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What can an Artistic Sensibility Bring to the Design & Production of Braille, & What Role Might UV Flatbed Printing Play in This?

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A thesis submitted to the University of Huddersfield in partial fulfilment of the requirements for the degree of Master of Research

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The University of Huddersfield
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Braille copy available upon request

Abstract:

Within the confined of this thesis I set out to address two questions. Firstly, I ask whether there is a role for UV flatbed printed Braille, as a viable, alternate technique that might complement orthodox methods of production? In addition I ask if there is a role for art and aesthetics in the context of Braille production?

With regards to the first question I feel confident that UV flatbed printed Braille does in fact have a role in modern Braille production, one centred on bespoke runs and highly custom work. By positioning it as a high quality, luxury method of production, printing firms that already own these machines would be able to offer an additional service with little to no extra initial cost. In addition the firms that own a UV flatbed would already be dealing with this kind of custom print work, positioning them perfectly to take advantage of the additional work that this Braille production method might offer.

Attached is an additional document that focuses on the practical aspect of my work, one which explains the production method and showcases the range of Braille that has been created as part of my research. One sample in particular my "Linda Lewis" sheet metal sign, has shown remarkable resilience. It has been installed in the University of Huddersfield's Print Bureau for over a year now, yet it shows no sign of wear and attempts to scrape or chip the dots with a scalpel have been repeatedly unsuccessful.

As for the less straightforward question of "*the role for art and aesthetics in the context of Braille production*" ; I begin by applying the philosophy of aesthetics, haptics, translation, critical realism and finally Différance. After this I look at the role of Braille in a wider context, initially exploring its place as a public disability aid, but later moving on to examine it as a private aid and how Braille as a medium might be integrated into lives of the sighted.

I go on to explore disability stigma and disability fashion, in an attempt to understand the ways in which Braille might interact with the built environment and the tensions which can arise when poor, or indeed merely functional Braille, especially when is may be the exclusive image of the disability aid we are presented with. This in turn allows for an examination of artistic intervention, how it might enhance, help or otherwise increase the profile Braille, in order that Braille and the unique experiences it offers, might play a larger role in both the sighted and non sighted world.

Chapter One: Introduction & Literature Review:

This thesis deals primarily with two related questions: Firstly it asks whether there is a role for UV flatbed printed Braille, as a viable, alternate technique that might complement orthodox methods of production? In addition it asks if there is a role for art and aesthetics in the context of Braille production?

Accordingly, two separate but parallel methodologies are required to adequately define my approach. The first, is design-centric and addresses the way in which I approach my practice. The second is art-centric and addresses the aesthetic significance of that practice.

I began looking at Braille at the beginning of 2015. At that time, my aim was to achieve a high quality coloured Braille, that was both easy to read and simple to reproduce. I was drawn to the "UV flatbed" because of its ability to stack multiple layers of ink. In theory, these layers could be built up in a way that creates a solid ink Braille dot.

Over the course of my earlier research I was able to find a number of emerging examples of ink and UV cured Braille. However, most of these examples came from highly specialised machines that could only create Braille[1]; most of which were designed primarily for either pharmaceutical packaging or signage.

Machines intended solely for the production of Braille are limited, and they tend to be more suited to large scale production than bespoke or artistic works. The method I have been working with offers a certain kind of versatility, as it allows some non-Braille producers to attempt small scale production, without large scale investments. Namely it allows professional printers who own a UV flatbed to attempt Braille alongside the high end bespoke work the machine is predominantly used for.

Another attraction of the UV printer was the control it gave us over our work. It allowed me to print my initial graphics, and then introduce another layer of Braille over the top. Using the same machine for both stages of our work reduced the margin for error and allowed me to better integrate Braille into my designs.

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[1] Annual Report CTI 2006: Braille Printing System for Quick Identification of Medicines. (2006). 1st ed. [ebook] Federal Office for Professional Education and Technology, p.41.

Direct Color Systems Llc, (2014). *Ada-compliant braille signage printer*. WO2014160778 A1 / US20160052298.

Schär, M., von Arx, U., Bircher, F., Krause, R., Bernet, P. and Selbmann, K. (2012). Printing Braille with inkjet. *Advances in Printing and Media Technology*, [online] Vol. XXXIX, pp.97-106. Available at: http://jpmtr.org/Advances-Vol-39%282012%29_online.pdf [Accessed 25 Nov. 2016].

Steel, G. (2009). *Digitally Printed UV Braille*. [online] PharmaBraille. Available at: https://www.pharmabraille.com/digitally-printed-uv-braille/ [Accessed 25 Nov. 2016].

Xerox Corporation, (2016). *Ultra-Violet Curable Gellant Inks For Braille, Raised Print, And Regular Print Applications*. US20100053287.

Over the last year I have created something resembling a "finished" product. A solid ink Braille dot, that has achieved close to the ~0.5mm[2] ideal dot height. I wanted to explore practical applications for the method, putting a focus on durability which is a recurring issue for UV printing as well as for Braille as a whole[3].

There is a clear pragmatic, functional dimension to my work, one that is dictated by the restrictive nature of Braille and its unique typographic ruleset. However, whilst adhering to these rules I wish to look at disability design from a graphic perspective; exploring the aesthetics of Braille and the ways in which disability aids can reflect the end user.

This will fold into a discussion of the way in which disability aids are viewed in public spaces, from the perspective of visual aesthetics; alongside an examination of the potential for haptic aesthetics in the context of reading Braille.

1.1: Positioning the Author

In the book *"Disability: Controversial Debates and Psychosocial Perspective"* Deborah Marks sets aside a small section to outline her reasons for tackling the subject of disability, as well as declaring her position as an abled bodied person. She states that: *"my position as a non-disabled woman running a course on Disability Studies calls forth a spectre of colonisation of the 'Other', which has been spoken about by many writers on feminism, disability, racism and hetrosexism"* (D.Marks, 1999)

One particular quote resonated with me partly because it hit upon something I had felt but had been as yet unable to put into words: *"Many of us would be suspicious of a white woman teaching anti-racism. So there are clearly issues in the way I theorise my position. As well as the whole question of material interests which will be of concern in this book, it is also important to examine emotional investments"* (D.Marks, 1999) In this vein I felt encouraged to set aside a section of my thesis to discuss my own emotional investments into disability, as well as confirming my own personal situation in order to offer a level of transparency to my writing.

When discussing disability it only seems right to declare that I come from a position of privilege. Neither I or anyone in my family have sight issues, nor do I have any other kind of disability that could have lead me to this field.

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[2] See Appendix B RNIB Braille specifications pt2. Dot heights range from 0.25mm for the swedish standard, all the way to a 0.8-1mm dot height for French standard. The most common heights range from 0.45-0.6mm, with English standard interpoint (English two sided print) stating 0.46mm to be the ideal. I work primarily with this standard and it should be assumed I am working to English specifications unless stated otherwise.

[3] *"Disadvantages of inkjet: Quality depends on the substrate. Curing / drying time may restricts print speed. High prices of inkjet inks. Ink consumption. Reliability (print head, ink). Durability."* Bircher, F. (2011).

Bircher, F. (2011). *Printing As A Material Deposition Process.* 1st ed. [ebook] Mumbai: Bern University of Applied Sciences: Institute of Print Technology. Available at:
https://www.ti.bfh.ch/fileadmin/x_forschung/forschung.ti.bfh.ch/Drucktechnologie/publikationen/vortraege/Bircher2011_PrintingAsAMaterialDepositionProcess.pdf [Accessed 25 Nov. 2016].

I was introduced to this area more by chance than design, when I came across a book on Braille. At the time I was working on "film for niche audiences" and this discovery lead me to create specialist showings of audio description only films, which were aimed at both blind and sighted audiences. This in turn lead me to position audio description as a separate but equal art form, rather than merely a substitute for the sighted experience of film.

It was while creating Braille tickets and placemats that I became fascinated with Braille and its various complexities. At the same time I was becoming enamored by the elegant design solutions offered by disability design, not just in the area of sight issues but in the field more broadly. Simply put I wanted to be a part of the discussions that I was beginning to encounter, rather than simply admiring the work of others.

1.2: Positioning the Method

Over the course of my research the exact production method has been refined and subjected to a number of changes. The most noticeable change has been to the final pass (or the last layer printed) where an "emboss" ink layer is added to give the dot a curve. This rounded Braille dot is considered preferable to a "flat" dot[4], as the lack of an edge makes the Braille less abrasive on the index finger.

This becomes particularly relevant for the construction of books, where a user might sit for hours reading. Flat head Braille could be thought of as the non-visual equivalent of colour vibration, where two colours work poorly together and cause a certain level of strain to the eye. Even on small runs this is considered bad practice and this kind of "aesthetic dissonance" is something that should be avoided.

It is worth noting at this point, in much of my research there is a strong correlation between function and aesthetic. This is primarily a result of what I perceive to be the inherent aesthetic qualities within Braille's function; that is to say Braille has been designed to feel a certain way, which has led to specific shape, spacing and manufacturing considerations. The domed dot is just one aspect of a much wider conversation about the visual and tactile aesthetic qualities that make Braille unique as a medium, yet it is quickly able to illustrate the close relationship of aesthetics and function within Braille; namely the need to create dots that feel nonabrasive, and the desire to create dots that are pleasant to feel, could be viewed as two disciplines approach to the same problem.

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[4] Flat head dots are considered "bad practice" by most if not all accessible signage bodies across the globe. This is reflected by the insistence of all Braille guidelines to use domed dots. To give just a few examples:

"Braille dots should have a domed or rounded shape – make sure they are not pointy or flat." (Formats Committee of Braille Literacy Canada: Accessible signage guidelines, 2016)
*"Braille dots shall have a domed or rounded shape"* (American Department of Justice: ADA Standards for Accessible Design, 2010)
"Braille dots shall be domed or rounded" (Braille Authority: Size and Spacing of Braille Characters)
See also Appendix for RNIB review of Braille specifications on spherical radius for English standard interpoint.

1.3: Braille and its functional Aesthetics

The UV printing method changes depending on the material. Though throughout the course of my research[5] it was revealed that non porous materials requires far fewer layers than porous ones. Things like fabric have been especially problematic as the initial layers tend to bleed into the natural grain of the material, resulting in a less stable foundation to the dot. This in turn makes the Braille far more prone to chipping at taller dot heights.
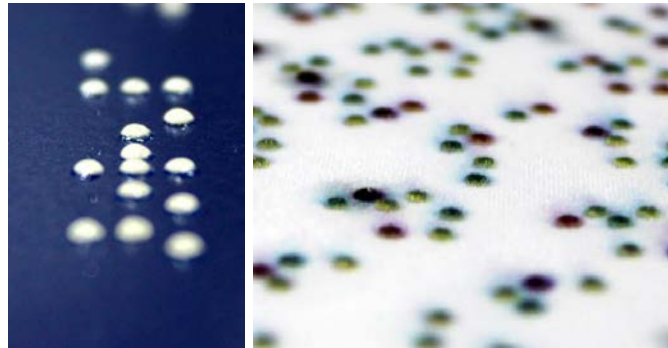
Visual Comparison of two UV flatbed printed Braille samples, one with white ink on a blue sheet metal (a non-porous substrate), the other a multi coloured polka dot pattern on white fabric (a porous substrate).

But an ideal non porous substrate like sheet metal or certain kinds of card, can require as few as 29 layers[6] to achieve a suitable dot height. In turn anywhere from 1 to all of those layers might be "emboss" layers. These emboss layers have the effect of curving the whole or in some cases the tip of the dot.

Most Braille "ink printing" tries attempts to achieve completely clear Braille, in order that dots can be applied on top of non-tactile lettering and be more seamlessly integrated. In contrast to this, my work focuses on applications of coloured inks, an area that is not currently being widely explored in regards to Braille. Yet colour may have an integral role to play in the progression of Braille, both in raising the medium's profile and in benefiting Braillists with partial sight. To give you an idea of just how essential colour might be to the blind, it is perhaps worth considering definition. The RNIB define "blind" as:

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[5] See additional materials for a more in depth review of my practice, and "polka-dot" Braille for a fuller explanation of UV fabric samples.
[6] *29 Layers: (3x9) +2 (27 Matt Layers +2 Emboss Layers (No Varnish)). Passes:16. Time: 3 hours per suite. Ink Cost: £0.77*

See additional materials "Braille playing cards" for further details on costing and process.

"Generally, to be certified as severely sight impaired (blind), your sight has to fall into one of the following categories, while wearing any glasses or contact lenses that you may need:

- *Visual acuity of less than 3 / 60[7] with a full visual field.*
- *Visual acuity between 3 / 60 and 6 / 60 with a severe reduction of field of vision, such as tunnel vision.*
- *Visual acuity of 6 / 60 or above but with a very reduced field of vision, especially if a lot of sight is missing in the lower part of the field."* (rnib.org.uk. 2017).

Or to quote the equivalent from the American Federation for the Blind:

"Legal blindness is a level of vision loss that has been legally defined to determine eligibility for benefits. The clinical diagnosis refers to a central visual acuity of 20/200 or less in the better eye with the best possible correction, and/or a visual field of 20 degrees or less. Often, people who are diagnosed with legal blindness still have some useable vision." (afb.org, 2017)

To turn these numbers into something less abstract let us turn to the "Snellen Eye Chart" to which all these definitions refer. The eye charts largest letter represents 20/200 vision if it is the only line that can be viewed from 20 ft. away[8]. While this does denote severe sight impairment it does not mean you are unable to see colour. In fact you may not only be able to see colour, but you might also recognise a certain degree of shape and even differentiate certain objects from one another. In this way high contrast colours might assist those who are unable to read traditional text, but are still able to make out colour and identify a bright sign as something they may read by touch.

Alternatives to UV Braille Printing

This method of Braille production is not the only one that uses inks or UV curing. In fact many mainstream methods use one or a combination of the two[9]. Creating Braille on a UV flatbed is only meant to help bridge some of the gaps between amateur and mass produced Braille.

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[7] 3/60 is equivalent to the American 20/400, they both link back to the Snellen Chart and are both "Snellen Fractions" which measure visual acuity. One simply works in feet while the other works in metres. A brief explanation of Snellen fractions can be read below:

[8] *"The person being tested normally stands 20 feet or 6 metres from the chart and reads as many letters as possible starting at the top, and a score is assigned in the form of the ratio or fraction d/dn, where d is the viewer's distance from the chart and dn is the distance at which a viewer with normal visual acuity could read the smallest letters that the person being tested can read. On this scale 20/20 vision is normal by definition, and 20/200 vision is a criterion of blindness originally introduced by the American Foundation for the Blind"* (Colman, 2009)

[9] TRUCT being one of the most common, using UV cured resin to create hardened dots.

The Emprint SpotDot (home printer) also uses a combination of ink image layers and Embossing to create images with tactile elements.

The Samsung's "touchable ink" project is also worthy of note, being one of the few emerging examples of ink Braille to focus on adapting existing ink jet printers rather than create an entirely new machine.

Much like traditional printing there is a home and industry standard. Home Braille printers and Braillers will still create high quality results, suitable for most jobs; yet these printers are limited in scope and scale. For instance a home printer won't be able to approach things like signage and non-paper crafts.

This is where industrial printing fits in, focusing on areas like book publication and materials that are harder to work with. This thesis will discuss the benefits of custom runs, filling the niche left between the small scale home printing, and the volume focused professional market.

Bespoke work often strives for a higher quality product. Things like bound wedding albums or engraved jewellery have a certain level of emotional connection to them, a preciousness that wants to be reflected in the end result. This is why our practical work focuses on expressive or artistic interventions into Braille, that offer a kind of creative play with the object or the process involved.

There will be a certain level of discussion into emerging technologies in this thesis, but it should be made clear that this technique is not meant as a replacement for traditional manufacturing and there is no claim that UV printing will begin to dominate the market. Instead this should be thought of as a complementary process, designed to give firms that would not traditionally make Braille the option of offering it.

TRUCT Printing

"Recently, transparent resinous ultraviolet-curing type (TRUCT) Braille signs are becoming more and more popular in Japan." (DOI et al., 2015). Although this method is increasingly in profile in Japan, it has not emerged in the same way in the UK and the wider world.

"In recent years, as a result of advances in Braille printing technology, the use of transparent resinous ultraviolet cured type (TRUCT) Braille has spread rapidly. As one of the most popular Braille printing technologies, the screen printing method is applied for printing TRUCT Braille. However, the screen printing method produces TRUCT Braille prints of poor quality." (DOI et al., 2015)

Most TRUCT Braille is focused on large scale manufacture. The process uses resin rather than ink and dots tend to be relatively poor quality. In contrast my work is geared towards small custom runs, aiming to deliver a high quality Braille dot over cost a effective one.

While TRUCT doesn't tend to deal with the same kind of work, the process itself is probably the closest thing to a mainstream UV Braille production method. With that in mind it is worth noting its place in the industries landscape, as well as highlighting the appetite for "printed" Braille that the adoption of TRUCT suggests.

Screen printed Braille is one of the most common types of TRUCT Braille and is quickly becoming an established method in Braille manufacturing. The ability to print raised tactile

images and type alongside Braille is a major draw of the process, it allows many aspects of the same sign to be created using only one machine. Yet it still has nowhere near the success of other methods, with utility processes like rotary Braille[10] still dominating the market.

Digitally Printed Braille:

Over the last two decades, digital print has become more and more pervasive. A significant advantage of digital is the ability to quickly tailor files without large extra costs. In the context of printed Braille this could allow for patient specific instructions on medication, adjustments of "use by" dates on other products or even changing information for users of different languages.

Custom runs are starting to become viable in many industries, mainly because of the success of 3D printing. Despite this, most Braille print still focuses on larger production runs due to issues of cost. With products like books the change to digital has been an obvious one, as it cuts out the costs of expensive plates and impractical die embossing, but for product packaging where only one or two words might be printed, non-digital methods can still play an important role.

UV Braille Printing Machines:

The UV printer is itself digital, and while a digital Braille embosser is somewhat adaptable because it can print a variety of Braille words, the UV flatbed is far more versatile. It can create completely different kinds of print work, which allows firms that already have this kind of printer to approach less mainstream applications.

If firms have to buy new equipment in order to create Braille, then they will have to look at how profitable Braille printing can be. Ultimately the industry has serious issues because of vague accessibility laws, a wide range of manufacturing techniques and a distinct divide between personal and professional printing.

To begin with let us look at Braille manufacturing techniques. These can be divided into production methods for the blind and production methods for industry. Braille typewriters, "Braillers" and the slate and stylus are all common household devices for the blind, while rotary drills, industrial book printers and even the UV flatbed, are only suitable for a manufacturing environment.

Machines such as the Juliet double-sided embosser[11] and the Embraille embosser[12] are the equivalent of a household inkjet printer for most Braillists. These printers are of high enough quality to suffice for most work, which means that the market for industrially manufactured

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[10] Rotary Braille involves drilling holes so that ball bearings can be glued inside them. Along with etching it is one of the most commonly used accessible sign making techniques.

[11] New England Low Vision. (2017). *Juliet 120 Double-Sided Braille Embosser*. [online] Available at: http://www.nelowvision.com/product/juliet-double-sided-braille-embosser/ [Accessed 24 Jul. 2017].

[12] shop.rnib.org.uk. (2017). *Tiger Embraille Embosser*. [online] Available at: http://shop.rnib.org.uk/braille/tiger-embraille-embosser.html [Accessed 24 Jul. 2017].

Braille shrinks. Large runs, non paper products and premium items have become the focuses of the Braille industry, in much the same way that traditional printing has repositioned itself in the wake of wider access to home printing[13].

The advantage of a print shop that can create Braille but whose main business is another kind of printing, is that Braille isn't the printer's primary source of income. This means that they can take advantage of the occasional extra work brought in by Braille, while still being versatile enough to not rely on that work for their whole business.

This is reflected in the success of other areas of this the industry, where techniques like laser etching and rotary drills evolved because the machines were already widespread. Given that sign makers began to approach Braille sign making with the machines they had available, it does not seem unreasonable to suggest that something similar is needed to push emerging Braille printing forward.

The cost of rotary and laser etching machinery can be much less than an industrial Braille printer, mainly because mass production has a tendency to reduce unit cost[14]. Ultimately if a machine is widely used in other industries it will cost less, be more widely available and be likely to have "better" models released in the future.

The Braille printing technique that I work with, will allow more print firms to approach Braille production. The UV flatbed is primarily used for varnishes and high end print. Meaning that the majority of owners already use it for bespoke runs of custom work. Accordingly it is well positioned to facilitate the kind of Braille production that is being suggested here.

Ultimately, this method could reduce the cost of some Braille by adapting rather than replacing print signage. This is especially relevant for bespoke signage, where only single copies of each sign may be needed. The combination of smaller print runs and working with pre-existing material, means that fewer options are available. For example it is not feasible to use rotary Braille on thin sheets of plastic, where drills may puncture or even shatter the material.

1.4: Braille manufacturing in a modern world

I have briefly mentioned "vague accessibility laws" in the previous section, but the subject needs more discussion due to its wide scale impact. One of the major problems facing Braille users in

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[13]The UK printing sector by market share: *"Advertising literature, business stationery, event programmes, tickets etc (35%) Newspapers, magazines, books, brochures etc (27%) Security printing (4%) Printed packaging (cartons and labels) (16%) Printing onto non paper/board (9%) Other printing (9%)"* (Neopost, 2014)

We see a clear focus on commercial and for business printing, and a noticeable absence of jobs we would consider the purview of home or day to day printing. The majority of these categories either focus on obtaining a higher quality print (advertising literature, books etc..) or printing that simply cannot be attempted by non-commercial printers (security printing, printing onto non paper/board). While the impact of home print on the print industry might be seen as common knowledge, it is still worth noting these changes as we can draw parallels between the changes within traditional print industry, and modern braille printing.

[14] A theory known as "Economies of scale" or *"a proportionate saving in costs gained by an increased level of production." (Oxford Dictionaries | English, 2017)*

the modern world, is that legally it doesn't have to be, nor is it expected to be on every sign. Meaning that most places will simply ignore Braille or place it solely on toilet doors and/or lift buttons.

The phrase reasonable adjustment arose out of the DDA or Disability Discrimination Act.

"It is the duty of the employer to take such steps as it is reasonable" (Disability Discrimination Act 1995, 6:1 Duty of employer to make adjustments).

This was then replaced by the Equalities act which uses the exact phrase "reasonable adjustment".

"A person (A) who is subject to a duty to make reasonable adjustments is not (subject to express provision to the contrary) entitled to require a disabled person, in relation to whom A is required to comply with the duty, to pay to any extent A's costs of complying with the duty." (Equality Act, 2010, 20.7 Duty to make adjustments)

While the term is often subjected to criticism because of its vague nature, its phrasing was originally designed to give people and organisations a kind of creative freedom, a way of working with each other in order to make tailored solutions and compromises. The idea was that these solutions should work for the individuals involved, rather than imposing a blanket approach to disability aids. Yet this terminology often makes it hard to determine what is "reasonable" and discrimination can often be hard to prove.

"Knowing what constitutes a "reasonable" adjustment can be very difficult. For employees, disclosure becomes an important issue. Adjustments can only be made if the employer is aware of a disability yet discrimination is very hard to prove." (Glozier, 2002)

The law also focuses on a disabled person's right to work and for an employer to make reasonable adjustments to facilitate that work. While this might extend to a ramp for access for someone with mobility issues, it will rarely focus on Braille signage for someone with sight issues. The more familiar a blind person is with a space the less they will require signage to navigate that space. Meaning that signage in the workplace might not be the priority that it should be in public spaces.

