatami stitches or simple fill stitches using a color gradient or curved stitches, and the lettering for the convict woman's name were added. The actual embroidery was stitched on a Husqvarna designer epic embroidery machine, using beige quilting cotton which felt appropriate for the depicted imagery yet has a dense enough weave to guarantee good results (if using the right combination of stabilizer, needles and embroidery thread). Speciality stitches like a candlewick stitch were used for details like Mary Sheriff's neckband and her tattooed dots. Usually multiple test embroideries were necessary to improve stitch density, stitch selection or color selection. Over the course of a year we developed an increasingly sophisticated way to create our embroideries, with some lessons learned being to use tie on and tie off stitches at the beginning of each stitch section to avoid fraying, to move start and end points of neighbouring sections of the same color into the same spot to avoid jump stitches (done so in the frills of Mary Sheriff's cap), or that the ideal way to stitch a round circle of 1cm in diameter (an offence) is a triple bean stitch of 1.4 mm length.

A few remarks should be added here in regards to the scalability and portability of data embroidery to other historical data sets. In order to create compelling objects that would entice an audience we deliberately chose an artistic approach by projecting the life lines of specific convict women onto hand-drawn and then converted sketches. But creating the right sketch for each woman varied widely in time, from multiple sketches created in one afternoon to repeated attempts to find the right design for a specific woman over months. Once this bottleneck was overcome it usually took about a day to vectorise the sketch and integrate the data points. The second part, the integration of data, could be automated for larger-scale projects. If embroideries were based entirely on data visualisations without the need to create an svg image from a sketch first this process could also be significantly sped up. Depending on the software the conversion into a stitch plan is a relatively quick process, and in our case could not be automated since it involved further creative decisions like the use of fill and speciality stitches. On our single-needle embroidery machine stitching one embroidery, usually 260 x 360 mm of size, took between 1-2 hours including cutting and hooping the fabric and stabilizer. For a large-scale project it could be considered to outsource this step to a professional embroidery business.

Exhibition The exhibition of the embroideries created for this project was opened at the beginning of June 2023 by renowned Australian artist Fiona Hall in Hobart's Penitentiary Chapel, the place where the original convict records (and main source of information) were once stored. The exhibition itself is placed in one of the converted court rooms, where some of the women would have been tried, in its historic context. While the official opening did not allow for querying the audience in the form of questionnaires, we did observe that visitors were taking a lot of time to look at the details in the embroideries and to read their accompanying stories, often repeatedly going back and forth between objects. We also learned that due to the crowded situation at the opening several visitors returned the next day to look at the embroideries again in their own time. Since the opening the National Trust Tasmania have reported continuing 'high levels of visitor engagement' and requested that the exhibition remain in place for as long as possible. They see it as a 'highly appropriate and effective means of visualising stories in place'[11]. We think therefore that our intention to create interest in the stories of Australian convict women has been met.

[9]https://inkscape.org

[10]https://embrilliance.com

5 Conclusion

In the 'Stitch in Time' project we have extended a traditional data visualisation, the *Life Lines*, to create data embroideries from 21 nineteenth century convict women with the intent to incite interest in their personal stories. These women form an important part of Australia's colonial past, of which little is known. This is very different to other convicts, e.g. the group of American political convicts who often published their experiences after they returned home in biographies [14]. Yet there is a wealth of data about the convict women available, which can be turned into compelling stories if we combine traditional approaches like qualitative source study with modern techniques like the data visualisations rendered into physical artifacts using embroidery.

We present this work to the visualisation community as an illustrative case study, outlining our approach to deal with a large body of historical and hence intrinsically qualitative data. We did so by turning selected life courses into physical objects that strongly reference the data they were inspired by. Further, and again a decision driven by the subject matter itself, we expanded the field of data physicalisation with, and described the necessary process of, a new technique we call *data embroidery*.

Acknowledgments

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