To complicate things further, Braille's cost usually means it is only found on mass production signage. Of necessity toilet doors feature heavily in my discussion of the medium, this is not because they are the best examples of Braille signage, but because they are often the only examples. These two factors create a very small market for Braille in public spaces, where even large public institutions aren't guaranteed to have any meaningful quantity of Braille on their sites.

One such example of this absence can be found in my own institution. The University of Huddersfield only has Braille on toilet doors and one or two other hygiene areas (showers etc..).

This has been confirmed by our estates department but there is still a need to quantify this accessibility gap by conducting a small scale survey.
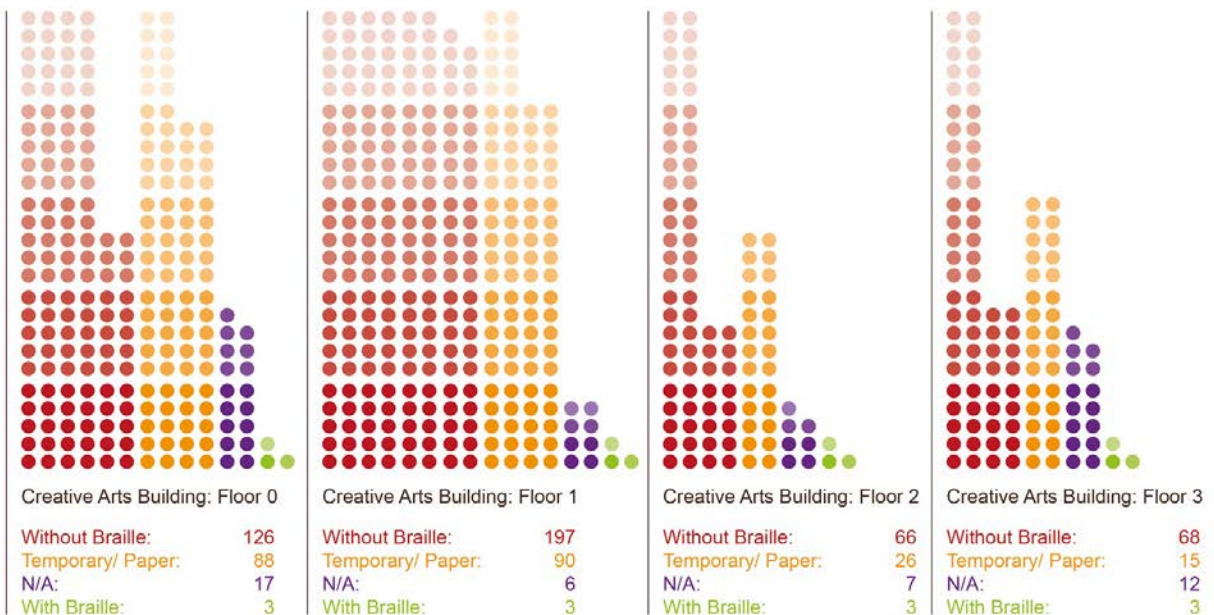
This case study only focuses on the creative arts building as the admissions from our estates department, renders a full scale signage count redundant. That being said this study should be treated as an example of a building with accessibility issues, rather than a comprehensive look at Huddersfield Universities accessibility. A full explanation of my methodologies and criteria for what defines a sign, can be found in Appendix A.

Unlike traditional signage, tactile signage is unlikely to appear from non-official sources, paper out of order signs or advertising posters will rarely feature hand embossed Braille cells. In this way official Braille signage commissioned by the university are likely to be only examples of Braille, meaning that their numbers can be reliably judged as accurate.

The primary reason for conducting my own survey was to showcasing the glut of signage and compare it to the drought of accessible signage. This study also allowed for a separate but no less relevant count of unofficial or handmade signs. By definition this number will be far more flexible than a count for official signage, with posters for events and workshops changing daily. It is also something the university would not be expected to have numbers for, while still being something relevant to the discussion of exclusion.

A quick summation of the methodologies used in this survey's data collection, reveal that the building was given quite favourable terms:

- No nonpublic area was accessed for data collection.
- Large "panel" signs were considered as one sign instead of many.
- Unreasonable and N/A signs were removed from the results.
- Paper signs (including official ones) were counted separately.

Creative Arts Building: Floor 0		Creative Arts Building: Floor 1		Creative Arts Building: Floor 2		Creative Arts Building: Floor 3	
Without Braille:	126	Without Braille:	197	Without Braille:	66	Without Braille:	68
Temporary/ Paper:	88	Temporary/ Paper:	90	Temporary/ Paper:	26	Temporary/ Paper:	15
N/A:	17	N/A:	6	N/A:	7	N/A:	12
With Braille:	3	With Braille:	3	With Braille:	3	With Braille:	3

A chart with information on all floors of the CAD building. Floor 0 had 126 signs without Braille, 88 Temporary/Paper signs, 17 N/A signs and 3 with Braille. Floor 1 had 197 signs without Braille, 90 Temporary/Paper signs, 6 N/A signs and 3 with Braille. Floor 2 had 66 signs without Braille, 26 Temporary/Paper signs, 7 N/A signs and 3 with Braille. Floor 4 had 68 signs without Braille, 15 Temporary/Paper signs, 12 N/A signs and 3 with Braille.

Despite this the results were not good. In total 457 official, permanent signs contained no tactile elements. This included but was not limited to:

- Below "eye level height" fire exit signs
- Fire assembly point signs
- "Push button to open" signs: Used to internally unlock many external doors and two fire exits. In the event of a fire these locks would be deactivated.
- Refuge call boxes: Designed to aid non mobile and wheelchair users in the event of a fire, critical when lifts are not a safe option.

Each floor contained 3 Braille signs, each with other raised tactile elements. All 12 of these were for toilet doors. The only other tactile navigation aids were lift buttons, they did not contain Braille but did have raised numbers. These buttons have been excluded from my data as they are not signs, yet it is still important not to omit tactile elements from this study as it allows for a more complete understanding of the buildings accessibility.

While the navigational signage on campus could stand to be more accessible, this is not an attempt to single out the University. There is simply a need to draw attention to the fact that even traditionally accessible spaces like public institutions, are not guaranteed to have widespread tactile signage. This is echoed in other public locations where toilet doors often sport Braille, but few if any other signage does.

This example should help position the UV printing method, as it is clear that the potential market is limited. Large institutions can often question the merits of costly tactile signage, especially considering how often rooms might change use. Indeed Huddersfield's own signage uses modular "clip on" panels and removable vinyl, allowing staff to move offices without having to commission new signage. This system also allows vinyl on old signage to be easily changed for new employees or a change in room use. Unfortunately this approach won't work with traditional Braille, which would require more permanent panels.

On top of this limited professional market, it is necessary to address the impact of amateur production. Home embossing is usually of quite high quality, and much like traditional home printing it will suffice for most jobs in our day to day lives. This further limits the potential market as it removes personal documents from the purview of UV's potential applications.

However a potential gap emerges when we have custom runs or "one offs" where people wish to use a less conventional material (plastic, metal etc…) which is less practical to produce at home; or in instances where a higher quality finish is desired (bookbinding, certificates etc..). The larger manufactures won't see much profit in this kind of work, and as such the prices they will charge will be quite high for single pieces, if that service is offered at all.

It should also be noted that there is a high degree of specialist knowledge required for Braille. Understanding dot height, spacing, rounding and a range of production methods is just the tip of the iceberg. Ideally someone working with professional Braille production would be able to read "Grade 2" Braille or at least understand the difference between contracted or uncontracted Braille. They should be able to proofread their product and know when to use the different kinds of contractions, both of which are essential skills for this kind of work.

With all these factors working against Braille you can begin to understand its scarcity. You can also see why designers and other creatives might be reluctant to address it in their own work and by extension why utilitarian Braille dominates what few examples there are. Yet Braille is still an incredibly important tool for the blind, and the difficulties surrounding it are precisely the reasons designers should approach the medium.

1.5: The Relevance of Braille in a modern world:

When speaking on Braille I am almost always confronted with some variant of the question "is Braille still relevant in a modern world?". Originally I hadn't intended to address this issue in my writing, however, given that it seems such a prevalent and persistent question, it has become necessary to consider it.

Our first response tends to go as follows: Braille literacy rates among children in the UK (a.k.a the early life blind or visually impaired) is around 5%, would you accept a literacy rate this low in regards to any other minority group?

"19,000 visually impaired children and young people in Great Britain, 5% of these are braillists, 34.5% have additional support needs." (Ssc.education.ed.ac.uk, 2016)

Reading has proven benefits, not only as a way of accessing information, but as a way of improving comprehension and shaping thought[15]. Few would argue that learning to read and write is not a valuable asset to a sighted child, yet pointing out Braille as obsolete in a digital age is commonplace.

"Only 18,000 adults out of 365,000 adults" read Braille, and while this statistic includes the late life blind (who are much less likely to learn Braille) it still shows a 20% Braille literacy rate among blind and visually impaired adults.

"Notes: John Sanders in 2009: 18 thousand adults in the UK use Braille as their main format for reading and writing. Two thirds of these had become visually impaired before the age of 16 and would have learned braille while still at school." (Ssc.education.ed.ac.uk, 2016)

There are debates around the question as to whether a blind person who is unable to read Braille (or another form of tactile writing) should be considered illiterate, especially with the rise of other assistive technologies like audio books[16]. There are also debates around the changing definition of the word literacy in a modern world. But within the confines of this thesis, those who are unable to read "physical texts" will be referred to as illiterate.

"Defining literacy in our changing world is not easy. Several years ago, being literate meant being able to read and write a little. Now, being literate means being able to read and write at a level to be successful in today's world and also being proficient at math, knowing how to use technology, and knowing how to solve problems and make decisions." (Literacy.kent.edu, 2016)

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[15] "reading for pleasure was found to be more important for children's cognitive development between ages 10 and 16 than their parents' level of education"

Reading for pleasure Research impact case study. (2015). [ebook] Institute of Education UCL. Available at: http://www.cls.ioe.ac.uk/library-media%5Cdocuments%5CReadingforpleasurestoppress.pdf [Accessed 5 Sep. 2017].

"Reading is meaning making, it's problem solving, and it's not simply just calling words"

Lipsey, T. (2016). Gov. Bill Haslam : Read To Be Ready Addresses a Need. [online] YouTube. Available at: https://www.youtube.com/watch?v=Xk-1Vn6WxiI [Accessed 5 Sep. 2017].

[16]Aviv, R. (2009). *With New Technologies, Do Blind People Lose More Than They Gain?*. [online] Nytimes.com. Available at: http://www.nytimes.com/2010/01/03/magazine/03Braille-t.html [Accessed 11 Apr. 2017].

Ccdigitalpress.org. (2017). *Notes from the Braille Literacy Crisis.* [online] Available at: http://ccdigitalpress.org/strategic/chapters/helquist/index.html [Accessed 11 Apr. 2017].

David Boles, Blogs. (2017). *As Braille Dots Fade, Blind Illiteracy Builds | David Boles, Blogs.* [online] Available at: https://bolesblogs.com/2010/02/16/as-braille-dots-fade-blind-illiteracy-builds/ [Accessed 11 Apr. 2017].

Nfb.org. (2017). *Just Saying No to Reading Braille.* [online] Available at: https://nfb.org/images/nfb/publications/bm/bm03/bm0303/bm030306.htm [Accessed 13 Apr. 2017].

Pharmaceutical Journal. (2013). *Why Braille dots should be removed from European medicines packaging.* [online] Available at: http://www.pharmaceutical-journal.com/opinion/comment/why-braille-dots-should-be-removed-from-european-medicines-packaging/11132018.article [Accessed 11 Apr. 2017].

Our second point comes from the places where Braille is commonly seen; Toilets, bleach bottles, pharmaceutical packaging etc… Is it important that a blind person is able to differentiate paracetamol from codeine in their own home? Is it important that they are able to find fire exits in an unfamiliar burning building? Should a teenage be able to go find the correct bathroom without an escort?

The list goes on, but the point I am trying to make is this; at its best Braille can be liberating, empowering and it can save lives. Accordingly the absence of Braille and a lack of Braille literacy, can be said to do the opposite.

Though it is right that the relevancy of Braille is addressed, a full exploration of this topic is beyond the scope of this research. It should also be noted that from this point on, all writing will assume Braille as relevant.

Chapter 2: The need for artistic interventions into Braille

2.1: Introduction to the Haptic as the Aesthetic

At first glance, it may seem counterintuitive to think of Braille in terms of font or type, even harder to think of it in the same breath as calligraphy. Yet at its core Braille is written language system, and as such it has the ability to be both expressive and emotive, as well as being a functional communicative tool.

This is not just about the word themselves, but the unique way in which the medium expresses those words. There is potential for beauty in the component parts of a word in both traditional and tactile writing; arguably letter forms are things of real aesthetic value, able to set tone, alter legibility and affect us in a range of different ways.

When looking at Braille it becomes clear that it has its own set of letterforms, as well as unique rules that have to be followed for it to function. Most of these rules are admittedly very restrictive, and in some cases they can seem quite alien when compared to the conventions of non-tactile writing. With this in mind it might seem a daunting task to approach Braille as something other than a utilitarian language system, and there is perhaps something quite telling in the fact that product design rather than typography tends to take ownership of Braille.

The list below gives some idea of the kind of restrictions Braille imposes:

- Braille dots must be half domes so as not to hurt the readers finger.
- Braille cells must fit under the index finger or it will be considered "jumbo Braille[17]" which is generally used as a teaching aid for those with reduced finger sensitivity. Above this larger size the type would not be considered Braille at all. The size of dots is tightly defined – interestingly, in the case of jumbo Braille it is the spacing rather than the dots that increases in size.
- Braille dots that are 0.2mm in height are considered Pharmaceutical Braille[18], or Braille printed on Pharmaceutical packaging. This is the lowest height at which Braille is still clear to read and not considered appropriate for textbooks or signage. Its lowered height is designed to cut costs and protect the medication, but that does come at the cost of readability.
- English Standard Braille dots are 0.46mm[19] high.
- Negative space between dots and cells is as important as the dots themselves, meaning that Braille has its own unique set of rules regarding kerning and leading[20].

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[17] "Jumbo Braille generally has dot spacing of order 25% larger than standard Braille." Gardner, J. (2017). *Braille, Innovations, and Over-Specified Standards.* 1st ed. [ebook] Oregon State University. Available at: http://userlab.usask.ca/GOTHI/Gardner.pdf [Accessed 11 Apr. 2017].

[18] "The CEN standard refers to a dot height target of 0,20mm" Pharmabraille.com. (2017). *Procedures for Pharmaceutical Braille Artwork – PharmaBraille.* [online] Available at: https://www.pharmabraille.com/pharmaceutical-braille/procedures-for-pharmaceutical-braille-artwork/ [Accessed 11 Apr. 2017].

[19] See Appendix B RNIB Braille specifications pt2

All of this means that the point size, shape and spacing of a Braille cell, can't be meaningfully altered without defying accepted standards of what can be defined as Braille. At best this can result in slow to read Braille, at worst it can result in dots that are no longer legible or that do not convey the intended meaning.

The idea of using the expressive approach of calligraphy in the context of a such a regimented writing system might seem impossible or at the very least absurd. However, if the focus is shifted to what can be changed rather than what can't, then a new kind of typography begins to emerge - one where considerations of placement, colour and material come to the fore. It is at this point that the notion of haptic aesthetics becomes central to this discussion; as if we can't rely on visual/sighted typography then we might begin to experiment with other senses.

"The term haptic emerges in Deleuze and Guattari's description of "smooth space," a space that must be moved through by constant reference to the immediate environment" (L.Marks, 2002)

When addressing the concept of the haptic or haptic perception, you might be forgiven for thinking we refer only to our sense of touch. Although there is only a subtle difference, the term usually denotes the sensations surrounding touch, focusing on an examination of those qualities that can enrich our understanding of our other senses.

"the term 'haptic perception' (or 'perception haptique' in French) may describe a number of different sensory processes. Even the definition of what haptic perception in fact is tends to vary from one theory of perception to the next." (Lee, 2014)

Haptics questions the primacy of the "ocular perspective", framing our over reliance on the visual as a limiter. In turn this allows for a consideration of our other senses, specifically how they work in relation and how a study of one sense might enrich our understanding of another.

Our language already reveals aspects of this relationship, albeit to a lesser degree than is discussed in haptics; soft might denote the blurred edges of an images and loud might denote bright colour. In this way we might begin to explore surface texture as blurred, or transfer traditionally sense specific terminology to our examination of other subjects. How might a discussion of "soft anger" or "inaudible sadness" allow us to understand the subtle aspects of emotion, how might an appreciation of touch enrich sight or taste?

There is also a focus on unrestricted movement or *"a space that must be moved through"* (L.Marks, 2002) in haptics aesthetics, one which allows for a range of aesthetic considerations. By thinking about the relationship between the haptic and the idea of beauty, we can begin to explore how our senses contribute to each other in order to build a better idea of the aesthetic qualities we value. Can the way something smells, tastes, feels affect us emotionally? Can something be beautiful through the way you use it or interact with it, rather than by how it looks?

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[20] See Appendix B RNIB Braille specifications pt1

On the subject of movement through space, there is a distinction to be made between the smooth and striated. In "a thousand plateaus" smooth space is described as: *"haptic rather than optical perception. Whereas in striated forms organize a matter, in the smooth materials signal forces and serve as symptoms for them. It is an intensive rather than extensive space, one of distances, not of measures and properties."* (Deleuze & Guattari, 1980)

Smooth space is filled by events or haecceities, far more than by formed and perceived things. It is a space of affects, more than one of properties. It is haptic rather than optical perception.

At first Braille seems one of the most striated of spaces imaginable, with strict grids, size, height and innumerable other restrictions. Compare Braille to any non-tactile writing systems of any language and you will see it has less variety in form. There are no different shapes, no brush strokes dots, no significant deviation from the segmented and regimented.

Even the evolution of Braille is less organic than that of traditional language, having only changed into noticeably different forms a few times in its lifetime. The move from the "night writing" of Charles Barbier could be seen as the systems first mutation, followed by the removal of dashes in the second edition[21]. After that we have the reassigning of characters for translation: The inclusion of [2,3,4,5] as [w] being by far the most notable in English, and finally the recent move to Unified English Braille (UEB)[22], designed to unified differences in English across all English speaking countries.

These changes all have one defining factor, they were orchestrated by creators or institutions rather than being gradual. While this might be partially explained by Braille's relative youth in comparison to almost any other writing system, there is still an undeniable rigidity in form that prevents change of shape, its binary nature restricting the potential for deviation that is indicative of almost all other language systems.

Yet the very invention of UEB suggests a kind of drift, why would Braille require unification if there wasn't already significant deviation across culture and country. While form is striated meaning is not; contractions and words which fall out of use take up a potential "slot" which might better serve Braille if its meaning were changed. The restrictive nature of the six dot cell makes waste intolerable, as there is a limited number of potential dot and letter combinations, especially when we consider that the aim of contracted Braille to shorten words that are regularly used. In this way Braille linguistic evolution appears striated in regards to form and smooth in regards to meaning.

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[21] Procédé pour écrire les Paroles, la Musique et le Plain-chant au moyen de point (Procedure for writing Words, Music and Plain-song using dots) 2nd ed, Braille, L. (1837).

[22] *"The UK Association for Accessible Formats (UKAAF), which sets national standards for the industry, decided in 2011 that UEB should be the UK's official braille code."*

RNIB - Supporting people with sight loss. (2015). *Unified English Braille (UEB).* [online] Available at: http://www.rnib.org.uk/braille-and-moon-%E2%80%93-tactile-codes-braille-codes/unified-english-braille-ueb [Accessed 19 Jul. 2017].

Continuing from this, the definition of smooth as "haptic rather than optical perception" seems to apply to the way in which people interact with Braille in the strongest possible terms. Not only is Braille uniquely haptic, is it also the antithesis of optical perception, designed to be read in the complete absence of sight. Earlier on in the same passage Deleuze & Guattari define smooth space as *"directional rather than dimensional or metric. Smooth space is filled by events or haecceities, far more than by formed and perceived things"* (Deleuze & Guattari, 1980)

This once again supports the idea of Braille, and by extension the conventions of the written word, as smooth. While there is a clear structure to the written word, one that could be seen as a kind of striation where reading direction is implied by convention, these "rules" and structure give way to a natural more haptic flow, a continuous way of engaging with information. Whereas a full stop or paragraph may indicate a striated end, or a perimeter that has been marked off, they rarely read as such. They do not cut or divide the flow of information and few would argue that a paragraph does not allow for organic continuation of a text.

What can be argued is that the grammatical devices give us points in which we might leave, breaths in which we may put a book down or digest what has been just said. So in many ways Braille may be considered a striated space, but one which, much like the process of sighted reading, has qualities that are experientially smooth.

Braille has unique Haptic qualities as it is not read by touch alone. It is only through the action of running your index finger across the page that Braille can be understood, and through this tactile process Braille becomes an event. To quote Shaviro in his discussion of both Kant and Deleuze:

"Beauty is therefore an event, a process, rather than a consideration or a state. The flower is not beautiful in itself; rather, beauty happens when I encounter the flower" (Shaviro, 2009)

While the concept of "beauty as event" is not specific to Braille, there are certain qualities that differentiate it as a medium. Compare it for instance to Shaviro's example of a flower, it is beautiful only by having been viewed as such, the event of beauty being only a byproduct of the observer and the subject (i.e an encounter), rather than something wholly a part of one or the other.

Think of it as a coming together of two "societies of events" or *haecceities*, both the observer and the flower are each a loose weave cluster of events, which when they come together might be described as producing a third event in the emergence of beauty.

While the viewer is an integral aspect of this emergence, they are in many ways passive, in some ways they are merely an observer to what they perceive as beautiful, in others they are an aspect of that beauty. Yet in both cases there is a limit to how involved they truly are, it is a case of something happening to them as opposed to something happening with them.

Braille on the other hand has the capacity to be something other than this. While it may still be considered beautiful in the sense that an observer may see it as a beautiful object it may also be seen as beautiful because of the way it is felt and interacted with, bringing the haptic qualities of the medium into how it is viewed in terms of overall aesthetics. In the same way it may also be seen to be beautiful through the words it conveys, which when combined with the haptic interaction shows us a more participatory example of what it is to experience beauty. As we shall see, both traditional and artistic Braille might be seen as beautiful, but it is my hope that through an aesthetic consideration of its component parts, we might have a greater chance eliciting the perception of beauty.

It is the difference between the act of painting and the act of viewing a painting; or the difference between the act of listening to music and the act of playing it. Where one might require you to surrender to a moment the other requires you to be an active participant, in Braille you must read, think and understand to continue the story, you must feel and register meaning in your touch. Whilst a movie will continue regardless of you, a book may only carry on for as long as you engage with it, it withholds part of itself through a need for commitment on the part of the reader.

This can be seen to jar with the idea of the beauty as event, and it is Kant who describes aesthetic experience as : *"A judgement upon an object of our delight may be wholly disinterested but withal very interesting, i.e., it relies on no interest, but it produces one."* (Kant, 1793)

It is the term "wholly disinterested" which seems the antithesis of our earlier point. However, far from taking the counterpoint to Kant, the idea of beauty through active participation could be seen to be making the same point in a different way. There are times where one becomes so engulfed by an experience that they are no longer able to focus on the mechanics of that experience.

A painter may not be able to put into words how they created a piece after the event[23], and most of us will have experienced the near transcendent event of being lost in a book; where you are no longer focusing on the act of reading and yet are reading more intensely that if it were the primary focus. In short it is a kind of disinterest, but one that is only obtained through first obtaining a kind of hyper interested state.

In many ways Kant explores a version of this *engulfing* in his discussion of the sublime, focusing on the numinous and distancing this sensation from his work on beauty. While Kant views the beautiful and the sublime as distinct forces, it can be argued that the sublime is simply a different facet of beauty. Indeed for predecessors like *"Baumgarten and Meier this aesthetic*

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[23] "*It's the kind of beautiful and utterly un expected chain of transformation that painters also know: the moments when it seems one thing is absolutely certain, and then something entirely unexpected happens instead...from the artist's vantage, the moment when paint suddenly forms itself into something is always at stake—always vexed, always sudden and mysterious.*"

Elkins, J. (2000). What Painting Is. p.123

magnitude is one of the necessary ingredients in beauty" (Pluhar, 1987) neither equated magnitude with a separate experience, but rather viewed what Kant would refer to as the sublime, as an integral aspect of beauty.

While Kant's account of beauty *"is connected with the form of the object"* (Kant, 1987) his view of the sublime *"is to be found in a formless object"*. Kant states that *"We call that sublime which is absolutely great"* and in its simplest terms describes beautiful objects as having "*boundaries*" and the sublime as *"boundlessness"*.

When we apply Deleuze idea of smooth space to Kant's definitions, we may view the distinction between the bound and the boundless as a conversation about striation. More specifically its effect on our ability to comprehend beauty. Indeed Deleuze's difference and repetition is sometimes described as an attempt to read Kant's Critique of Pure Reason through his Critique of Judgment[24]

When discussing active engagement (or a state of disinterest after first obtaining a "hyper interested state"), we do so by first stating that we must transcend mechanics in order to arrive at the essence, in this way we might move from reading to experiencing. No longer is the book the boundary, instead it is bound only by the ideas and the world imagined in that book. The same could be said for playing music or painting, we go from being concerned with the form of an object to finding beauty in the formless aspects initiated by said object.

While I do not wish to state that the sublime and the beautiful are one in the same, the sublime could still be seen as the largest approximation of one kind of beauty. This in turn could result in lesser but connected experience, one which might overwhelm without necessarily having to inspire awe. While this goes against the idea that "*All sublimity involves vast magnitude*"[25] a smaller equivalent isn't inherently a contradiction, that is to say, the idea of it does not conflict with many aspects of what defines the sublime.

In "Without Criteria" Shaviro discusses the differences between Whitehead and Kant in regards to knowledge and its connection to the beautiful:

"*in every act of experience there are objects for knowledge" objects that in principle can be known. But Whitehead immediately adds that "there is no reason to assume that these objects actually are cognized, or that cognition actually is involved, in any given experience. Most of the time, it is not.*" (Shaviro, 2009)

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[24] "*For Kant, an Idea, such as God, soul, or cosmos, is at once unifying and totalizing, serving as the "focal point" under which an entire realm might be gathered. For Deleuze, however, as explored in Difference and Repetition, Ideas are completely immanent and transcendental structures of differential relations (relations between elements that are undetermined in themselves, but determined in reciprocally in the relation), elements, and singular points.*"

Protevi, J. (1999). Some Remarks on Deleuze and Kant. [ebook] Available at: http://www.protevi.com/john/DG/PDF/Remarks_on_Deleuze_and_Kant.pdf [Accessed 19 Jul. 2017].

[25] "*All sublimity involves vast magnitude; and nature, Kant says, is most sublime in its "chaos," in its "wildest and most ruleless disarray and devastation"* (Pluhar on Kant, 1987)

Neither stance is directly opposed to the idea of a hyper interested state leading to one of transcendent disinterest, but Kant's position gives a greater weighting to the role of an object for knowledge.

My own position is that there is a link between the quality of the object for knowledge and the chance of achieving a disinterested state. Not that the object itself contains any inherent beauty, but that through an aesthetic consideration of its component parts, it has a greater chance of being seen to be beautiful and eliciting the perception of beauty.

The passage goes on to state Whitehead's view that: "The inclusion of intellectual functioning in the act of experience" is in fact quite rare; "no knowledge" is by far the most usual case" once again this seems to jar with the idea of active engagement, yet it in fact only reinforced an earlier point. A state of disinterest though a state of interest, can only be obtained when we lose sight of basic function or component parts, yet continue to interact with them without comprehending those acts on a continuous level.

All of these points might seem to comment more on the idea of reading rather than the medium in which the book is read. However, much like a badly designed or poorly formatted page might remove us from the experience, a "beautiful" or aesthetically interesting medium might help draw us into this kind of euphoric state of disinterest.

In this way artistic interventions into Braille might serve as a novelty to the Braillist, a new way to experience something with which they are already familiar. It might also allow us to take some of the unique experiences connected to the act of reading Braille, and apply them to experiences in a sighted world.

Braille activates sensitive areas of the finger that are not often utilized in other mediums, and it is this sensation that is prime for exploration; it is this distinctive kind of sensation that will serve to ground the foundation for a haptic aesthetics of Braille.

"..the skin enables the organism to learn about its environment. It is the medium, in all its differentiated parts, by which the external world is perceived." (Montagu, 1971)

Humour me as you read this, take your index finger and run it lightly across a surface like a table or keyboard. Barely touch it, as if you are just trying to glide across it. Now imagine reading a full book this way, think how quickly a rough surface could feel like sandpaper, or how a sharp edge could numb you.

By playing with material we can play with the sensations a reader feels. Traditionally creating hard but very legible dots is the goal with signage, but what happens if Braille is made from sponge, or some other less rigid material? Can we create a Braille that has to be read delicately in order to be read at all? Does changing how a poem is felt change how someone feels about it?

What about temperature? Can we make pieces out of ice; that the very act of reading with a warm hand destroys? Can an outdoor sign be heated; to warm up an exposed hand in the dead of winter or too melt ice that might obscure its dots?

When considering the idea of playful or harder to read Braille, it is worth noting the role artistic interventions may play in the advancement of traditional applications. That is to say that the playful can advance the utilitarian. If we examine the previous example of heated Braille, we can see that it is distinctly utilitarian, focusing on legibility in cold weather and the prevention of ice formation. Yet the idea came from playing with temperature as a sense in an attempt to create a more pleasant way in which to experience Braille. In this way it is possible that both approaches may be developed in tandem, in the hope that the best aspects of each might influence the other.

In previous chapters I have noted the absence of Braille or the way in which it is not as widespread as it should be. Yet if we wait for Braille to be everywhere before exploring it artistically, then we will never explore it. Certainly Braille is not new, Grade 2 English Braille was completed in 1905 and Braille has been around in some form since the early 1800's[26], and in this way when questioning the need for creative examples, it is not enough to claim it a natural progression once widespread adoption has taken place. Indeed it is a driver of adoption and not a result of it.

In promoting the need for ubiquitous Braille it does not follow that we should lose sight of its aesthetic dimension, and there is a danger that we devalue the medium if we focus purely on utilitarian pieces.

Through a design led considered appropriation of the visual language of Braille, artistic exploration does not have to be shallow or merely referential. It can become a way to embed Braille into the public consciousness, bringing the medium into the world of the sighted, deepening the connection between how something is felt and the way in which we feel about it.

In the discussion of the haptic we draw parallels between Braille and the written word, we examine and indeed judge Braille by the standards of other equivalent modes of communication. Similarly in the discussion of Braille's relevance we are confronted with the variety of other mediums in which the blind may engage with information; for instance why should the blind read when audiobooks exist?

With this in mind, there seems a natural bridge towards the idea of translation, a way in which we might not only compare Braille to other mediums, but examine the connections between them. Braille is unique in its exploration of the haptic, and yet arguably other forms of communication also have the capacity to be haptic. In the following discussion of the role of translation we will see the need for a shift in register, a way of transitioning more sensitively between platforms, allowing us to explore traditionally non tactile mediums in a haptic fashion.

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[26] Braille, L., 1829. Method of writing words, music, and plain songs by means of dots, for use by the blind and arranged for them. *Paris, France: National des Jeunes Aveugles [National Institute for Blind Children]*.

In this way we might allow our eyes to wander, to view a painting in the context of smooth space to be traveled. We might touch with our eyes, or be caressed by sound, similarly Braille might be influenced by the successes of other mediums, and we might shift to a more optic register when discussing mainstream Braille or Braille for the partially sighted.

2.2: Translation: Braille as medium rather than replacement.

A discussion of translation is particularly relevant in regards to Braille: As an art form that is most predominantly concerned with allowing access, it is by the nature of both its audience and practitioners, profoundly limited in its production of original material.

While original material can and indeed should be generated in Braille, there are simply more writers of traditional language than tactile ones. Braille is also a relatively recent invention, meaning that we have far more historic texts that must be translated into Braille, and relatively few Braille texts that must be translated into other forms.

"The task of the translator, Benjamin concluded, was to render the relationship between the words of the original and a third thing that it indexes, which he called pure language, and even God" (L.Marks, 2002)

In this text Marks discusses the work of Walter Benjamin, focusing primarily on the links between the translation and the original. By examining Marks' summary as well as the original text, there will emerge a compromise that can be thought of as a translation in its own right.

In this way we might examine the connection between the two pieces in conjunction with viewing both as individual works. This connection between the pieces can be likened to the concept of "pure language" that Benjamin so often describes. This relationship will be strengthened by the addition of my own declared position as a third example of translation, as well as a document that is to be taken on its own terms, rather than being seen as an interpretation that is overdetermined by personal bias.

Benjamin looks at the inadequacy of translation, more specifically questioning the need for translation in regards to artistic works. He goes on to ask who the translation is meant for:

"Is a translation meant for readers who do not understand the original? This would seem to explain adequately the divergence in their standing in the realm of art. Moreover it seems to be the only conceivable reason for saying "the same thing" repeatedly" (Benjamin, Arendt and Zohn, 1968)

When discussing Benjamin's thoughts on translation, it is only natural that we begin to draw parallels with our own experiences of translation. With regards to my own research this centres on the unique challenges of converting non tactile work into equivalent Braille pieces.

It is worth noting that few Braille words are directly translated, with contracted forms creating word structures that would seem alien to the laymen. Yet once the "language" of Braille is understood it becomes clear that a discussion of translation in the traditional sense, is incredibly limited in scope. While symbols for grammar and phonetic pairings change, sentence structure and meaning are easily transferable, converting text into Braille is by its very nature the translation of English into English. Therefore is no need for synonyms or approximations in books that can just as easily convey the original word.

Yet this is not universally true for more utilitarian applications of Braille, with signage in particular being particularly susceptible to reductionist language and inadequate translation; in some cases this can result in signage with meaning heavily removed from the original. This kind of translation becomes even more problematic in the case of iconographs, that often infer multiple meanings that can't be adequately addressed in the single translation.

The aim of Braille contractions has always been to reduce the space Braille texts use, Braille has to be felt in order to be read, preventing the kinds of point size changes we are accustomed to with non-tactile writing. For instance a contracted or grade 2 *"Braille Bible is made up of at least 40 large books" (Rhodes, 2017).* Contracted texts are around 20%[27] more space efficient than their uncontracted equivalents, which over the course of large texts can be a significant saving. This has obvious ramifications with regards to costs, availability and practicality, all of which are vital factors in accessibility of Braille works.

Yet signage and utilitarian applications of Braille, can often bring this desire to save space to other aspects of translation; simplifying words or omitting paragraphs in order to reduce costs or to fit text into restrictive spaces. Yet this "stripping down" can have ramifications for how translations are interpreted "Fire Escape, Keep clear" can and become "Way Out"[28] and the toilet icons for "disabled bathroom" can become "accessibility", both of which have significant flaws as translations.

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[27] Durre, I. (1996). *How Much Space Does Grade 2 Braille Really Save?.* [online] Eric.ed.gov. Available at: http://eric.ed.gov/?id=EJ526012 [Accessed 8 Dec. 2016].

[28] The literal translation of the Braille sign featured here, is [capital symbol](w)(a)(y) (o) which is designed to read (Way out). However the word out should be represented by (ou) rather than (o) and while this does not majorly affect legibility, it is still an error and as such it should be noted.

Two images of a white and blue, metal Braille sign. The Braille says "way out" or "Way O" and the traditional raise text reads "fire escape keep clear".

This particular fire exit sign from Huddersfield train station, demonstrates the flaws in reductionist translation perfectly; mainly because the phrase "way out" objectively doesn't supply us with all the information we need. "Way out" doesn't tell you that this is a fire exit, and it certainly doesn't tell you not to block it, with this translation you could be forgiven for thinking that this door is just a way out of the station, and if this door is alarmed (as fire exits often are) then this sign could result in a Braille user setting that fire alarm of accidently.

Benjamin prompts us to question whether all things require translation or for whom the new transition is intended. To revisit an earlier quote *"Is a translation meant for readers who do not understand the original?*

When we apply this line of questioning to Braille it seems more profitable to look at the absence of translation opposed to examining the audience of existing translation, as on the surface of things the intended audience for tactile features is a far simpler question than the audience of translations of artistic works. If we see an absence of Braille then must we not question why it is not thought to be in need of translation? If it does not require translation, then must that fact in of itself not throw doubt upon the point of the original?

If a logo isn't translated into Braille or given tactile elements on packaging, then why is it there and indeed do we want it there? While it offers brand recognition and advertising for the brand, can it be said to enrich our lives or the experience of the product? Or does this become something more insidious, a kind of "visual clutter" an obstacle blocking important or more interesting messages? If a fire exit sign is not translated into Braille, then is it vital for that sign to be there? If the words are not seen to be so essential as to demand that the blind can read them, are they so unimportant as to harm the visual landscape of the sighted? The absence of Braille is ugly, a symptom of a system that does not hold accessibility in the regard it should be held. Yet can't it also be said that the glut of visual language in our own environments is also ugly, a detriment to our world that those unable to see are able to ignore?

I am aware that Benjamin refers primarily to artistic works in his writing, but the word "translation" in the chapter "the task for a translator" was chosen for a reason. It is within this original discussion that I find a strong link to my own work, which considers Braille both a language and a tool for artistic expression, one with its own unique characteristics.

Braille is not a replacement for traditional texts, or at least it is a replacement in the same way that audio description is a replacement for film or film a replacement for books. They are new mediums that can convey things in ways unique to themselves, while at the same time they allow a different kind of access to the original.

I concede that meaning is often lost in translation, but new aspects of that original meaning can develop through the translated form. Sometimes the original and the translation are both inadequate, and only by viewing both are we able to achieve a more holistic understanding of

the transcendent aspects of both works.

In Mark's work she talks of her distaste for the idea of unified or "pure" language, seeing the differences between translation and original as having their own merits. She sees the range of approaches not as weak attempts to imitate, but as individual expressions that often offer new perspectives. A book translated into film is often far removed from the original, yet the new medium allows a range of experiences not offered by the original. In her words: *"Difference is life; unison collapses life into death".* (L.Marks, 2002)

Yet at the same time we can view connections as the essential aspects of all connected works, this in turn can offer us a pure language heavily influenced by difference. By definition the study of connection requires an examination of surrounding works, in this way the pure language becomes reductionist, as the goal of this examination is to distil that which unifies.

Simultaneously this study becomes expansive, as it requires an understanding of difference in order to separate the similar. This in turn results in a pure language that is composed of the essential and informed by the different. As long as the resulting pure language isn't separated and presented as the essential (which would be a new translation in of itself) then this approach allows a better understanding of all aspects of the individual works, as well as a more comprehensive understanding of the whole.

My own views lie somewhere in between both Marks and Benjamins philosophies. While translation can often lose the hidden depth of the original, it is often better to view the translation as a new kind of original rather than an imitation.

It might seem trite to equate translations of books with toilet doors and fire escapes, but in many ways the arguments draw parallels. "The task for a translator" examines the loss of substance, the idea that subtlety, complexity and double meanings can be lost in the process of poor translation. In discussion of "real translation" Benjamin states that:

"A real translation is transparent; it does not cover the original, does not block out its light, but allows the pure language, as though reinforced by its own medium, to shine on the original more fully." (Benjamin, Arendt and Zohn, 1968)

I believe the intent behind translation is usually the driving factor in the success of the new work. If translation is done without consideration for the original then it can obscure the real message, creating a weak imitation rather than a true interpretation.

Following on from this, a translation created purely for utility (or one with the aim to strip the words down to their bare essentials) can remove meaning rather than summarise it. This is common in the world of public Braille, where external factors demand a reduction, rather than faithful translation of its non-tactile equivalent.

As previously mentioned Braille signs are particularly susceptible to this kind of reductionist practice, there is less space and thus we have fewer words to distil essential meaning. With translations of pictograms the exact translation is often disputable and vague, as the icon itself may hold multiple meanings. Similarly if you have to prioritise information, you can only give the reader a glimpse of the original, rather than a true sense of it.

The process of streamlining language rather than merely transcribing it, comes with a range of pitfalls. Mistranslation can result in large deviations from the original message which at their best these are abrupt but functional depictions of the original, but at their worst can create dangerous misunderstandings or omit essential information.

Yet there is often a need for translations to simplify in order to save space with utilitarian applications of Braille, especially where space is dictated by external factors like the area available next to a door.

A common example would be a disabled toilet sign, which often only features the word "accessibility". It could be argued that this translation does not adequately translate the pictogram it is a substitute for, but far more problematic is the fact that this translation can only work for as long as Braille isn't wide spread.

The omission of the word toilet is particularly telling, Braille is so scarce that when finding the word accessibility on a sign, one must assume it to be a toilet. This is despite the fact that "accessibility" should be a relatively commonplace word on signage, indeed it should feature on disabled access routes, fire escapes and lifts to mention just a few.

Sadly Braille is only expected to be in certain locations, and this has led to the omission of the word toilet as the sign simply doesn't require that kind of contextualizing. We do not need to differentiate toilets signage from non-toilet signage, as there are so few Braille signs that the word accessibility should be assumed to be a toilet unless stated otherwise.

With longer Braille pieces it is often omissions rather than reductions that become a translations biggest failing. Whereas reductions remove depth and hidden meaning, omissions can often detract from an experience in more subtle and unexpected ways.

A prime example of this kind of negative practice can be found in Pharmaceutical packaging; a medium where what is included is not so much a discussion, but an order dictated by space restrictions and legal guidelines.

Below is a box of the type I am discussing, as well as a non-tactile direct translation of the Braille that is found on it:

paraceta
-mol
500mg

caplets

There is a stark difference between the the original and the translation, with each box containing minimal Braille and huge quantities of traditional writing. I began by questioning if this was an adequate translation? But after that I started to look at aspects that might show the translation to be better than the original?

This packaging fails to make a wide range of information accessible, including but not limited to:

- Dosage (for adults and children)
- Number of caplets
- Expiry date[29]
- Possible side effects
- Storage Information
- Intended use (pain relief)
- Batch number
- Health warnings (Do not take if you have ever had a stomach ulcer, are pregnant etc..)

While it is clear that the omission of this information is very serious, pharmaceutical packaging still stands as one of the most successful implementations of Braille of all time. The fact that a blind person can take a boxed product off the shelf and know what it is through touch, is something that has yet to be equaled by any other industry. This is down to the introduction of laws regarding Braille on medication[30], and the development of a specific kind of Braille for this kind of work.

These translations are not really "true" but they work better than no Braille at all, which is one of the sad realities of this medium. The utilitarian nature of the public Braille is sometimes not beautiful, but no Braille and poorly implemented Braille is ugly.

The omission of so many details for the blind does beg one question; in an era of portable internet search engines, is this kind of information really necessary on every box? If the blind don't need quick access to it why do the sighted?[31]

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[29] *"an expiry date"* is an implicitly stated, legal safety requirements for pharmaceutical packaging. This does not extend to Braille dates. In addition *"Medicines must include a patient information leaflet (PIL) if the label does not contain all the necessary information."* This once again does not encompass Braille, though it is a legal requirement to supply an accessible version upon request.

Gov.uk. (2014). *Medicines: packaging, labelling and patient information leaflets - GOV.UK.* [online] Available at: https://www.gov.uk/guidance/medicines-packaging-labelling-and-patient-information-leaflets [Accessed 24 Jul. 2017].

[30] *"All medicines must have the name of the medicine displayed in Braille on the labelling."* Gov.uk. (2014).

[31] It is worth noting that pharmaceutical companies have a requirement to supply PILs (*patient information leaflet*) in accessible formats on request. However this information is not supplied with the packaging by default, allowing for a much slower kind of access; one that could be argued is equivalent to searching for an e-reader accessible version via a search engine.

"You *must make you [sic] PILs available for blind and partially-sighted patients"* Gov.uk. (2014).

Ask yourself how often do you read the fine print? If you buy the same product on a regular basis, then you may read the details once and then probably never look at them again. If you have an allergy you will look at an ingredients list, but wouldn't it just be easier if stores supplied "allergy shopping"? Lists which allowed you to remove foods with certain ingredients from your "virtual shelves".

Or perhaps in-store labels that show "contains nuts", "gluten free", vegetarian, vegan etc...? We already see this on restaurant menus, so why clutter packaging with all this information when one symbol would do? If we rely on very basic information on products, and use external platforms like websites to check ingredient lists of specific brands and products, do we lose anything?

Ultimately that is how the blind have to work with products, they either rely on assistance in shops, or use websites to find out more about a product. It could still be argued that most of these omissions are unacceptable, but thinking of Braille in terms of non-tactile writing can allow you to decide that for yourself.

Think for a moment, then ask "what is the most basic information we need to be able to read on this product", that information is the least amount of Braille that should be on that product.

Four Images of a paracetamol box, showcasing the large range of traditional written information on both the box and the patient information leaflet (or PIL) inside that box.

Two images of blank paracetamol boxes, only featuring the words (paraceta-mol 500 mg caplets) as these are the only words featured in Braille on traditional boxes.

To illustrate this we have removed all information from a paracetamol box. Then we translated the original Braille into non tactile lettering. While we have already outlined the scarcity of Braille on pharmaceutical packaging, there is another aesthetic dimension to this kind of reductionist design; one that is better illustrated through functional examples of packing.

Taking all information off boxes is an extreme example, one more designed to make you think than be a real commercial proposition. But there is clearly too much text on some products, and there is an interesting visual language that emerges when we translate Braille back into non tactile writing. The removal and omission of words can be dangerous, but if we treat this translation as all the information anyone needs, then we can de-clutter our visual landscape and potentially create a more streamlined approach to design.

This work highlights the glut of type in our visual landscape, the scarcity of Braille and the inadequacy of some translations. But hopefully it shows that there is a beauty in simplicity, and that the design considerations used to create Braille, can influence how we create other work. This is just one way in which designers might "adopt" the visual language of Braille, using its design ethos to create products for a sighted world.

Moving away from pharmaceutical packaging we can begin to think about examples of "ugly omissions" in other contexts. What if we were to leave out the bibliography of an academic paper in a Braille version? Even if it was not translated due to costs rather than any kind of malice, we can still see that the translator has assumed something about the reader. Namely that a blind person could never be engaged enough in the work to look for further reading.

This might not be the intent of the translator, but on the outside looking in, it is what it appears to be. Thoughtless translation is dangerous and very rarely successful, something that is also true of thoughtless translation in artistic works.
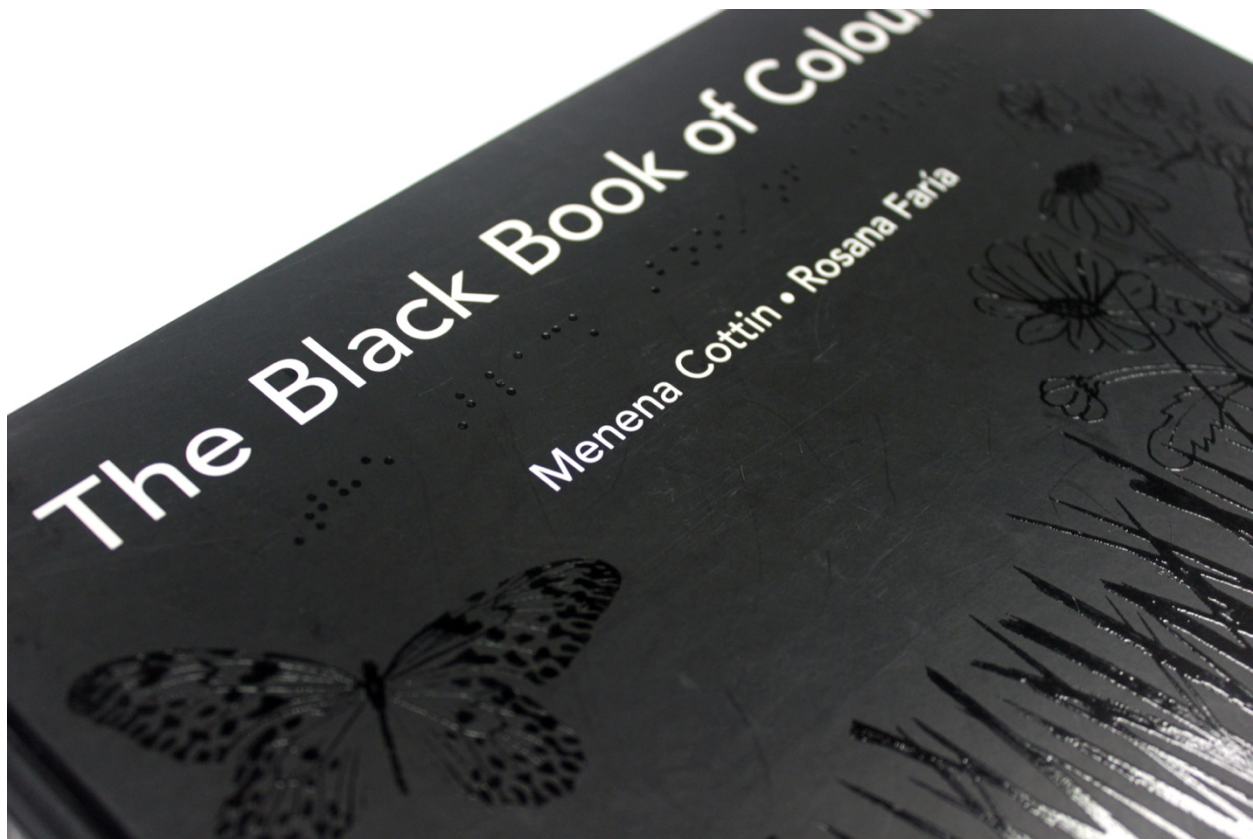
An image of "The Black Book of Colours" front cover, it features the title of the book in both "gloss" Braille and traditional non-tactile text. It also features the authors names in traditional non-tactile text, and a range of tactile illustrations including a butterfly and cut grass, these are printed in a clear gloss on black, making them hard to see in order to encourage the audience to rely on touch instead of sight.

Menena Cottin's and Rosana Faria's "Black book of Colours" (2010) is a seminal work in the area of artistic and expressive Braille. It is the book that introduced me to the world of tactile writing, and as such I have a particular fondness for it. Approached more objectively, however, from a disabilities studies perspective, it must be acknowledged that there are serious flaws with the design of the piece. In this sense, I will be presenting it as both an example of good and bad practice in the field.

I should also note that the book is referred to as an "introduction for sighted readers" and in that way some of our criticisms may be seen as unduly harsh. But it is necessary to address these flaws, as I will ultimately go on to use the book as an example of best practice in the field. It is difficult to fully explore what it does well, without first discussing where it falls short.

The first "translation omission" can be found on the front cover. The book has the title written in Braille but not the author and illustrator's name. Future pages do go on to state their names but it still feels like something that should have been included, especially since both names are featured in traditional lettering.

Similar omissions occur when the name of the publisher is not translated on page one, and in the final pages which include publication information, website information and a brief summary of the artist's backgrounds, contain no tactile elements. On top of that the reviews and summary on the back of the book also have no Braille equivalent.

I am aware that this book is not intended for the blind, and to be honest the Braille itself is not actually high enough to be read by a Braillist (as it is far lower than even Pharmaceutical Braille). But the book still presents Braille as "readable" by the nature of its formatting. By including Braille alongside visual text but separate from illustrative tactile elements, we see a clear distinction drawn between word and image. Were it not for the small disclaimer on the back of this book, there would be no way for the laymen to assess the viability of the Braille. It is my opinion as a designer that the Braille text was deliberately designed to *look* legible.

An image of a page in "The Black Book of Colours" it shows more tactile illustrations this time taking the form of leaves, with text and gloss Braille clearly separate on the opposite page.

Assuming a non-sighted person were able to read this book, then height would not be the only issue. Sadly, there are other omissions that give unintended negative messages. Namely that a blind person would never need to reference this book, they would never need to read the reviews or even identify the authors via the cover. If we consider the book as something only intended for a sighted audience, then these omissions might become understandable, though still not completely excusable, yet the fact still remains that the Braille not being legible by touch is the book's biggest failing.

An image of a page at the back of "The Black Book of Colours" it shows a Braille Alphabet that does not include grammar and punctuation symbols.

At the back of this book there is a page on the Braille alphabet. Even if we assume that the budding Braillist would be learning to read Braille by sight alone, there is still one major issue with this translation. The Braille alphabet does not feature grammar, but the main text does. This means that on the same page the title "Braille Alphabet" cannot be translated effectively by the alphabet provided, as the symbol for capitalisation has been omitted, and extends to other punctuation like commas and full stops.

It is hard for this review to not come off as an attack on the piece itself, but it isn't intended as such. It is simply meant to illustrate the ramifications of omissions in artistic translation. The height of the dots and the lack of Braille on certain pages, gives us the impression that the letters have been treated as illustrations as opposed to text.

Yet to all intents and purposes the book portrays itself as something to be read, even giving the reader a translated alphabet to try and read with. Many aspects of the book have been considered in great depth[32] and are incredibly successful, but due to the Braille's height and certain important omissions, aspects of the translation can be deemed to be thoughtless.

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[32] For instance, the book is landscape rather than portrait, and much wider than it is tall, this simple change accommodates Braille far better than traditional book formats. Yet the reduced height still allows for the portability of traditional books, something which tends to be lacking in Braille texts which are often cumbersome due to their necessarily increased size.

I will go on to talk about this book in more depth later on, mostly extolling its virtues. But I personally believe that the book would be more successful with complete Braille translation and Braille of the correct height. Indeed it could be said that the piece would be a stronger poetic statement if it was more functional, as it would not only be more inclusive, but it would be a better "introduction to the sighted" for those wanting to learn more.

One final note about the place of Braille as a medium before we move on. As a form of translation it is by no means alone, it is part of a rich landscape of translation methods. Braille exists amongst audiobooks, web-readers and a string of other aids. Each can integrate themselves within a user's day to day lives without conflicting with one another, and each can have a different impact on the user.

A range of smaller but parallel solutions, is almost always the most productive way to create for the disabled, choice and variety can give a kind of freedom, and lead to a better acceptance of the aid.

In addition the combination of many translations, might help create a kind of "true version" of the original. It is possible that non visual translations of colour, might give all of us a better understanding of it. With this approach we can see mediums for the blind not as weak imitations, but as new empowering ways to experience the world. Experiences which the sighted as much as the visually impaired might benefit.

A version of this idea can be expressed in relation to critical realism:

There is a distinction in certain branches of epistemology, where by the primary natures of objects (motion, solidity, number etc..) are viewed as intrinsic values of said object(s), while secondary natures (taste, colour, smell etc..) are categorised differently, requiring an observer.

"I think that tastes, odors, colors, and so on are no more than mere names so far as the object in which we locate them are concerned, and that they reside in consciousness. Hence if the living creature were removed, all these qualities would be wiped away and annihilated"
(Galilei, 1957)

So while critical realism still requires the realist belief that existence does not require an observer, there is still an understanding that some aspects may be dependant on the perceivers interaction. For example Roy Bhaskar who is often credited with initiating critical realism, offers a solution to the question *"if a tree were to fall in a forest and no one were there to hear it, did it really fall?"*

"If men ceased to exist sound would continue to travel and heavy bodies to fall to the earth in exactly the same way, though ex hypothesi there would be no-one to know it" (Bhaskar, 2008 [1975])

In this way we can understand that critical realism takes the ontological position that things

exist. However this is not the primary focus of critical realism, instead it *"is concerned with the nature of causation, agency, structure, and relations, and the implicit or explicit ontologies we are operating with." (Archer et al., 2016).* Critical realism wishes to examine the connections and interactions between objects, for instance:

"A is always followed by event B; but in order to do this, we require a thick and robust account of causation, structures, and processes which is able to do justice to the complexity and heterogeneity of the social world."(Archer et al., 2016)

This in turn gives us a kind of holistic understanding, one brought about by the amalgamation of many different perspectives. There is the fundamental understanding that no single perspective can fully encapsulate the true essence of a thing, which in turn posits that even amalgams will not have a complete picture, due to the absence of even a single perspective.

In a way critical realism could be said to parallel Walter Benjamin's "pure language" where an understanding of many translations allows for a more holistic view of the essence. But while Benjamin talks primarily on translation, critical realism tries to apply this in broader terms, such as entire schools of thought.

With this in mind we might posit that Braille offers a kind of unique perspective, one that gives us insights and experiences that can only be understood by an exploration of Braille as medium. Similarly those with disabilities might offer understandings unavailable to the rest of the population, the deaf may understand sound purely in terms of vibration, and the blind may understand colour through abstract concepts and association.

We might also link both critical realism and Benjamin's work on translation, to the Derridean concept of différance.

"Derrida's argument against the false privilege of presence, against delusive certainty that representation is secondary and somehow inessential, against the unfounded belief that the domain assumptions of our culture are as natural as cold in winter and warmth in summer." (Boyne, 1990).

In deconstruction we see the dismantling of traditional paradigms in favour of a more considered and moderate approach. We see Derrida's concern centred on the idea of "false privilege, where *"One side of each opposition has a presumed privilege over the other"* (Boyne, 1990)

To note just a few examples, we see that reason is favoured over passion, words over pictures and most relevantly to this thesis, we can see that sight has privilege over touch.

Différance is integrally connected to the concept of deconstruction, but rather than asking us to examine an opposite, Derrida uses différance to state that any term implies its antonym. *"According to Derrida we have no access to reality except through concepts, codes and categories, and the human mind functions by forming conceptual pairs such as these." (Prasad,*

2017). For instance strong implies weak, and good implies evil. Similarly there is a connection to other terms that contextualise a word in wider language.

Or if we take another example, a home is distinct from a shed partly by its purpose, and from a mansion partly by its scale. In this way every word we say comes with a complex web of connected terms and none can be truly understood without a more fundamental understanding of the context in which word and subsequently the language, is rooted.

Pure language looks to distill an essence, critical realism looks to better understand a position through an examination of its context, and deconstruction attempts to bring the antonymous to the fore, in order to gain a better appreciation of both aspects of a conceptual pair.

Collectively they all share the position that an individual perspective does not allow for complete understanding, and to obtain a better understanding of any one subject, we must first obtain a more holistic view of the subjects broader context.

In regards to disability aids, we might view them a way to further contextualise relevant tangential fields. In this way Braille could bring new notions of haptic aesthetics to fields like surface pattern or textiles.

Similarly the privileged position of the abled over the disabled in certain fields, could be seen as perfect examples of where Derrida's theories might be applied. What can those who have no visual understanding of colour bring to the conversations on tone or hue? How might the deaf help us better appreciate music? What can the less mobile teach us about how we navigate an increasingly fast paced word?

Chapter 3: Stigma & the profile of Disability aids

"The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." (Mace, 1985)

"Design for ALL is design for human diversity, social inclusion and equality." (The EIDD Stockholm Declaration, 2004)

The idea of universal design is not a new concept, but originally the term was closely associated to architecture. The movement pioneered accessibility, with the aim of allowing older or mobility impaired users unhindered access to public space. Those involved championed legislation, mostly around access and opened up streets[33], civic buildings and a range of other public areas. Many who had previously been shut out of those spaces found themselves able to once again access the world, and it allowed them to claim back their sense of belonging. In the words of Napolitano (1996)

"Being able to use the environment is about more than being able to 'get about'. At a deeper level it is about a sense of belonging. Until the environment supports mobility impaired people's participation with dignity and pride intact, this sense will continue to evade them."

3.1: Disability Aid Stigma & Difference Within Universal Design

Since its conception the term universal design has begun to take on new meaning, and is now applied not just to spaces but to objects. The idea of a universal product might seem at odds with Laura Marks *"Difference is life; unison collapses life into death"*. But at its best a universal product is more than just a single object, it is something fluid and adaptable, it offers a range of approaches that cater not to the user but to the individual.

"If I can no longer operate the keyboard, I'll switch the computer to speech mode. Or use my finger on the monitor" (Herwig, 2008)

Even at its most basic universal design removes a single barrier to use, and despite the fact that an easier to hold pen does not cater to those unable to hold, there is still something admirable in this approach. Inclusive design may be a more accurate term for this way of working, where every effort is made to decrease difficulty of use while still considering a desirable aesthetic.

In his book "Universal Design, solution free barriers to living" Oliver Herwig openly discusses the limitations of a universal approach:

"The future will not be won with more equipment and more intelligent features, but with products that make life easier. Perhaps you are thinking about walking sticks, wheelchairs, or so called

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[33] Notably Selwyn Goldsmith is credited with the creation of the "dropped curb" which is now a common accessibility feature of streets around the world.

monkey poles. But I am not. Medical supplies design will remain a specialised niche even in the future". (Herwig, 2008)

While disability design is certainly niche, it could be argued that designers across all disciplines are uniquely situated to address the field. The basic requirement for designers to understand their audience creates an empathetic, understanding and creative breed of professionals.

I concede that expertise is required to understand the field of disability design, but it is not necessarily the case that "medical supplies" are any more specialised than any other area of product design. The most successful approaches to disability aids have removed the label of "aid" all together, and with that in mind the idea of hearing devices worn for fashion or wheelchairs sold for leisure, are not as unlikely as they first sounds.

3.2: The Tensions Between Fashion & Function

"Eyewear is one market in which fashion and disability overlap. On rare occasions that the words design and disability are mentioned in the same breath, glasses are often referred to as the exemplar of a product that addresses disability, yet with little to no social stigma attached. This positive image for disability has been achieved without invisibility" (Pullin, 2009)

Pullin discusses the tension between fashion and function, as well as exploring the idea that fashion can remove the stigma from disability aids partly by bringing it into the mainstream. Glasses are arguably the most successful disability aid, yet in an era where other more discreet options are available (contact lenses, laser eye surgery etc..) why are they still so often the preferred option?

Glasses are accepted not because they are discreet, but rather because they are not. Fashion brands across the globe have addressed glasses as desirable objects, so much so that some brands report up to 20% of their glasses are bought with clear lenses.

"up to 20% of some brands glasses are purchased with clear nonprescription lenses" (Pullin, 2009 on "Ibid")

If we compare the success of glasses to hearing aids, then it becomes apparent that there is stark contrast between their respective public image. Where fashion has pushed one aid forward, discretion has allowed another to stagnate.

By all accounts hearing aids should have been far easier to integrate into the mainstream. Not only they are less intrusive than glasses, but ear based fashion items have been commonplace since the modern hearing aids conception (Earrings, headphones etc…).

Yet like many aids they continue to be stigmatised, with few seeing them as anything but a medical device. There are a plethora of reasons one might opt to not wear a hearing aid, ranging from discomfort to the commonplace audio feedback; something which creates a high

pitched whistling noise that the wearer often doesn't notice until it is highlighted. But with two thirds of the hearing impaired opting not to wear them, there is obviously a bigger problem in play.

"Sergei Kochkin has documented through his MarkeTrak studies that the market penetration of hearing aids is approximately 25%... 75% of people who have hearing loss but do not want/use hearing devices." (Sanford MJ, Anderson T, Sanford C, 2014)

Hearing aids have a medical association, the very name "aid" speaks volumes about how they are currently perceived. They are heavily linked to aging and many who need an aid fear that wearing one will be seen as a lack of capacity.

"One element of stigma is the fear that people with hearing loss are seen as less capable (RNID, Hidden Crisis, 2009). A 2005 Mori Poll of more than 2,000 people showed that almost a quarter (22%) are worried that people would think they were getting old if they wore a hearing aid. One in five expressed concern about being treated differently." (Action on Hearing loss, 2011)

Age association is an undeniable reality of the world we live in, as the majority of people who need hearing aids are elderly[34]. On top of that they are by far the most common user group that the general public will come in contact with. Many of us will know multiple older people with hearing aids, but far fewer of us will know a teenager with one.

This is intrinsically linked to the problem of the "medical aesthetic", where aids are designed only in terms of utility and cost. The aids themselves start to become "ugly by association" as they are linked to medical environments and used by those in vulnerable positions. Using that aid starts to be connected to a lack of capacity and at its worst can start to equate disability to illness. In other words disability starts to be looked upon as something to be cure or treated, rather than an accepted aspect of someone's identity.

"The equipment would be marketed to health or social work services, and would be designed mainly for use within an institutionalised setting, such as a hospital or care home." (Clarkson, 2003)

"Its utilitarian chromed construction became more reminiscent of hospitals, where tubular metal remained prevalent for hospital beds and trolleys, IV stands and crutches, and thereby reinforced the medical model of disability as a condition to be cured." (Pullin, 2008)

It might be suggested that the same problems can be linked to "public disability aids" like Braille signage. If Braille is only seen in areas that no sighted person would enjoy touching (like toilet

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[34] In the UK there are an estimated 11,043,000 people with hearing loss. Of those 9,859,000 are over 50.
(Action on Hearing loss, 2011)

doors and hygiene areas) then it may start to become associated with a kind of uncleanliness. If the few signs that are available are in harsh or "ugly" materials like ball bearings or etched plastic, then we perpetuate the idea that inclusivity has to look like this. If Braille is "tacked on" or signs are poorly adapted, then we end up in a situation where accessibility is associated with "negative interventions" and the general public start to think of it as something that robs a space of its original beauty.

Ultimately bad adaptation make the concept of accessibility ugly by association, and as much as a personal aid can reflect poorly on the individual, public aids have the ability to reflect poorly on the entire user group.

"When adaptations are made to them (Victorian buildings) without any consideration of the extent to which they are in tune with the environment, they reinforce associations of disability as something which cannot be harmoniously included into the 'able' world." (D.Marks, 1999)

3.3: Overcoming stigma through mainstream adoption:

If disability aids makes someone feel alienated or in somehow less, then they may be deterred from using that aid. This is something that is commonplace across many areas of disability design, but it is slowly being overcome in a variety of ways.

With the success of glasses a culture of "fakes" has emerged. With this in mind we can posit whether the opposite could be true; could encouraging the use of disability aids by users who do not need them, benefit those who must use them?

At first this feels like quite an unsettling question, it is natural to feel uncomfortable at the idea of someone faking a disability. However if we examine the question more closely it isn't as clear cut as it first seems. There are multiple ways in which we might use a disability aid without claiming to be disabled.

One example is the inclusion of able bodied athletes in disability sport. *"Wheelchair basketball is one of the few Paralympic sports where able bodied players are allowed to compete up to Paralympic level"* (Wheelpower.org.uk, 2016).

This kind of long term inclusion of able bodied athletes at all levels, helps keep the sport alive and dramatically increases the available number of players. To give you an idea of just how important able bodied inclusion is to the sport, we must examine the size difference between the able bodied market and the wheelchair user market. When looking at able bodied adults who play sport in the UK, we see that:

"55.8% of 16-to-25-year-olds take part in at least one sport session a week, compared to 32.4% of older adults" (Sportengland.org, 2015)

Compare that to the percentage of those with a disability actively engaged with a sport:

"Figures from our Active People Survey released on 10 December 2015 show that 1.58 million people aged 16 years and over with a long term limiting illness or disability (17.2%) played sport once a week." (Sportengland.org, 2012)

Now add that to the fact that less than 8% of those with a disability use a wheelchair, somewhere *"between 640,000 and 750,000"* (Audit commission, 2016).

The exclusion of able bodied athletes would dramatically limit the amount of players, and this in turn would reduce the opportunities for those disabled athletes that wished to play team sports. As one disabled athlete put it:

"...sheer numbers of players are a problem: You need at least ten players (more realistically, fifteen to twenty) to actually run a match between two teams. Excluding nondisabled players from consideration, this amounts to digging up at least ten people who are (a) disabled, (b) wheelchair users, (c) athletes, (d) interested in the game in the first place, and (e) close enough to tourney and practice sites to actually participate." (Clark, 1996)

That is not to say that wheelchair sport is all inclusive, not everyone believes that the able bodied should be allowed to participate. This is especially true of individual sports like wheelchair racing. In 2002 Daniel Sadler was asked to return winnings from the London Marathon when his status as able bodied was "discovered". At the time the organisers hadn't realised he was not disabled, but nor had anyone asked Daniel if he had a disability. In the words of the organisers *"We'd assumed that anyone in a wheelchair must be."* (Vallely, 2002)

Kevin Baker the chair of the British Wheelchair Sports Foundation at the time, warned of the dangers of including abled bodied people in the sport: *"In a decade disabled people begin to feel at a disadvantage. They would find they had lost one of their few sports."* (Vallely, 2002)

In truth a lot of people feel this way, but many view able bodied participation as a sign of the sports acceptance as a "proper sport". Tanni Grey-Thompson was the chair of the British wheelchair racing association at the time, and had won four Paralympic gold medals for wheelchair related sport. Her comments were decidedly more positive:

"It's about whether wheelchair racing is a rehab thing for poor disabled people or a proper sport."

She goes on to talk about the "BWRA"'s policy on able bodied participation, and notes that being able bodied is by no means a clear advantage for wheelchair racing.

"The BWRA more than 10 years ago decided it wasn't a problem for an able-bodied person to participate, she says. "People assume Dan has an unfair advantage. In fact there is none at all. He may have stomach muscles that work, but he's carrying more weight, he gets cramp in the legs, and he makes a less aerodynamic shape." (Vallely, 2002)

A similar conversation can be had around wearing hearing aids for fashion. While actually wearing the technology would be very expensive, wearing headphones designed to look like hearing aids wouldn't add a significant extra cost.

What if headphones were released with a headphone and hearing aid version? This in turn gives two target audiences, the hearing and the hard of hearing. There is a clear link to those who have listened to loud music for a large portion of their life and those with hearing loss. If there is no aesthetic difference, it would allow an aid to be a fashion statement, while still offering the kind of discretion users clearly want.

The same approach could be applied to ear plugs or jewellery, and once hearing aids have developed an aesthetic different from the "medical" version, then the industry can begin to develop its own unique visual language.

Hearing aids that are designed to be compatible with i-phones are already on the market, with the apple website listing 45 compatible sets: (Apple Support, 2016)

It is somewhat telling that apple are the ones leading in this field, as they have been moving into the "health industry" for some time. Their focus on accessibility across all their products, their newly released wireless headphones (airpods) and the fitness marketing surrounding the apple watch, make them perfectly positioned to tackle this market.

On their website Apple talks about the role it has had in the development of these products:

"Apple has worked with top manufacturers to create hearing aids designed specifically for iPhone and iPad... Glance at the battery status or change the left and right volume, together or separately. And quickly apply your audiologist's environmental presets as you go outdoors or enter noisy locations, like restaurants, without having to rely on additional remotes." (Apple (United Kingdom), 2016)

Other companies, such as Boss have gone one step further, and brought their own brand of hearing aid to market[35]. In this way it would not come as a surprise, if Apple were to release its own brand of hearing aid. They have the funds, the relevant professional expertise and more importantly the drive to do it. If we look at google glass, the apple watch and the amazon echo they all have a few things in common. They are all projects by the biggest players in the tech industry, they all have health and disability applications and they all generated large amounts of positive publicity for their respective company. More importantly for apple, is that they have the status as a style icon to turn their trademark white casing into the new visual language for hearing aids.

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[35] Boss "HearPhones (combination headphones and hearing aids)

There is a profit to be made by applying technological advancements to other industries. Indeed the subsequent technical innovation the development of these devices can create, can often make them worth investment. Think of it in terms of formula one, not only do these events advertise car brands, but many of the advancements that pushed the sport forward, have later become commercial applied to mainstream car manufacturing.[36]

In this way getting a clearer sound out of a hearing aid might transfer well to getting a superior sound out of a headphone set[37], or developments in voice recognition might lead to better subtitle generation. The hearing aid industry doesn't have to be lucrative for apple, as long as the technology and advertising of the product filter into the rest of their business.

My area of expertise is Braille, and although my desire, ultimately, is to see it achieve mainstream adoption it isn't quite as easy to "adopt" as a pair of glasses or a hearing aid. Braille must be learnt, it takes time, patience and a range of unique skills. Even the act of writing Braille requires specialist equipment and we must concede that unless you will be working with the visually impaired, there is little need for most people to pick up a slate and stylus. However Braille's "aesthetic language" might be far easier to adopt, and thus be a more viable avenue for the medium to achieve widespread adoption.

By increasing the visibility, variety and quantity of public Braille, we might push the medium to the fore of public consciousness. In this way professional and to a lesser extent public engagement can dramatically increase the profile of Braille.

Through creative projects that use Braille as a medium, artists and designers can push Braille in ways that go past simple legibility and availability. Creatives can look at Braille in ways that many can't, by treating it as its own unique art form we can bring some of the experiences it offers into the mainstream. An understanding of Braille and the ways it is applied, might lead to advancements in other areas like tactile illustration, surface pattern and many other products that can benefit from a better understanding of the haptic.

Whether it's wheelchairs for sport, hearing aids for fashion or Braille as pattern design, any disability aid can benefit in some way from adoption by non-disabled users. Access to aids, product development, reduced unit cost and a string of other well established reasons, dictate that the more people use a product the better it will become over time.

Disabled users are a very small percentage of the population, and if we confine these products and mediums to those niches, then they will either stagnate or die. Wheelchairs have benefited

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[36] *"Jaguar's groundbreaking work on disc brakes for its road racing in the 1950s"* in addition *"F1 cars are now more like road cars than ever, particularly when it comes to fuel efficiency." to name just two examples of the industry's influence.*

BBC News. (2015). F1 tech still shaping tomorrow's transport - BBC News. [online] Available at: http://www.bbc.co.uk/news/business-31096844 [Accessed 25 Jul. 2017].

[37] This is especially true of directional sound and changing levels of background noise. *"they will actively suppress noise and the added directionality will make a real difference in noisy situations." (Hearing Aid Know, (2017)* on Boss "Hearphones" combination hearing aid and headphone.

greatly from advancements in the bicycle industry[38] and hearing aids may benefit from their continued integration with headphones[39]. But if we rely on these external forces as our only source of research and development, we will begin to see unsuitable or impersonal disability solutions.

If wheelchairs are only developed through their association with sport, then they will not always be suitable for older or less athletic users. The tastes of a 90 year old woman may differ dramatically from that of a 20 year old Paralympian, and both might want something a little less "racing" based for day to day use.

Braille is being pushed forward by the print and tech industry, with tactile displays, 3D printing and raise UV print becoming an integral part of how we produce Braille. But all of these are manufacturing processes, and if Braille is not approached artistically then all we will see is a new generation of utilitarian examples emerge.

If Braille is only created to prove that the technology can create dots, instead of looking at how new production methods might push the medium forward, then we are doing Braille a great disservice.

We are being given tools and it is up to artists and designers to apply those tools. By treating Braille as both medium and end goal, rather than an accompaniment or test sample, we can push it forward as a thing of beauty rather than necessity or legal requirement.

3.4: Disability Aid Profile: Fashion vs Discretion.

The conversation around fashion vs discretion is well documented in the field of disability design. I have already discussed fashion to an extent, but there is a need to elaborate on the ways in which it could progress the industry in the future. I will also compare the merits of the approach to discretion, and discuss how both could benefit from professional engagement.

From my perspective, I view discretion as the least useful half of the conversation, but to argue that it doesn't have a place is to reject both the reality of people's lives and the reality of many devices functions. While hearing aids might benefit from becoming mainstream, it would naive to think that every individual would welcome the approach. To take it to its extreme, not everyone would want to make a fashion statement out of their colostomy bag.

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[38] *"Composite manufacturing has progressed significantly of the recent years, becoming more accessible in the commercial market what was once the reserve of the aerospace industry. For the manufacturing of a wheelchair frame, the bicycle industry offers some viable options." Deans, C. (2017)*

"Bicycle - Wheelchairs 1881 - pushrims were added for propulsion, 1900 - wired spoked wheels adopted by wheelchairs, 1912 - 1 3/4 horsepower engine was attached to a invalid tricycle, 1916 - London produced first motorized wheelchairs….Suspension (bicycles)" (Wheelchairnet.org, 2017)

[39] Boss "HearPhones (combination headphones and hearing aids), Nuheara's earbuds (headphones that integrate hearing aid features) and Apple's continued integration of their own products and hearing aids.

Yet discretion is not always needed, and indeed is not always positive. Glasses succeeded because they could not sink into the background, and many of the advances in prosthetic limbs have come from a rejection of realism.

"This is where it really hit home for me — that my legs could be wearable sculpture. And even at this point, I started to move away from the need to replicate human-ness as the only aesthetic ideal" (Mullins, 2009)

Among other things Aimee Mullins is an athlete who has competed at the Paralympics. Her talks are well documented and her conversations around prosthetic limbs talk extensively about the role of fashion and identity. Her talks are unique to prosthetics, and she states that:

"It is no longer a conversation about overcoming deficiency. It's a conversation about augmentation."

This is something which features heavily in personal aids yet relatively little in public aids. But at its heart this progression from "deficiency to augmentation" is directly linked to the public image of the prosthetic. Something which might benefit public aids greatly.

Mullins original TED talk explored her "cheetah legs" and the role prosthetics had played in her Paralympic career. This talk was more about her journey, but it lead to a wealth of opportunities with designers like Alexander McQueen, who actively sought out Mullins in order to design limbs for her.

Famously Mullins walked down the runway on a pair of hand carved wooden legs, and has appeared in the art film "Cremaster 3" playing six different characters each with dramatically different legs. These ranged from fully transparent plastic to legs that looked like actual cheetah limbs (a nod to the iconic design of the running blades she is known for).

Her second talk explored the theme of acceptance through mainstream, as well as a shift in how we approach disability conversations. Her experiences as a model and an actress has moved her away from this idea of functional or realistic, and had allowed Mullins to see fashion and sculpture as an integral part of her identity. The fact that she is able to slip into 12 different pairs of legs, allows her a greater range of flexibility than most people, even allowing her to change her height to match the occasion.

However one section of her talk speaks about acceptance more than any other, namely her conversations with children. Mullins requested time with the children on their own, so that adults couldn't tell them that a comment or question was inappropriate, allowing them to be more creative and honest with their enquiries. She opens with the question:

"I woke up this morning, I decided I wanted to be able to jump over a house — nothing too big, two or three stories — if you could think of any animal, any superhero, any cartoon character, anything you can dream up right now, what kind of legs would you build me?"

After a string of answers one girl eventually asks, why would you want to jump over a building…
why wouldn't you want to fly. At this point Mullins relays her epiphany, she realised *"It is no
longer a conversation about overcoming deficiency. It's a conversation about augmentation."*
These children didn't see her as disabled, they saw her as super human.

3.5: Perceptions & Self-Perceptions of the Disabled

At this point it is worth noting that the celebration of the "super human"[40] aspects of
Paralympians, is not without issue. Those with severe difficulties caused by their disability can
have unrealistic expectations thrust upon them, while those with ability might have an opposing
pressure to excel in order to "make up" for those who can't.

This problematic idealising of disability, is reflected by the recent coinage of the term "supercrip"
a term deliberately loaded to feel uncomfortable. It is the kind of "defiant naming"[41] that
sometimes surfaces in communities confronting unique problems. The term is not intended to
be pleasant, but it should be regarded as an attack on a concept or collection of mis-
conceptions, rather than being aimed at a specific individual or group[42].

The pitfalls of seemingly positive conversations; as well as the opposition that arises from those
pitfalls, are worthy of note. While we may explore the virtues of a positive public image for both
disability aids and users of those aids, it should be a conversation tempered with an
understanding of the potential hostility that can arise, especially from communities that may
reject positive "spin". Those with hearing aids may not welcome adoption for fashion and
conversations on augmentation may seem mocking to those whose aids do not allow them
equivalent ability to a non-disabled user.

*"People -cripple or not - wince at the word cripple, as they do not at handicapped or disabled.
Perhaps I want them to wince. I want them to see me as a tough customer, one to whom the
fats/gods/viruses have not been kind, but who can face the brutal truth of her existence
squarely. As a cripple I swagger"* (Mairs, 1986)

The idea of augmentation might be addressed as a way to enable conversations on disability
aids, yet at the same time it isn't something that can be easily applied to every aid, indeed it
might seem particularly irrelevant in regards to Braille. However the change in perception from
an aid to something that makes you powerful, amazing or even beautiful, is a point that could be
directly applied to almost any aid both public or personal.

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[40] The title *"We are the superhumans"* was one of the slogans for the (London 2012, Paralympic games).

[41] *"Defiant self-naming"* p.146 (D.Marks, 1999)

[42] Confrontational naming of others or a concept of others is not without president. We see those on the autistic spectrum, referring
to the non-autistic as "Neurotypical", and those in the transgender community using cisgender or cis normative to reference those
who identify with the gender identity they were assigned at birth. While neither are implicitly negative terms they can certainly be
said to be confrontational, and both are used in a negative context similar to that of "super-crip".

If we move away from Mullins and look at the landscape of Olympians as a whole, we see that the prosthetics at the Paralympics are clearly not trying to camouflage their owners disability. Few would argue that these objects are stigmatising or ugly, and indeed the profile of individual styles like the running blade have allowed them to be instantly recognised by many of the general public.

Many disabled athletes have obtained a degree of celebrity status - numerous high profile magazines approach Paralympians, to participate in risqué editorials, which are designed to show an athlete not only as beautiful, but as the peak of physical fitness. It is worth noting that while some of these athletes have posed with a disability aid, many have opted not to use their aid in shoots, or simply do not use an aid at all.

We could draw parallels between these choices and conversations around glasses and hearing aids, there seems to be a trend towards athletes with certain kinds of disabilities embracing certain aids as "part of themselves". In contrast other athletes opt not to use any kind of aid at all[43]. Where one aid might flourish because of its connection to celebrity, another might be stigmatised because of a celebrity's choice not to use one.

Wheelchairs, running blades and aids that feature in the athlete's sport, are often pictured in these kind of shoots. Whereas prosthetic arms are much rarer, as there are fewer sports where this kind of prosthetic won't be a hindrance, rather than an aid.

It is hard to deny that the Paralympics has greatly improved the profile of many disabilities and by extension the disability aids that surround them. But if certain aids simply aren't used in these kind of environments, then isn't it possible that those aids might become conspicuous by their absence?

There is a suggestion that certain aids might become beautiful by association, and it is commonly understood that celebrity association can boost the profile of products and brands. With this in mind the idea that a disability aid can be boosted by its connection to a celebrity, is not particularly groundbreaking.

"Till (1998) and McCracken (1989) have suggested that celebrity endorsers can build brand

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[43] Ali Jawad. (2016). *Sports Uncovered*, (465).

Amy Purdy. (2014). *ESPN the magazine 2014 Body Issue*, (6).

Bethany Woodward. (2015). *Sport Uncovered*, (410).

GagDaily News. (2012). *New Zealand Paralympian Portrait Session*. [online] Available at: http://www.gagdaily.com/facts/3676-photoshoot-new-zealand-paralympian-portrait-session.html [Accessed 7 Feb. 2017].

Jordanne Whiley. (2015). *Sport Uncovered*, (429).

Lewis Edwards. (2015). *Sports Uncovered*, (418).

Photogallery.indiatimes.com. (2017). *Maya Nakanishi*. [online] Available at: http://photogallery.indiatimes.com/topic/Maya-Nakanishi-goes-nude [Accessed 7 Feb. 2017].

Zimbio. (2012). *Cameron Leslie Photos : New Zealand Paralympian Portrait Session*. [online] Available at: http://www.zimbio.com/photos/Cameron+Leslie/New+Zealand+Paralympian+Portrait+Session/Bau4UY_bL-k [Accessed 7 Feb. 2017].

equity by creating secondary associations. Seno and Lukas (2007) have proposed that a celebrity endorser operates as a co-brand for the endorsed brand resulting in the creation of equity for both the endorsed brand and the endorsing celebrity." (Spry, Pappu and Bettina Cornwell, 2011)

Although I am drawing parallels with endorsement, I want to make it clear that this is less about "brand association" than it is about achieving mainstream acceptance through high profile use. It also links to the fact that these objects, must first be desirable in some sense, in order to be adopted by anyone.

Without beautiful aids we can't have the lime light of the fashion world or the virality of a Buzzfeed video. Without McQueen, prosthetics might never have had the profile boost of Mullins on the runway, and without the further consideration of artists and designers other disability aids might never achieve mainstream acceptance.

In other words the process is cyclical, we must first have beautiful aids in order to achieve widespread acceptance of those aids.

It could be argued that the reason certain disability aids have done so well, was that they couldn't hide, or were so essential that users simply could not opt out of wearing them. The early failures at realism with prosthetics and the absence of mainstream contact lenses for glasses, allowed them (or indeed forced them) to develop a visual language of their own.

With glasses this was a focus on fashion, with prosthetics a focus on mechanics and athletics. Each has its own unique landscape that is being pushed forward because of their profile, and although glasses are significantly ahead of the game I genuinely believe we will see prosthetic design in the mainstream at some point in the future. Maybe one day it might alter the landscape of the footwear industry.

3.6: Raising the Profile of Disability Aids

These comments about athletes and celebrity may seem tangential, but through them we can learn a lot about Braille. In order for Braille to achieve a higher adoption rate it must first have a more positive profile. In order to achieve a more positive profile it must be pushed into the mainstream. In order for it to be pushed into the mainstream it must be beautiful. In short, it is my opinion that public artistic interventions into Braille, will generate more Braille creation and more widespread Braille adoption.

However if a disabled celebrity opts not to wear a disability aid, then might it have the opposite effect? Namely if an athlete who could use an aid makes a point of not wearing one, could that be seen as a rejection of the aid itself? If you truly look up to an athlete who has a similar disability to yourself, and you find that they don't use a disability aid that you rely on, isn't there a risk that you might reject that aid in order to emulate your hero?

Although not using an aid is certainly not a bad thing, and each individual must make the choices around what is most right for them. There is a danger that a lack of exposure to role models who wear your chosen aid, could result in its kind of stigmatisation. There is still a relative scarcity of disabled professionals in mainstream media, and there is no doubt in my mind that the Paralympics is by the far the most plentiful area for disabled role models of all kinds.

"Around 4,350 athletes from more than 160 countries will travel to Rio to compete in 528 medal events in 22 different sports." (Paralympic.org, 2017)

You are not only likely to find a Paralympian with your own disability, but one of your own race, gender and nationality. Compare this the field of acting where an overwhelming majority of disabled roles are played by non-disabled actors, with some studies claiming the figure to be as high as 95% on some platforms.

"We found that according to the ADA's definition more than 95% of characters with disabilities are played by able-bodied actors on television" (Woodburn and Kopić, 2016)

Its becomes not only a question of whether certain aids are going to be left behind because of their lack of exposure, but whether using that aid when you see athletes opt not to wear it, might make you perceive your own reliance on an aid as weakness. An absence of that aid in the public consciousness could be as stigmatising as a negative one.

Braille suffers from a similar kind of problem. When discretion isn't an option fashion flourishes, but when it is an option conflicts emerge. Most Braille is able to hide in plain sight, it is small, often made from the same background material and in many cases is designed not to obstruct non tactile information (see pharmaceutical packaging). Moreover Braille isn't traditionally worn, so it isn't forced into the limelight like many personal aids are.

There is a scarcity of Braille that can be linked directly from its ability to sink into the background. As long as Braille isn't common place then not seeing it in any one specific place, is never going to be particularly shocking. Eventually this might include not seeing it anywhere.

Compare this to the plentiful supply of other public aids like ramps. Traditionally these aids are more common, in some ways because of the universal design movement and because of the large variety of people who can make use of them. Yet it could be argued that a major contributing factor of their success is their size, they are more common because they are large enough for us to notice their absence.

It becomes obvious every time you walk with an elderly relative or try and wheel a bicycle into a building. You not only realise that something is missing, you are confronted with the uncomfortable realisation that it's not okay.

Ramps do not sink into the background, and in many cases a disabled person can't ignore the absence of one. For instance someone who is permanently confined to a wheelchair, can't just ignore three flights of stairs, while a Braillist looking for a specific room in a new environment, has other options like asking directions to compensate for an absence of tactile lettering.

This evocative image of a wheelchair is often used to explain other areas of disability, it can often highlight the problems of less "visible" hurdles the disabled face, by drawing parallels to the more "obvious" visible examples.

"Noise is to dementia patients, what stairs are to a wheelchair user" (Farrelly, 2014)

It can also be used to help us understand the conversations around disability aids, especially things like the blurred lines between aid, tool and augmentation.

"an aeroplane is a mobility aid to non flyers just as a wheelchair is mobility aid for non walkers" (Oliver, 1996)

Either way we see that there is a clear difference between people's understanding of disabilities they can see, and those which they cannot. The way visual examples are offered up as explanations suggests a level of "common knowledge" about the problems that face wheelchair users, as they rely on a certain level of general understanding about the issue in order to draw parallels.

This understanding far from being a negative, can be applied as a metaphor for other issues faced by those with less visible issues or challenges. An understanding of any aspect of disability might be used as a springboard to offer other insights into more specific or less common conditions, that the general public might not know about.

3.7: Disability, Stigma and Visibility

Mental illness is a prime example of the stigmatised invisible. The general public approach the conversation less understandingly than other disabilities, and most won't equate its hurdles to traditional ideas of disability.

It is widely understood that mental health simply isn't given the same acknowledgment that physical disability is.

"People who experience mental health conditions or intellectual impairments appear to be more disadvantaged in many settings than those who experience physical or sensory impairments" (The world health organization, 2011)

"Perhaps most prevalent of all is the myth that disabled people are those with visible physical impairments, when, for example, people with mental health impairments account for a substantial and growing proportion of all disabled people and over one third of Incapacity

Benefit claimants" (Roulstone and Barnes, 2005)

In fact many struggle with the idea of mental illness as a disability at all. Something which becomes even more pronounced when examples of addiction are included in the conversation. The line between mental impairment and disability is defined as:

"A person (P) has a disability if :
(a) P has a physical or mental impairment, and
(b) the impairment has a substantial and long-term adverse effect on P's ability to carry out normal day-to-day activities." (UK Equality Act, 2010, s6 (1))

Or in other words:

"A mental health condition is considered a disability if it has a long-term effect on your normal day-to-day activity." (Gov.uk, 2017)

However if look at the definitions of a mental illness like alcoholism, then we can see that classifications start to become part of the problem.

Alcoholism is defined as a both a disease and a mental disorder by the American medical association[44]. It is defined as a mental illness by its inclusion in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)[45], and as previously stated, is diagnosed as a disability if it "*has a long-term effect on your normal day-to-day activity*" by the UK equalities act.

Although these definitions are taken from many places from around the globe, they are well respected sources and the UK equalities act has equivalents all over the western world, many of which have similar definitions of disability[46].

However this means that Alcoholism can be a disease, a mental health disorder and a disability all at the same time. Yet the modern understanding of disability is very rarely talked about in terms of illness, as illness suggests cure. When applied to alcoholism or drug addiction, the idea of cure might not seem controversial, but when talking about disabilities like deafness it can be incredibly problematic.

Suggesting that a fundamental aspect of a person's identity might be a defect to be corrected or an illness to be cured, takes away many of the empowering aspects of disability conversations.

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[44] Morse, R. (1992). The Definition of Alcoholism. *JAMA*, 268(8), p.1012.

[45] Diagnostic and statistical manual of mental disorders. (2014). Washington: American Psychiatric Publishing.

[46] "*The term disability means, with respect to an individual,*
(a) a physical or mental impairment that substantially limits one or more of the major life activities of such individual;
(b) a record of such an impairment; or
*(c) being regarded as having such an impairment.." (*Americans with Disabilities Act (ADA), 1990)

"In Chacón Navas the Court defined disability, for the purposes of the Directive, as: "a limitation which results in particular from physical, mental or psychological impairments and which hinders the participation of the person concerned in professional life." (Waddington and Lawson, 2009)

On top of this there is still a blame culture around certain mental disorders, one that doesn't appear to the same degree with physical conditions. I will concede that I have chosen alcoholism as a deliberately extreme example, and the fact that many have a problem with its classifications is part of the reason I wanted to draw attention to it.

There is something uncomfortable about comparing a wheelchair user to a drug addict, but if we look at these definitions there is a sense in which we might perceive each of them as being in some sense disabled. This stigma exists across the whole spectrum of mental illness, and although conditions like depression rank lower for "blame" it still exists.

"60% and 54% stated that alcohol-dependent persons are themselves to blame for their problem, compared with 34/33% for eating disorders, and only 4–13% for depression, panic attacks, schizophrenia and dementia." (Schomerus et al., 2010)

"...with the probable exception of people addicted to illegal drugs, those suffering from alcohol dependence are generally held much more responsible for their condition than those suffering from other mental and medical disorders." (Schomerus et al., 2010)

The invisible nature of some conditions means that they are sometimes dismissed, disbelieved or at the very least treated with dramatically different levels of respect than their visible counterparts. While we are able to see that someone in a wheelchair may need a ramp, we are often unable to see that those with less visible issues might need other considerations or adaptations.

There is a recognised stigma around mental illness and there is the idea of a "concealable identity", where those with an issue hide this from the wider world to avoid the stigma that surrounds the illness.

"Workers with mental illnesses worry about their illnesses being "discovered". The direct stigmatization effects of mental illness are profound " (Joachim and Acorn, 2000)

This idea of being "discredited" is a legitimate reason to keep a condition private. But as we have seen with glasses and wheelchairs, an aid or indeed a conditions public profile, is a critical tool for its mainstream acceptance. While keeping a mental illness private may in many cases be the right choice for the individual, the public conversation around mental illness still needs to continue. Sadly its ability to not be seen, can result in some conditions being completely ignored.

The point I am trying to make is this. Invisible disabilities are treated with much less empathy, understanding and compassion than visible ones. In turn we can draw a parallel between the stigmatisation of the disabled and the stigma of disability aids. Those who are less visible are less thought of and in many cases seen as less.

If certain aids aren't used by those who could benefit from them, then those who have no choice but to use them may find the stigma they receive to be that much worse. If hearing aids still have a high level of stigmatization attached to them, many might opt not to wear one even it dramatically worsens their hearing. The potential benefits of the aid outstripped by the need to appear "normal".

If aids are designed to become more discrete then we might see conversations around those aids will lessen, both in intensity and frequency. Discretion has an integral role to play in the design conversation, but if something is able to hide well enough, are we able to notice when it's not there at all? If an aid isn't in the public consciousness, then it risks not being there for the people who need it.

Yet a focus on fashionable aids might be naive. Some will view this idea of fashion as drawing attention to a flaw, or as part of a wider pressure imposed on them to "overcome" their disability. This need to excel or somehow make up for a perceived shortcoming can be dangerous, and if an aid emphasises that, then it either risks not being used or instead being resented.

For example there may be an assumption, that those in wheelchairs must be athletic, due to both the aids design and public image being deeply rooted in sport. Wheelchairs have been pushed forward by both the bicycle industry and wheelchair sport; if all wheelchairs have a "sporty" look then this could result in certain expectations put onto the shoulders of the user. Couple this with the fact that the most high profile wheelchair users are athletes and you might see how someone with limited ability or a lack of interest in sports, might feel inferior.

A wheelchair is never going to be able to "hide" but more discreet options are still a possibility. Options that remove the sporty aesthetic and replace it with something else, live somewhere in between the two options. Rather than say fashion or discretion, it might be better to think in terms of tailored.

This explains part of the reason for discreet options, not because the person is ashamed of their disability, but because offering a range of options is almost always the best option for disability aids. Some of these options are going to edge towards discretion and examples like pacemakers show that at their best, discreet aids can be so invisible as to not be considered aids at all.

Yet we are not the same people we were yesterday, nor are we going to be the same people we are today, tomorrow. In that vein we must accept that what works today on the runway might not work for an evening meal, what feels right at a wedding may not be right for a funeral.

"Some days you do not want all the world staring at your legs, other times you want them to be looking for the right reasons." (Mullins, 2009)

However, discreet aids can sacrifice function for invisibility and their lack of presence in the public eye can increase the stigma around that aid. While Mullins collection includes realistic

prosthetics she would not have been able to engage the world in conversation were it not for her "cheetah legs" and other pieces that didn't shy away from the limelight.

The argument "fashion vs discretion" is portrayed as a binary, when in reality it is often a sliding scale or amalgamation of aspects of the two approaches. The truth, is that aids should be considered and tailored to the group individual whenever feasible. When this is not possible offering a range of smaller parallel options is always going to be preferable to a one size fits all approach.

This links back to artistic intervention into Braille; as although a large amount of public Braille is not as intimate as something as personal as a hearing aid, it's clear that Braille still has the potential for intimacy. The act of reading novels is often viewed as a deeply personal experience, and when you couple this with a haptic medium like Braille, it isn't hard to think of the process of reading as sensual. It is after all intimate touch.

Braille doesn't always have to be visible or fashionable, and in fact it would could be inappropriate in some cases. But a real consideration of all aspects of a piece's application, and a range of sensitive approaches to Braille manufacturing, will be integral to raising the mediums profile and ultimately mitigating any perceived stigma around its use.

In contrast to the "supercrip" there is the idea that you can vastly underestimate a disabled person's ability to perform even basic tasks. This is something the general public are going to be far more familiar with, as the road to recognising the capabilities of disabled people has not been an easy one.

The first example that comes to mind comes from a conversation around disability awareness training:

" Simulation exercises attempt to give non-disabled people an insight into the experiences of impairment... However such training often fails to capture some of the most difficult aspects of their impairment, such as the effect of cumulative frustration, pain, fatigue or social isolation. On the other-hand simulation can often over estimate some aspects of difficulties. People using a wheelchair for the first time will not have built up their upper body strength or gained proficiency achieved by a seasoned wheelchair user." (D.Marks, 1999)

Many misconceptions can be greatly worsened when this kind of training is done badly, and misconceptions about the use or usefulness of a certain aid can also be problematic. Simulation can be done to great effect, product designers simulate Parkinson's Disease with shock gloves (in order to test their designs) and social workers learn how to control a wheelchair and experience how certain movements might feel to a user who is being pushed.

But outside of very specific training or testing, this kind of education could almost always done better by simply asking those who use those devices about their experiences.

Braille suffers from quite a few of these misconceptions, some of which I have already addressed in my first chapter. But this perpetuation of misconception is a real danger to education and the proliferation of the medium. To examine every falsehood would be out of scope of this thesis, but it is important to review one or two of the most common examples to demonstrate the harm an ill-informed appropriation of Braille can pose.

In non-tactile English the letter [A] is a single character and [B] on its own on a page it means B. In turn if you see AB on a page it will always mean [AB]. All of these are perfectly reasonable statements, and all of these innate truths of the English language are often assumed in regards to Braille. However this is only partially true for uncontracted Braille, and all these statements are false in regards to grade 2 or contracted Braille.

As a designer I am exposed to design based interventions more than the general public, couple this with my specialism into Braille and I am consistently exposed to, or actively seeking design based interventions into Braille. With that in mind a few themes have started to emerge in work I see, some with flaws that stem from misconceptions that repeat time and time again. One such example of misconceptions influencing design are "Braille fonts".

It should be noted that this is not a comment on typeable Braille, when I discuss the issues of a design based Braille font, I am referring to a Braille alphabet layered on top of a traditional one, not a font designed for the blind to create printable computer documents. This doesn't work for a number of reasons but the biggest one is that depending on context a Braille character can mean a wide variety of different things.

Although these could function as visual reference posters, the actual market for that application is very small. Almost all these pieces would far better serve their audience by exploring contractions or at least showing a better grasp of Braille spacing and grammar if the only approach grade 1.

Even if these fonts were only intended as reference sheets for the sighted, the fact that they surface relatively often perpetuates a myth for those who don't delve further into their research. It would be easy to think Braille is just a direct translation of English if these were the only pieces you were exposed to.

The fact that each letter is often a capital, is further proof that these pieces lack a certain understanding of the medium. They don't recognise that a capitalisation symbol is needed to indicate a capitalised Braille letter, and thus none of these Braille cells in isolation can represent a capital.

I will attach links to some examples[47], but I do not feel comfortable including copies of work that

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[47] Anon, (n.d.). [online] Available at: https://s-media-cache-ak0.pinimg.com/originals/a1/f2/c9/a1f2c9a8612bcfdb49a00c1dfca5570a.jpg [Accessed 30 Aug. 2017].

Fontriver.com. (n.d.). *Cite a Website - Cite This For Me.* [online] Available at: http://www.fontriver.com/i/fonts/visual_braille/visualbraille_specimen.jpg [Accessed 30 Aug. 2017].

I am explicitly targeting for bad practice, especially when the intent of said work seems to have come from a genuine place. That being said I will still outline the aspects of these "fonts" that do not function within the framework of Braille, and attempt to create a Braille ABC that adheres to the rules grade 2, namely:

- Any letter between (a) and (j) can refer to a number (1-0) respectively, if a number symbol is directly in front of it.

- Single cells can mean full words if placed in isolation, within the context of a sentence. For instance (b) becomes (but).

- Single Braille cells may also refer to phonetic sounds, which in turn may refer to full words if placed in isolation, within the context of a sentence. For instance (wh) becomes (which).

- Letters may refer to different words (or two letter contractions) when contraction symbols are placed in front of them.

- Letters are only capitalised when a specific capitalisation symbol is put in front of them.

With this in mind I created a Braille ABC in order to try and educate the sighted about the nature of Braille, and hopefully create a useable teaching aid in the process. This also included an abstract explanation to explain the piece to those who may be completely new to Braille.

It should be noted that this sheet does not include all Braille contractions, nor does it include all symbols. This sheet simply lists all five decades[48] and the first 33 two letter contractions, all of which are created using single Braille characters, preceded by one of three contraction symbols. For example the word "Your" can be contracted to (y)(r) and is not included on this sheet as it is the beginning of a much larger convention of contractions in grade 2. This sheet is a relatively comprehensive starting point, but it is a nonetheless still a starting point and not a full glossary of all grade 2 contractions.

Fontyou.com. (n.d.). [online] Available at: http://fontyou.com/blog/wp-content/uploads/2015/06/LearningBrailleType_SimoneFahrenhorst_02.jpg [Accessed 30 Aug. 2017].

[48] Braille patterns are arranged into decades based on the numerical order of those patterns. Listing all five decades is more easily understood as listing all single Braille cells and their meaning.

a 1	but 2	can 3	do 4	every 5	from 6	go 7	have 8	9	just 0	knowledge	like	more	not		people
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
quite	rather	so	that	us	very	it	you	as	will	still	and	child		for	of
q	r	s	t	u	v	x	y	z	w	st	&	ch	ar	for	of
the	with	shall	this	which		out				enough	were	in			
the	with	gh	sh	th	wh	ed	er	ou	ow	bb	cc	ea	en	gg	in
ing	his	by/was		to	CAP-ITAL SIGN	NUM-BER SIGN		be				DOT-5	DOT-4&5	DOT-4&5&6
ing	66 ?	99	–	!			,	•	:	•	'			

		DOT-5	DOT-5	DOT-5	DOT-5	DOT-5	DOT-4,5&6	DOT-5
in	to	c	d	e	f	h	h	k
into		cannot	day	ever	father	here	had	know

DOT-5	DOT-5	DOT-4,5&6	DOT-5	DOT-5	DOT-5	DOT-5	DOT-5
l	m	m	n	o	p	q	r
lord	mother	many	name	one	part	question	right

DOT-5	DOT-4,5&6	DOT-5	DOT-5	DOT-4&5	DOT-5	DOT-4&5	DOT-4,5&6
s	s	t	u	u	w	w	w
some	spirit	time	under	upon	work	word	world

DOT-5	DOT-5	DOT-4&5	DOT-5	DOT-4&5	DOT-4,5&6	DOT-5	DOT-5
ch	th	th	the	the	the	ou	wh
character	through	those	there	these	their	ought	where
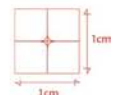
DOT-4&5
wh
whose

This tile system can be separated into two distinct sections, single Braille characters and two letter contractions. Orange characters represent the most common meaning of each Braille character, with the first examples representing the letter or phonetic sound that the cell represents. The second examples representing the sole meaning of each two letter contraction.

The dark blue represents the word a single Braille character represents, when featured in isolation in a sentence. The light blue on the other hand represents the component parts of a two letter contraction, or the numbers that (a) through (j) represent when they are prefaced by the number symbol.

Lastly red represents grammar, which is also included in most two letter contractions as "contraction symbols".

This tile system is designed to be a cheap, printable teaching aid, which can be used as both cut out tiles for workshops or an embossed poster "cheat sheet" if left intact.

The posters biggest function is to help the sighted understand the nature of Braille, deconstructing the system into its base parts. This in turn can help parents or educators (many of whom will be learning Braille with the child in order to teach it) to quickly understand and review work without necessarily having to be able to read the embossed aspect.

This tool is designed for beginners who are moving on from grade 1 to grade 2, but it can be used just to teach grade 1 by ignoring the bottom tiles.

This sheet is designed to be embossed using basic equipment available to all blind users. It comes in two forms, a true Braille scale where tiles also have accurate spacing and a jumbo tile, where the point size is the same but the tiles are four times bigger for those who need larger tiles to handle them properly.

Hopefully this kind of artistic response, combined with the wider conversation on disability simulation, demonstrates the potential pitfalls of tokenistic or ill-informed adoption. While widespread adoption is integral to the eventual acceptance of disability aids, as well as the development of said aids own unique visual culture, this adoption cannot be built upon the perpetuation of misconceptions. Miss inform can negatively reflect both the user group of the aid itself, which in turn can inadvertently neuter the unique aspects that are most worthy of exploration.

3.8: Braille, Perspective and Difference

The misconception that the blind have "better hearing" perpetuates the concept of a deficiency correcting itself, rather than allowing the unique perspectives of the blind to come to the fore. Instead a more in-depth understanding of blindness or partial sight might allow for more

productive conversation. To take just one example that I have already examples, why not discuss the concept of colour from the perspective of those who have no visual reference. This complete or partial lack of optical perception promotes a different kind of understanding of colour, light and even detail, one centred around a language far more reliant on other senses. This is a far richer dialogue, not only because of its basis in truth rather than partial truths, but because it has relevant applications in philosophy, as well as our ability to understand non visual perspectives of predominantly visual concepts.

Similarly an overly simplified view of Braille perpetuates an image of a weak substitute for non-tactile writing, rather than a unique written art form. The view of Braille we specifically see in "Braille fonts" not only prevents the general public from understanding Braille, but ultimately hides the fact that there is something to understand. If these fonts are your only point of reference then you may view Braille as simply English directly translated, which in itself can prevent you trying to dive further into the subject. Why attempt to learn more if you believe there is are no depths to delve?

If we think about the idea of learning a new language, then Braille may not be the consideration it should be, simply because it doesn't feel significantly different or relevant. While other disability language skills like sign language are beginning to feature in mainstream language classes, akin to a foreign language option,[49] Braille has had nowhere near this level of integration.

There are fundamentally differences between the two in some critical aspects, for instance BSL or British sign language has been officially considered a language by the UK government since 2003[50]. Whereas Unified English Braille is only considered a derivative of English and merely a writing system. Yet sign has no written component, despite many sign languages having completely different systems of grammar[51]. In this way it could be said that Braille is the counterpoint of sign, it has no verbal component yet the writing deals with a completely different kind of rule set than the language in which they speak.

By drawing these parallels it can be seen that Sign Language is more able to succeed where

[49] Kinsman, M. (2017). Introducing British Sign Language in a Scottish Secondary School. *Scottish Languages Review*, [online] Autumn 2014(2 8), pp.1-12. Available at: http://www.scilt.org.uk/Portals/24/Library/slr/issues/SLR%2028/28-1%20Kinsman.pdf [Accessed 6 Jul. 2017].

BBC News. (2017). *Should pupils have to learn sign language? - BBC News.* [online] Available at: http://www.bbc.co.uk/news/education-38979904 [Accessed 6 Jul. 2017].

[50] *"BSL was finally recognised by the UK government as an official minority language in 2003"*

British Sign Language - Learn BSL Online. (2017). What is British Sign Language? - Information about BSL. [online] Available at: https://www.british-sign.co.uk/what-is-british-sign-language/ [Accessed 6 Jul. 2017].

[51] *"British Sign Language uses a grammatical structure commonly described as a Topic Comment Structure. This basically means that the topic is stated first and then a comment about that topic is stated and explained afterwards- similar to a lot of foreign spoken languages."*

Learnsignlanguage's Blog. (2017). Simple grammar explanation of British Sign Language. [online] Available at: https://learnsignlanguage.wordpress.com/2010/10/*04*/simple-grammar-explanation-of-british-sign-language/ [Accessed 6 Jul. 2017].

Braille struggles. Once again, I equate this to the increased profile of the sign when compared to Braille. Sign language is more visual and signing might be an individual's primary (or only) form of face to face communication. This in turn means it simply cannot be bypassed in the way in which Braille often can be.

Linking back to my earlier discussion of wheelchairs access, we see a clear link between those disability aids that succeed and those that have barriers that highly visible or less easy to bypass. While the absence of Braille signage can be worked around, the same can't be said for the absence of a ramp. One may delay or hinder access, where the other can completely prevent access altogether. Similarly those who sign are not guaranteed to be able to lip read or speak, creating a more obvious barrier that cannot be worked around, at least not in the same way or to the same degree that Braille can.

When we move away from personal disability aids and instead address to public ones, then the conversation changes in many ways. These aids have to be used by large quantities of people, and that can lead to one of two things, either we see homogenous "one size fits all" approaches, or we see universal design principles sensitively applied.

This refers to aids that are tailored to a space, that have a consideration of the end user without being personalised to the individual. In other words they are personalised to the environment to allow for an equivalent experience, rather than a custom one.

The conversation around discrete public aids is still there, and some exist that the majority of the general public might not even know about. "Spinning cones" are located on the underside of most zebra crossing boxes in the UK and are an incredibly successful public aid. These cones spin when it is safe to cross, allowing those with both hearing and sight issues to use the crossing.

These aids are "protected" by their invisibility, as vandalism is a real issue in many public spaces. The same can be said for Braille and making high visibility Braille for certain locations might single them out as things to be destroyed. Yet in many areas this isn't the case, and we need to acknowledge the difference between certain environments. An office building and a park will have different vandalism risks and are exposed to different levels of wear.

This doesn't remove the need for artistic interventions into Braille, but instead reinforces the need for considered design, an acknowledgement of the nature of the space the aid is intended for. Just because one approach is unsuitable for one area, doesn't mean that it cannot be appropriate for another.

The absence of Braille is disabling, and although an image of a non-tactile sign might not be as evocative as a wheelchair user next to a flight of stairs, in many ways they are equivalent. Both are examples of disabling environments, where access has been withheld because of a lack of consideration of the public space.

If you look at a toilet door you might see etched or rotary Braille. While there is nothing inherently "wrong" with either of these methods, the majority of signs made this way focus on utility over aesthetic. Ease of cleaning and durability become the top priorities above all else.

The other side of this is "Braille tokenism" where designers have looked at Braille and created responses without any really understanding of the medium. When catering for the sighted this isn't too much of an issue, and expressive applications of Braille are something I will always champion. But when designs are explicitly aimed at Braillists then many of these attempts can come off as naive or at their worst painful. So how do we judge the merits of artistic Braille?

3.9: Function, Aesthetics and Judging Good Braille

It is easy to use the phrase "raise awareness" but it is a term with little to no ambition. Indeed nothing we do can be considered a failure if judged by this standard; every project on Braille will in some sense raise awareness. Instead we can view the success of "Braille art" using more specific criteria. Does the artist understand its audience (sighted or blind)? Does the piece educate or inform us about Braille? And does the piece tap into the tactile nature of the medium?

This assessment process is something that has played an important role in both the creation and review of my own practical work. In turn this process lead me to loosely categorized Braille into three areas, the good, the bad and the ugly. I am interested in the tensions between the three and in some cases we might view the same example as both good, bad and ugly. The fact that something can be both "good" and ugly presents something of a contradiction, but one that in turn brings up questions about the role of intent in design.

Roughly summarized the good is functional and works with in the contexts it was designed for, the bad is either not functional or doesn't work within the context it was designed for, and the ugly can fall into either the good or bad category but at its core it there is something fundamentally unpleasant about it. This might be an ignorance of the audience, a lack of consideration of aesthetics or a sense that Braille has been a clear afterthought on the part of the designer.

If we define good is Braille that functions well and works within the contexts it was designed for, then both utilitarian Braille and expressive Braille can be seen as good. Within the confines of this thesis, utilitarian Braille hasn't been shown in the most positive light, but we must acknowledge that it is a vital part of the landscape.

It is important to point out traditional manufacturing as a positive rather than negative force in this conversation. It has its own unique merits and applications, and it is only through the proliferation of other kinds of approaches and not the destruction of existing Braille, that the medium can truly move forward. It is not utilitarian Braille that creates "ugliness" it is the absence of other kinds of Braille.

We are now in a good position to revisit our discussion of The Black Book of Colours, and to evaluate its aesthetic, as opposed to functional dimension. The Black book of colours is a tactile illustration book which talks about colour, specifically from the perspective of a child who has had no vision from birth. The work talks about colour association and the role other senses play in our understanding of colour. The idea is that through interactions in a sighted world, colour becomes as fundamental to the blind as it is to the sighted, that two shades of blue that are identical to a sighted person, could be completely different to a blind person.

Defining colour in terms of function, texture and association rather than sight, can often create a wider spectrum of defined colours. Similarly those who are deaf and who sign, have unique gestures for their own name. In this way two people who are called David might have completely different signs for themselves, eliminating the chances of confusion when talking about someone.

Both these benefits are unique to the community and mediums of disabled groups, and with these small examples you can start to see the benefits these mediums could have if applied to day to day life. What if we started referring to each other by name and gesture? Or start to think of non-coloured things like numbers and atoms in terms of colour association?

This is something I feel the book does very well, in a very small amount of words it conveys a beautiful story, while setting the groundwork for much wider conversations. The way the book focuses on the experiences of a child, in language appropriate for a young age group, allows it to be used as an accessible children's book. It lets children ask questions about disability that they or their parents might never have thought about without this kind of input.

The Book uses clear gloss to create tactile illustrations and Braille, which I'm afraid is where it runs into problems. The Braille itself is nowhere near high enough to be effectively read by the blind, being far lower than pharmaceutical Braille. However a non-tactile approach to Braille is not necessarily a bad thing under the right conditions.

"Braille that functions well" in most cases means Braille that is comfortable to read and adheres to the strict rules that make it legible. However when Braille is aimed at a sighted audience rather than Braillists, then we no longer have to adhere to all the same rules.

Treating Braille as illustration or pattern design rather than letterforms, is one way in which the sighted might adopt Braille's visual language. Textured fabrics that use the visual dots of Braille might not be legible, but they can still convey the tactile nature of the medium, and allow designers to integrate aspects of Braille into an increasingly visual world.

What if we print flat "Braille" patterns onto net curtains, transcribe poetry or book passages. This would give the piece a different hidden dimension, while still allowing it to be abstract enough to work as a modern or neutral pattern. As long as the artist or designer understands the audience, then there is nothing wrong with creating Braille inspired work that isn't for the blind. In fact this kind of work could be good for Braille, by helping to get visually impactful uses of the medium

into people's home. This is not raising awareness, this is integrating something into people's lives in a way that works for them, it is about showing that Braille can be beautiful, not just about showing that Braille can be.

The danger comes when a piece presents "non tactile Braille" as something to be read by the blind. When dots made from holes perpetuate misconceptions about what the blind can read and how Braille works. Despite the book's claim that *"Braille letters are included as an introduction for sighted readers"* the Braille is still presented separate from illustrations and next to words. Without a strong understanding of the medium it is understandable that the context the Braille is situated might make you think it is legible to the blind, in fact I originally assumed it was when I first discovered the book.

The black book of colours is by no means perfect, but the poetic, artistic approach it offers has spread Braille into many homes. I stand by my earlier comment, that had the book been legible to a blind audience it would have been a stronger poetic statement, but the book itself has still opened up many conversations that might never have happened otherwise.

This was a book aimed at children, designers, artists and those with an appreciation for beautiful objects. I know many people who own a copy of this book and I have found to my delight that as I talk to academics, they are already very familiar with the piece; indeed a few even own copies.

It is telling that the volumes of *Braille Law* held at the University of Huddersfield's library have never once been loaned, but the copy of the Black Book of Colours went missing some time ago. There is a kind of engagement that comes with this kind of poetry, that simply can't be achieved by stating the argument. "Braille can be beautiful" is never going to be as effective as just showing beautiful Braille.

Conclusion:

I began this thesis by querying the viability of the UV flatbed printing process as a means of producing Braille, whilst also asking whether there might be a role for art and aesthetics in the context of Braille production?

We saw how, through a careful application of haptic aesthetics, we are able to create sensitive Braille-works that satisfy all functional aspects of Braille, whilst at the same time addressing considerations of beauty, audience and mindful (yet playful) experimentation. This can be seen as a way of pushing the medium forward, both by raising the public profile of Braille and by encouraging considered engagement in both sighted and non-sighted audiences.

This is not merely an advancement through artistic practice, but a collaborative approach, that allows for the cross pollination of ideas between functional, utilitarian application and creative, *experiential* artistic intervention. Such an approach understands that no single translation will ever be universal, but nevertheless foregrounds the need for inclusivity, whilst at the same time consciously integrating the experience of beauty into that inclusion.

In addition it considers how disability aids might be perceived, both by the user and by the public at large. It recognises that profile plays a critical role in the acceptance, adoption and ultimately the progression of disability aids; mainstream adoption allows for better access, as well as the removal of stigma that can arise from an absence of representation. This in turn allows for the furtherment of said disability aids own "visual language" through the establishment of a fashion identity. Ultimately, we might turn disability aids into desirable objects; removing the medical aesthetic and lessening associated stigmas.

It is my view that through integrating assistive technologies into the mainstream, we might altogether dispense with the label "disability aid". The question then becomes whether we will allow other industries to dictate the form this new aesthetic will take, or whether there will be a considered effort to craft a language unique to the communities and people that these aids were created for. By producing objects that are both desirable and accessible to the abled, we might in turn influence the design of other industries, those outside of disability design.

Crucially I apply this philosophy not just to personal aids, but to public ones, where a consideration of space and the need to create equivalent experience, replaces the need for "fashionable aids". At the same time the ethos of disability fashion is still integral to the application of successful disability aids, it simply focuses more on the connection between aid and space, shifting but certainly not removing the need for a true aesthetic consideration of user experience. Indeed it can be said that by including aids in public spaces, it is the general public and not just the disabled that become the intended audience.

In this way aids must not detract from the inherent beauty of a space, nor must they rob that space of its character, lest they perpetuate the myth that disability aids cannot be integrated into an able bodied world, at least not without lessening or cheapening the experience of the able

bodied. At the same time it is critical that these interventions be apparent enough, in order that they might become seen and recognised by the able bodied. In this way we might one day see the absence of accessibility as an oddity, one which is conspicuous and widely noticed even by those who do not require assisted access. In the near future we might view the absence of Braille signage, in the same light that we now view the absence of wheelchair access.

I make the case for the adoption of the visual language and unique experiential aspects of Braille, whilst conceding that widespread Braille literacy is not as easily adopted as glasses for fashion or wheelchairs for sport. However, I also make the case for an increase in the variety and quantity of functional Braille and the implicit need for designers and artists to approach a field they are uniquely equipped to tackle; namely that the empathic and creative group of professionals that the arts produce are able to tackle disability aids in ways most other fields could not.

In regards to the broader, but in some ways simpler question of the role of UV flatbed printing in the context of Braille production, it should be recognised that the aim of the UV method, is to offer the option of Braille production to printing firms that traditionally would not be able to offer the service. Any company that owns this kind of printer will almost certainly be dealing with bespoke work, due to the nature of the machine. This positions them well to take advantage of the additional work that might be offered by providing high end Braille production as a service.

Not having to buy in new equipment and not having to rely on Braille as a primary source of income, would allow companies with this kind of machine, to transition, and to subsequently operate competitively in this area. It comes down to the fact of being able to offer more services with no extra costs, ultimately making a company more versatile and by extension more competitive.

As for its viability as a manufacturing process, I feel confident that the UV printing process can be demonstrated to function successfully on a variety of substrates. One sheet metal sign has been installed in the University of Huddersfield's Print Bureau for over a year now, it shows no sign of wear and attempts to scrape or chip the dots with a scalpel have been repeatedly unsuccessful.

There are a few areas where the method shows weakness[52], namely colours darkening, the yellowing of clear ink when overexposed to UV light and chipping problems when dealing with certain materials (fabrics etcs..) yet the success of some of my samples has shown that this method does have application. Namely bespoke or small custom runs, of high quality pieces.

The method is not designed to, nor is it capable of, replacing most mainstream manufacturing. It is merely a supplemental technique that allows for the creation of high quality bespoke production. Within the confines of my own design work, it has allowed for the creation of a wide

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[52] See additional material for more detail of artistic interventions and assessment of practical work.

range of pieces, as well as offering a greater level control, as I was able to print Braille on top of existing work printed on the same machine.

Attached is a copy of my additional material, a collection of all the work that has been a core aspect of my research, artistic practice that has in turn influenced my approach and the direction of my writing. While you may not be able to touch and play with these images, I hope they still convey a sense of the Braille works, and for those of you unable to view them as images, I have written detailed descriptions[53] which I hope give you a similar sense of them. I will end here, as while I could continue to extol the virtues of Braille for an eternity, there is one thing that I know to be true above all else, a fact have already previously mentioned earlier in this thesis:

"*stating the argument "Braille can be beautiful" is never going to be as effective as just showing beautiful Braille.*"

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[53] That may be read by an e-reader or similar.

Appendix A: Case study: Huddersfield university CAD building: A look at informal and formal signage in regards to Braille:

Braille Survey: Huddersfield University: Creative Arts Building

For the purposes of this study it is necessary that we define the parameters of what constitutes a sign. In this way we have brought forward three defining features which we will use to count and include signage within this study. A sign must be:

- Text based/ contain some text based element.
- Deliberately designed to convey information.
- Displayed and attached to a vertically, such as those attached to a wall or door. In this way posters might be viewed as signs where flyers would not be.

These requirements removed a few signs from our data, but it should be made clear that none had any tactile element.

Unlike traditional signage, tactile signage is unlikely to appear from non-official sources, paper out of order signs or advertising posters will rarely feature hand embossed Braille cells. In this way official Braille signage commissioned by the university are likely to be only examples of Braille, meaning that we can reliably judge their numbers as accurate.

The primary reason for conducting our own survey was to showcasing the glut of signage and compare it to the drought of accessible signage. This study also allowed for a separate but no less relevant count of unofficial or handmade signs. By definition this number will be far more flexible than a count for official signage, with posters for events and workshops changing daily. It is also something the university would not be expected to have numbers for, while still being something relevant to the discussion of exclusion.

In addition conducting our own survey allowed us to streamline some of the definitions of what constitutes a sign, as well allowing us to collect data on multiple other points. For instance it was important to exclude covered and "not in use" formal signs, as well as having a separate category for signs where Braille would be inappropriate, including them in our count without artificially inflating our non-tactile category with unsuitable signs.

It is also worth mentioning that our data was only gathered from public/ semi-public areas, the moment a keycard was required then signs from that area were not included. This was a way of removing personal spaces from the count, which was a deliberate choice for this case study. As we only wished to highlight the absence of Braille in public and semi-public spaces; it would be unfair to judge people's workspaces/offices with the same scrutiny, especially since we are also counting informal signage.

Definitions of categories, exemptions and special cases.

As we observed and noted quite a large range of signage, it was inevitable that we would come across signs that didn't fit neatly into a category. This is a list of exemptions or special cases that we felt were necessary to declare.

"Full floor" panel signs were counted as one sign. Counting these examples as more than one would have drastically increased the number of non-tactile signs. Notably the largest example could be found in the foyer, which could have counted as up to forty-seven individual signs if we judged each removable panel as individual. This is excluding blank "not in use" signs, which also make up large sections of the piece.

Smaller panel signs were counted as one sign each, even when connected to other panel signs, this was down to the intended function of most of these examples, with almost all naming a different member of staff or room number. We did not count any that were currently "not in use" or blank.

"Fire door keep shut" wall mounts were counted as one sign each. This added one extra sign to almost every door in the building. The nature of fire safety signs meant that it seemed appropriate to include them in this particular count.

 N/A signs include but are not limited to:

- Signs on automatic doors.
- Signs above head height.
- Signs pinned under notice board plastic.
- Out of reach signs on windows etc...

Temporary signs were defined as all signs made of paper/ laminated card. These are separate from N/A as although some were posters, the majority were more important. First aider information and fire assembly points were amongst the worst offenders, both of which it can be argued should have contained tactile elements.

Fire safety layout maps were also not included as they were not wall mounted. Most were located in holders so that they could be removed in the event of an evacuation. It is worth mentioning that a ground floor tactile map would be considered best practice.
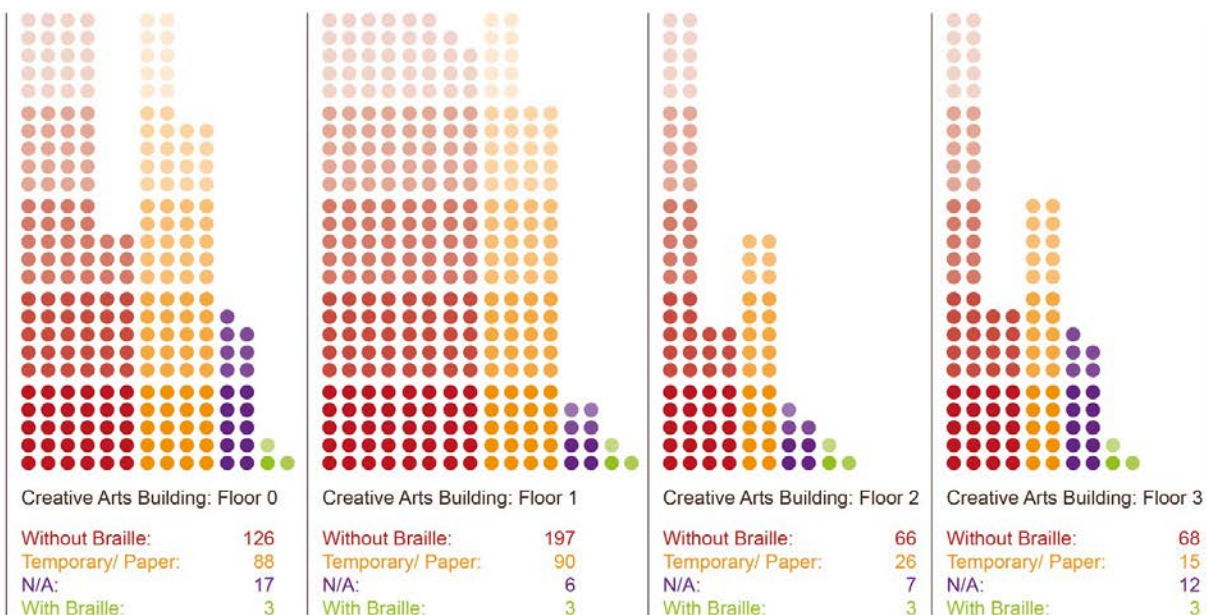
A chart with information on all floors of the CAD building. Floor 0 had 126 signs without Braille, 88 Temporary/Paper signs, 17 N/A signs and 3 with Braille. Floor 1 had 197 signs without Braille, 90 Temporary/Paper signs, 6 N/A signs and 3 with Braille. Floor 2 had 66 signs without Braille, 26 Temporary/Paper signs, 7 N/A signs and 3 with Braille. Floor 4 had 68 signs without Braille, 15 Temporary/Paper signs, 12 N/A signs and 3 with Braille.

Results:
To reiterate the building was given quite favourable terms in this survey:

- No nonpublic area was accessed for data collection.
- Large "panel" signs were considered as one sign instead of many.
- Unreasonable and N/A signs were removed from the results.
- Paper signs (including official ones) were counted separately.

Despite this the results were not good. In total 457 official, permanent signs contained no tactile elements. This included but was not limited to:

- Below "eye level height" fire exit signs
- Fire assembly point signs
- "Push button to open" signs: Used to internally unlock many external doors and two fire exits. In the event of a fire these locks would be deactivated yet it could still be argued to be an area of concern.
- Refuge call boxes: Designed to aid non mobile and wheelchair users in the event of a fire, critical when lifts are not a safe option.

Each floor contained 3 Braille signs, each with other raised tactile elements. All 12 of these were for toilet doors. The only other tactile navigation aids, were the buttons in the lift, they did not contain Braille but did have raised numbers. These buttons have been excluded from my data as they are not signs, but in the name of transparency it is important to declare them.
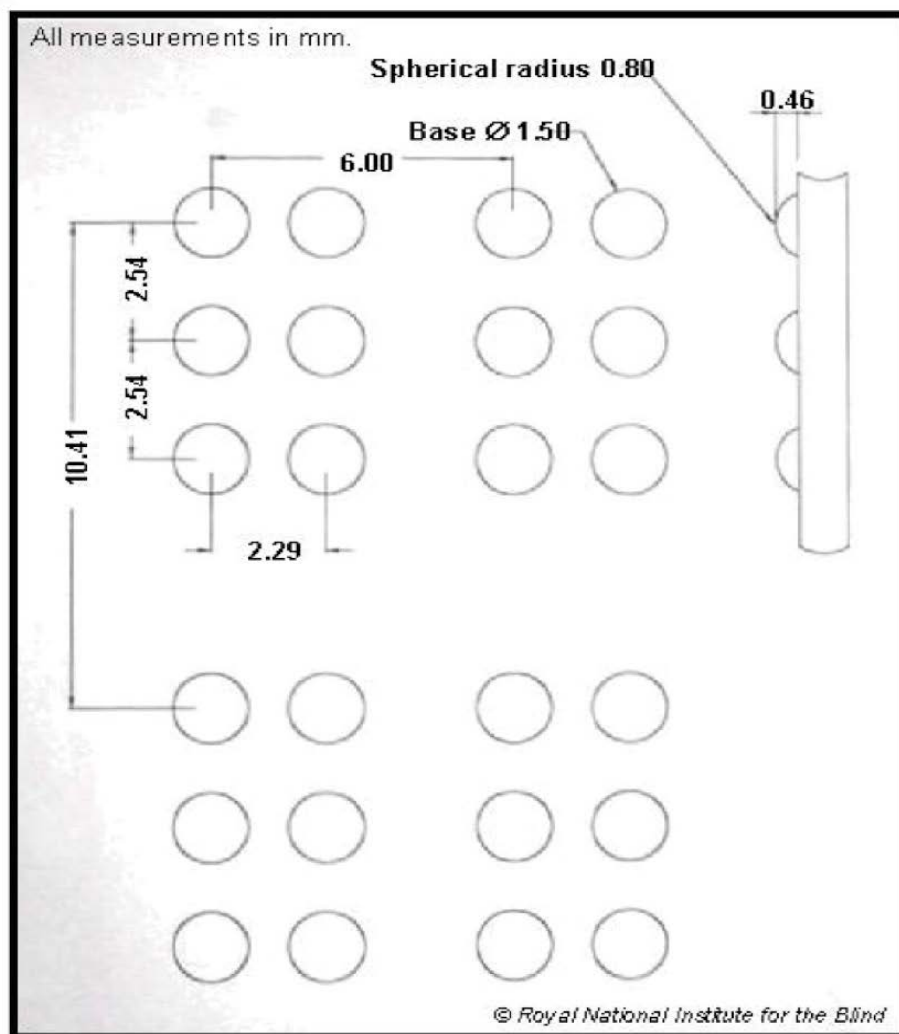
An image from the RNIB explaining dot height and spacing: Spherical Radius 0.80mm, height 0.46mm, spacing between each vertical dot 2.54mm, spacing between each horizontal dot 2.29. Spacing between dot one and dot one on the line below line 10.41mm, spacing between dot one and dot one in a cell directly next to it 6.00mm.

	Horiz dot to dot mm	Vertical dot to dot mm	Cell to cell mm	Line to line mm	Dot base diam mm	Dot height mm
	a	b	c	d	e	
American Library of Congress [1]	2.5	2.5	6.25	10.0		0.5
American National Library for the Blind [2]	2.28	2.28	6.09	10.16		0.5
American Standard Sign [3]	2.3 - 2.5	2.3 - 2.5	6.1 - 7.6	10.0 - 10.1	1.5 - 1.6	0.6 - 0.9
Australia Sign [4]	2.29 - 2.50	2.29 - 2.54	6.00 - 6.10	10.16 - 10.41	1.40 - 1.50	0.46 - 0.53
Californian Sign [5]	2.54	2.54	5.08			0.64
ECMA Euro Braille [6]	2.5	2.5	6.0	10.0	1.3	0.5
Electronic Braille [7]	2.4	2.4	6.4			0.8
English Interline (alternate print and braille lines) [8]	2.29	2.54	6.00	12.70	1.4 - 1.5	0.46
English Interpoint (braille on both sides of the paper) [9]	2.29	2.54	6.00	10.41	1.4 - 1.5	0.46
English Giant Dot [10]	3.25	3.25	9.78	17.02	1.9	0.81
Enlarged American [11]	2.54	2.54	7.24	12.70		
Enhanced Line Spacing [12]	2.29	2.29	6.1	15.24		
French [13]	2.5 - 2.6	2.5 - 2.6		>10	1.2	0.8 - 1.0
German [14]	2.5	2.5	6.0	10.0	1.3 - 1.6	≥0.5
International Building Standard [15]	2.5	2.5	6.1 - 7.6	10.0 - 10.1	1.5 - 1.6	0.6 - 0.9
Italian [16]	2.2 - 2.5	2.2 - 2.5			1.0	0.5
Japanese [17]	2.13	2.37	5.4	13.91	1.43	0.5
Jumbo American [18]	2.92	2.92	8.76	12.70	1.7	0.53
Korean [19]	2.0	2.0	5.0	6.0	1.5	0.6
Latvian [20]	2.5	2.5	5	10.0	1.6	0.45
Marburg Medium	2.5	2.5	6.0	10.0	1.3 - 1.6	
Marburg Large	2.7	2.7	6.6	10.8	1.5 - 1.8	
Portuguese [21]	2.29	2.54	6.0	10.41	1.4	
Small English [22]	2.03	2.03	5.38	8.46	1.4 - 1.5	0.33
Spanish [23]	2.5	2.5	6.0	10.0	1.2	
Standard American [24]	2.34	2.34	6.22	10.16	1.45	0.48
Swedish [25]	2.5	2.5	6.0	10	1	0.25

An image from the RNIB explaining dot specifications from around the world.

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Contents &
Introduction.

Contents & Introduction.

In my thesis I define good Braille as:

"Braille that functions well and works within the contexts it was designed for."

I go on to say that artistic interventions into Braille need to be reflected upon and assessed critically. To that effect I began to outline a set of questions that I used to assess the creative work of those working commercially in the field.

• Does the artist understand its audience (sighted or blind)?
• Does the piece educate or inform us about Braille?
• Does the piece tap into the tactile nature of the medium?

These questions aren't designed to create a "paint by numbers" formula for others to follow. It's a loose guide that is meant to be vague enough to allow for a variety of artistic interventions to be defined as a success.

There will be exceptions, and not every piece needs to tick all three boxes to be considered successful, but as a framework for critical assessment it can be a helpful tool. With that in mind it only seems fitting to apply this assessment to my own practice.

My practical work has two very distinct areas of development:

• The development of a method for consistently creating Braille using a UV flatbed printer, then exploring the applications of said method; and:

• The creation of "arts and crafts" Braille where I create things that are either accessible to a wide audience or that are easily reproduced by the general public.

The first area focuses on bridging the gap between amateur and professional Braille printing, looking at custom runs and bespoke production. This section is about exploring what the UV printer can do that traditional manufacturing methods can't.

At the same time I am trying to create artistic pieces; that showcase the real applications of artistic interventions into Braille. I will be focusing on material and colour to explore Braille from a graphic perspective, trying to make things that are both beautiful, and thought provoking. In short the work for this section can be thought of as more traditional graphic design.

The second section has far more in common with arts and crafts, though one or two pieces are not easily categorized into one discipline. These are less about the finished piece and more about education and engagement. There will be a focus on "reproducibility" and some of this work will be more at home in a primary school than an art gallery.

Most of these pieces will be made out of cheap or common household items, with each trying to engage young Braillists. By trying to merge aspects of their art education with their language education, I hope to enrich both and offer up a range of projects parents and educators can easily approach.

My research also has one guiding set of restrictions that are dictated by the medium. Namely that I can't alter certain aspects of Braille without risking it ceasing to be Braille. This includes but is not limited to:

• **Point size**: Braille cells must fit under the index finger or it will be considered "jumbo Braille" which is generally used as a teaching aid for those with reduced finger sensitivity. Above this larger size the type would not be considered Braille at all. The size of dots is tightly defined – interestingly, in the case of jumbo Braille it is the spacing rather than the dots that increases in size.[1]
• **Shape**: Braille dots are "semi spheres" for a reason, a sharp point or the flat surface of a cylinder can cause major discomfort when reading[2]. The shapes must also be above a certain height to be read, and flat dots or holes are completely illegible.
• **Spacing**: The space between letters, between sentences and between dots, are the size they are for a reason. Changing any of these can make Braille illegible and dot spacing especially can change the entire meaning of sentences.
• **Height**: I should always strive for the ~0.5mm ideal dot height, but when that is not possible I should never dip below the 0.2mm pharmaceutical Braille minimum[3].

All of these examples have some room to be altered, but they have to be carefully considered and as a general rule shouldn't be touched if there is an alternative. Although there are certainly things to be explored in these areas, I believe they are the least profitable paths I could explore. They all have established reasons as to why they have been designed like this, and changing them often results in a worse Braille or a product that shows an ignorance of the medium.

With all this in mind my work will focus primarily on what I can change as opposed to what I can't. Namely: Colour, Material and Interaction with non visual senses (temperature, smell, taste etc…)

There will also be a focus on creating playful ways to engage people using these variables, as the nature of artistic interventions into Braille needs to get past simply creating Braille for the sake of Braille or "tokenism". Functional and interactive aspects, coupled with an understanding of the context in which it will be used, are vital to this progression.

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1 "Jumbo Braille generally has dot spacing of order 25% larger than standard Braille." Gardner, J. (2017). Braille, Innovations, and Over-Specified Standards. 1st ed. [ebook] Oregon State University. Available at: http://userlab.usask.ca/GOTHI/Gardner.pdf [Accessed 11 Apr. 2017].

2 Flat head dots are considered "bad practice" by most if not all accessible signage bodies across the globe. This is reflected by the insistence of all Braille guidelines to use domed dots. To give just a few examples:

"Braille dots should have a domed or rounded shape – make sure they are not pointy or flat." (Formats Committee of Braille Literacy Canada: Accessible signage guidelines, 2016)

"Braille dots shall have a domed or rounded shape" (American Department of Justice: ADA Standards for Accessible Design, 2010)

"Braille dots shall be domed or rounded" (Braille Authority: Size and Spacing of Braille Characters)

3 See Appendix RNIB Braille specifications pt2. Dot heights range from 0.25mm for the swedish standard, all the way to a 0.8-1mm dot height for French standard. The most common heights range from 0.45-0.6mm, with English standard interpoint (English two sided print) stating 0.46mm to be the ideal. I work primarily with this standard and it should be assumed I am working to English specifications unless stated otherwise.

1.1/ First Prototypes:
Tabletop Movie Posters & Tickets

The first notable braille piece we created came from my third year project. Even at this stage it was obvious that we had issues surrounding dot height, but we had proven that the basic concept of "UV ink braille" was sound. It was here that we realised that some ink colours reacted differently to curing, something that would be the basis of many future experiments.

The white ink was much thicker, which in turn made the white dots far harder. At lower heights this meant that the white was much easier to read than black and yellow. This was particularly relevant at this point in development, as our initial Braille was only reaching the standard pharmaceutical height.

Shortly after the completion of this project we began to develop this Brailling method as independent project in it's own right, focusing on achieving the allusive ~0.5mm ideal dot height.

The concept of Braille advertising was incredibly interesting and on the whole I believe it was a successful piece, Braille mounted on flat surfaces or in locations Braille is commonplace was a way of turning a traditionally visual medium into something engaging for the blind. Despite this the limited dot height was an undeniable stumbling block, one which ultimately let the work down. The dots were only just legible and if we reproduced this piece today I can say with confidence that height would no longer be a concern. However it is still worth referencing this project at the point, as it was the foundation of all later work and the first time I had approached Braille as a medium.
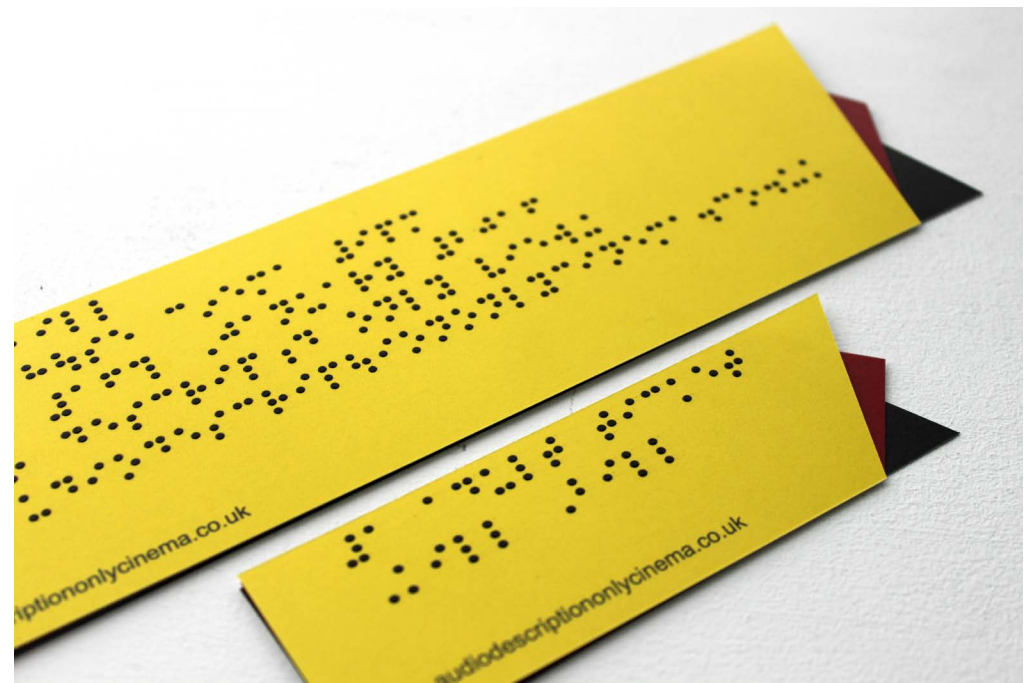
1.2/ Buisness Cards &
Low Height Braille Sample

After contacting the RNIB to showcase the development we had made so far, it became necessary to create a series of small card samples; something portable that could be carried around in wallets and be shown too as a proof of concept. In this vein we created business cards, as they served the secondary purpose of leaving our contact information with those we were visiting in Peterborough.

The feedback we received was overwhelmingly positive; I was told that the dots felt high quality and that the samples were easy to read. But it was at this meeting where the issues around durability first began to surface. Chipping was noted as a real problem area, especially with the black print sample where dots were easily scraped off.

It was suggested that we trial a set of playing cards using the clear ink dots. This would be a real test of the dots durability and would allow us to experiment with a multiple curing and finish settings for the four card suits.

1.2.1: Low Braille Sample:

At around this time we were still struggling with dot height. With this in mind we printed a sample designed to give us an idea of the lowest possible height, where any haptic feedback was possible.

We printed pass by pass until we were at a stage where there was clearly "something" there even if we were not sure it would be legible. This get us a practical understanding of the sensitivity our own fingers which was invaluable at this early stage.

The sample came out at around 0.1mm about half the dot height of pharmaceutical Braille or equivalent the height of the braille in the black book of colours[1]. While in retrospect we can see that this is not an legible dot height, it was a very useful tool for us at the time. It gave us an appreciation of the difference between best and worst practice Braille and helped us understand the issues of low dot height, in a far more practical sense than merely being told.

1. Cottin, M., Faría, R. and Amado, E. (2010). The black book of colours. London: Walker Books.
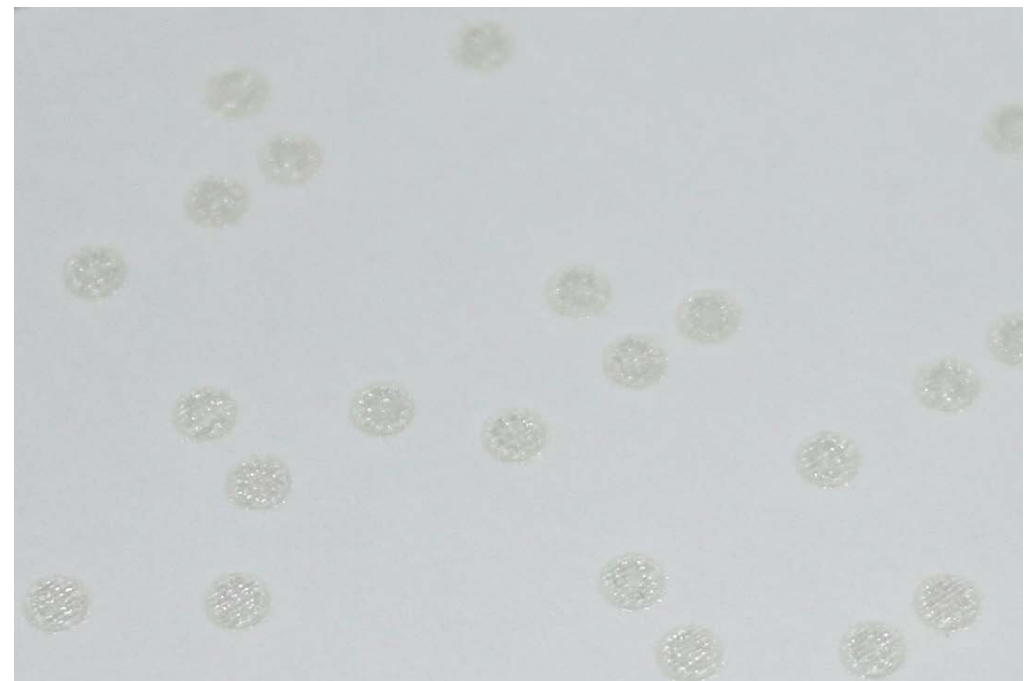
1.3/ Braille Playing Cards & The RNIB

The playing cards had a different kind of Braille, or different kind of finish on each suit. This is the full breakdown of cost, time and other variables involved. The only detail not included was the UV light settings as they were consistent for all four suits.

I concede that at first glance this chart might appear confusing, but it can broken down into a few key elements. Firstly the number of layers indicates the height of the Braille, which on this particular substrate was ~0.5mm. The addition of extra layers on the diamond suite does not drastically change this height, instead the purpose of these extra emboss layers was to better curve the dot.

We also have the addition of emboss layers, these extra layers give each dot a natural curve, and in later samples we will actually increase the number of emboss layers as it allows us to create more of a more spherical dot as opposed to the domed cylinder we see on taller dots.

Next we have the rather confusing "number of passes" which is linked to the resolution in which we are printing. Simply put the higher the resolution we are printing the more passes the machine requires to create the layered image. By reducing our resolution by over half (from 300 dpi to around 100 dpi) we were able to use fewer passes without seeing any detriment to the final product. This is down to the simplicity of the shapes we are working with, as more complex images would no doubt suffer heavily from this kind of drop in resolution. The advantage of this drop is a reduction in printing time, which in a commercial context is ultimately a reduction in cost.

The varnishes listed were either a spray varnish; which was applied after the fact and not factored into the cost of print, or a "full coat" varnish which was a clear ink layer applied using the UV printer. The spray varnish cost can see seen as insignificant due to the low cost of a full bottle and the relatively small amount each application uses, the ink varnish on the other hand adds considerable extra cost. It is worth noting that while this coating covered the entire card, it still printed at the lowest possible resolution, resulting in the cheapest possible version of this kind of finish, as well as a less than perfect coat.

Sadly I do not believe playing cards are a practical application of this method. While we do think that UV print has a home with in this market, the way we create UV printed Braille just isn't quick or cost effective enough for this kind of mass production. In addition we have since found one company[1] creating a print Braille option, allowing customers to alter background images for personalised runs. (Makeplayingcards. com, 2016)

The cards on the MCP website seem to have a reduced Braille height. This would reduce costs and make the dots less easy to break or chip. It would also allow them to be more easily shuffled and overall they appear to be a high quality product.

I believe that this is the market most suited to digitally printed Braille. Small custom runs, that take advantage of the ease in which a design can be altered to offset some of the costs of production. As runs get smaller Digital UV Braille becomes more relevant to the conversation, larger production methods don't see the niche as profitable and many people want options in between ametur and mass market.

The cards we created were sent to the RNIB and feedback has been overall positive. The only issue that arose was chipping, something we thought might be an issue in this kind of high use environment.

1. Cards (2017). Custom LED UV Embossed Braille Playing Cards. [online] MakePlayingCards.com. Available at: http://www.makeplaying-cards.com/design/custom-led-uv-embossed-braille-playing-cards.html [Accessed 16 Aug. 2017].

Clubs: 29 Layers: (3x9) +2
27 Matt Layers +2 Emboss Layers (No Varnish)
Passes:16
Time: 3 hours per suite
Ink Cost: £0.77

Hearts: 29 Layers: (3x9) +2
27 Matt Layers +2 Emboss Layers (Spray Varnish)
Passes: 16
Time: 3 hours per suite
Ink Cost: £0.77

Spades: 29 Layers: (3x9) +2
27 Gloss Layers +2 Emboss Layers + (Coated Varnish)
Passes: 9
Time: 1.5 hours per suite
Ink Cost: £0.77 + £4.30 (Coated Varnish)

Diamonds: 31 Layers: (3x9) +4
27 Gloss Layers +4 Emboss Layers + (No Varnish)
Passes: 9
Time: 1.5 hours per suite
Ink Cost: £0.90

1.3/ Braille Playing Cards & The RNIB

"Evaluation went well and all looks promising. Other than minor issues (the Braille was on the wrong side of the card compared to current Braille cards - easily correctable) very positive. The only concern is whether or not we can do anything to improve Braille not falling off/scraped off against other cards whilst maintaining its ease of access which was felt to be good.

Regarding your research masters possibility, all good and very happy to support; welcome to any Braille research we have carried out. Steve" :

E-mail Response from Steve Tyler "Head of Solutions, Strategy and Planning at RNIB"

We could try to create a low height version, or one that has a primer layer before the ink is applied, but as there is now a high quality version of this online, it feels like work that has already been done.

Our method works for very custom runs of products and while playing cards have an element of customisation, I don't believe that extends to the Braille itself. An ace of spades will always be [as] and that makes playing cards more viable for large scale production. The MPC "card backs" change but almost all other elements stay uniform, this allows them to scale orders and makes playing cards less viable for my own work.

The cards were always going to be a challenge, they are a high wear product with low profit margins. They can also be easily and effectively adapted by hand, which lessens the need for interventions into an amatur market.

Not everything is negative and I can certainly bring some things away from this test. First of all the readability of my braille is felt to be good, the dots have been received positively even though the tests flagged durability issues.

These issues can influence my product development from this point onwards, turning dot durability into a major factor in my future designs. I will have to find ways of strengthening the print without compromising on the height we have worked so hard to achieve.

Not every material or product will be suited to my technique and I feel I now have to be more directed in what I choose to adapt. The question is not what can we print on, but what can't we print on, there has to be some acknowledgement of the limitations of what this technique can produce and that in turn has to influence what we choose to adapt in the future.

1.4/ Acrylic Poetry:

Following on from the RNIB feedback we began trying to "strengthen" the Braille. We worked on clear acrylic as it's a material that was unlikely to cause us problems, and as it's more durable than paper the material won't give out before the dots do.

These "poetry signs" were designed to be quite playful, they look like everyday utility signs but contain inspirational quotes on them instead of basic information.

This particular sign says "What is the point in seeing if you never try to understand"

These quotes are hidden in plain sight and work as in-jokes for those who can read them, while beinging near invisible to those who can't.

We increased the strength of the UV curing and were very quickly able to see a strengthening of the dots we produced. We had initially been hesitant to increase the UV light's strength, as it does tend to yellow some colours at these settings, but thankfully we have seen no such yellowing at this height. It is also worth noting that there is a point where this increase creates a more brittle rather than a stronger dot, though this sweet point varies depending on the substrate and in some cases ink colour.

The signs have lasted around a year so far and although they have not been put under intense wear, we haven't been able to chip them off using our nails or a scalpel. We would like to achieve more height than we currently have on this sample, but the curvature of the dot is exactly what we were aiming for.

The next step is a sign that is installed in an area where it will be in near constant use. Somewhere where it may be cleaned and felt, while still being easily observed to see if it starts to degrade.
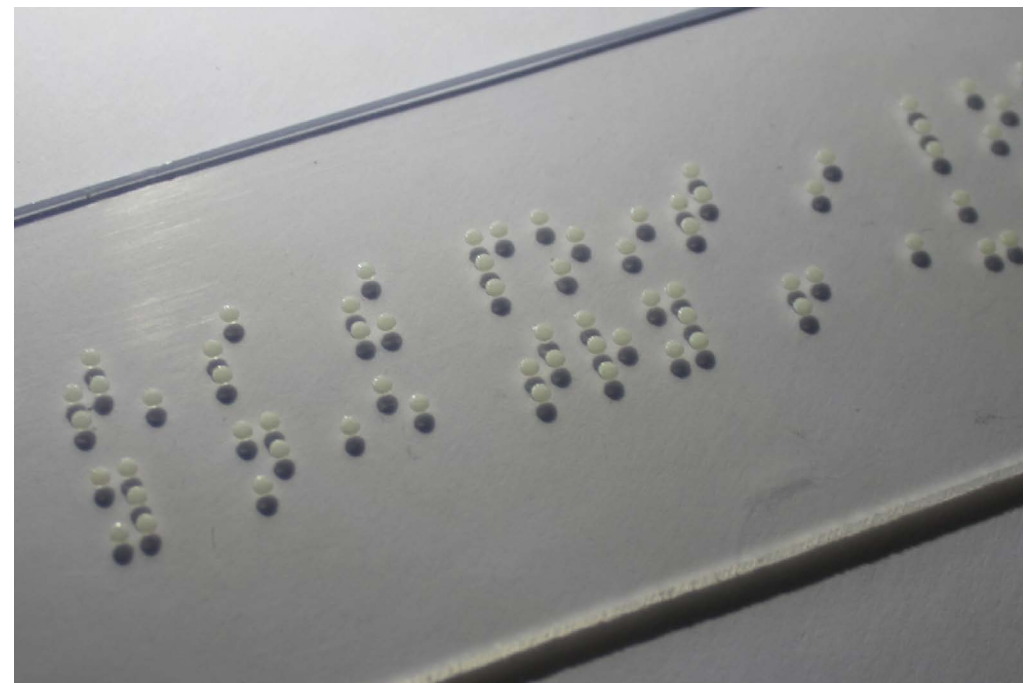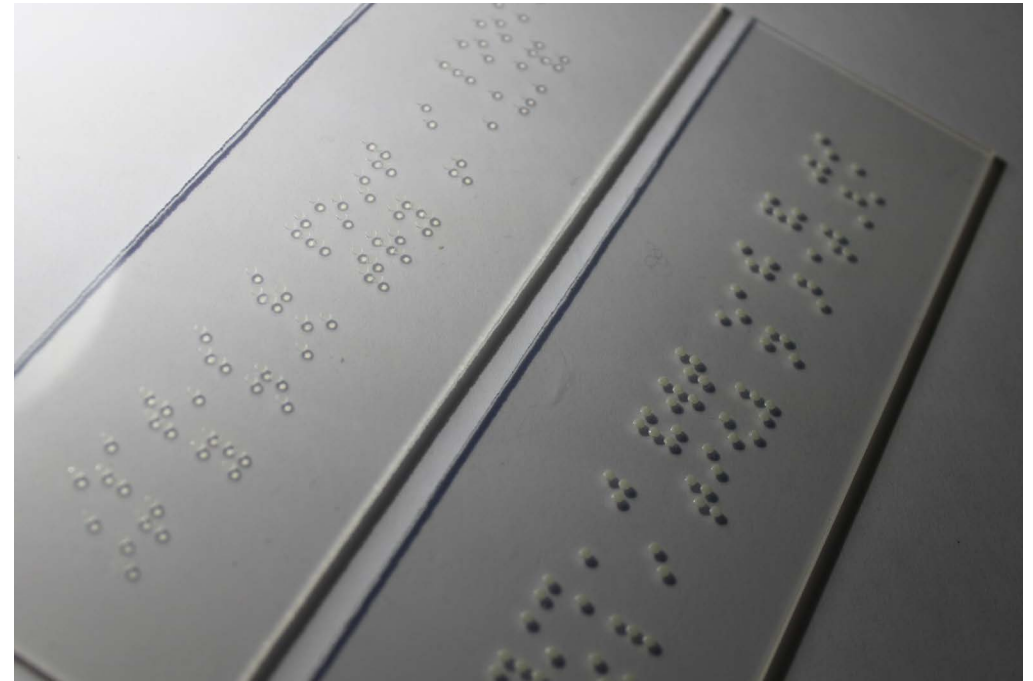
1.5/ Adapted Signage:
Linda Lewis

It is important that Braille on adapted signage feel well integrated. If Braille seems "tacked on" or otherwise negatively impacts the look of the piece, then it can been seen to have a stigmatising effect on either the space or other disability aids. In this vein we choose to adapt an existing university sign rather than create a completely original one, showcasing the methods potential to work in tandem with existing graphics.

We used white ink because it highly contrasts with the blue and because it mimics the signs existing lettering. We also raised the height significantly by creating a puddling effect using more emboss layers, something that we had seen used on other textural print work. This effect worked well, but we sadly had some "spillage" from printhead connecting with the dots. This has been fixed in later samples, by simply cleaning the printheads and lowering the print bed half way through the print.

This will be one of the main tests of our Braille, checking how suitable it is for signage. Over the course of this year it will be in use both as a sign and as a sample to show my work to others, meaning that it will be in more use than an average sign. When judged alongside other adapted signage it will be a good indication of how well the dots hold up to "normal" use and wear.

1.5.1: Adapted signage: Linda Lewis: Progress

Early signs are good, the piece has been in place for almost a year now with no sign of wear or damage. The height is perfect, the colour is consistent and the puddling has created a regular (albeit not perfect) dot shape.

This is my most successful sample to date and has become the bedrock of my UV research. It has survived near constant use and excessive handling, indeed it has even been brought to multiple conferences. Since it hasn't been damaged by use, cleaning or transport, I am confident in saying that this technique is fairly durable when applied to metal signage.

It is worth noting that everything from this point on will either be an exploration into artistic interventions into Braille, an examination of new substrates, or a look at how colours and materials react to this method.

1.5.2/ Adapted Signage: Bathroom Signage

This was an attempt to adapt a "non flat" bathroom sign, one that already had some level of tactile element for the blind. This was particularly challenging for the UV printer, as it essentially has to "drop" ink and cure it from a greater distance than it was designed to do. Before we even began this test we realised there was a high probability of failure, and sure enough we were right.

The dots began to "burst" and pool into each other, running and "bleeding" over the surface of the metal. This would not have been a problem if the dots were curing properly, yet even on higher settings the curing was imprecise and quickly turned the dots brittle, we have often had a problem with chipping but this sample broke apart almost as soon as we touched it.

In summary, at less intense curing settings the print wasn't stable enough to stick, with dots overflowing when new layers were added to the still improperly cured base layers. While at the other end of the spectrum the highest curing settings resulted in dots that practically shattered.

While this was a failure, it points out a clear limitation of the machine that is worth noting. The flatbed can only reliably print onto flat surfaces, and while it can print further away from the page it will never create a stable or functional result. This means that other tactile elements like raise plastic icons, would have to be added later if this method was to be used.

1.6/ Adapted Signage:
Maker Library Sign

This Braille is 1 mm high, twice the height of traditional Braille. We created this mainly to prove we could, and although the method will probably never be used to create "tall Braille" it is interesting to note that it retains its initial strength even when pushed to this extreme.

However we have noticed a yellowing of the clear varnish; this isn't too much of a problem with this sample, but it does need to be a consideration for future samples. This discolouration may become more of a problem with bright colours, so this will become an area of focus for the next few months.

On a side note this could be considered a new kind of Braille font. As much as these dots still function, the height increase has turned them into domed cylinders instead of half spheres. I am unsure of what kind of application this font could have, but with the rigidity of the Braille font system any successful alterations that we are able to make are worth noting.

1.6.1: Maker Library Sign Progress:

A mixture of an improperly cleaned surface, overtly high Braille and a very irradiated dot has lead to large amounts of chipping. At time of writing we have lost half the dots on the sign, but this has only become noticeable about 6 months after production.

Previous samples (see Linda Lewis sign and acrylic poetry) are not showing this problem, but this sample was exposed to over twice the curing of the other samples. This was due to the additional layers needed to create the extra dot height, all of which needed to be irradiated which in in turn further irradiated the already printed base layers. This resulted in a less stable dot which began to badly chip, while I believe our UV process still has a range of applications chipping has been a frequent and recurring concern. While this is something we have been able to overcome to some degree in certain samples, it is a fundamental weakness in the technique that must be constantly considered.

While this sample hasn't worked, it is worth noting that my earlier observations about an alternative Braille font still hold. If this cylinder were to be created using domed metal rods or some kind of wooden doweling, there is still a potential for a kind of "tall Braille".
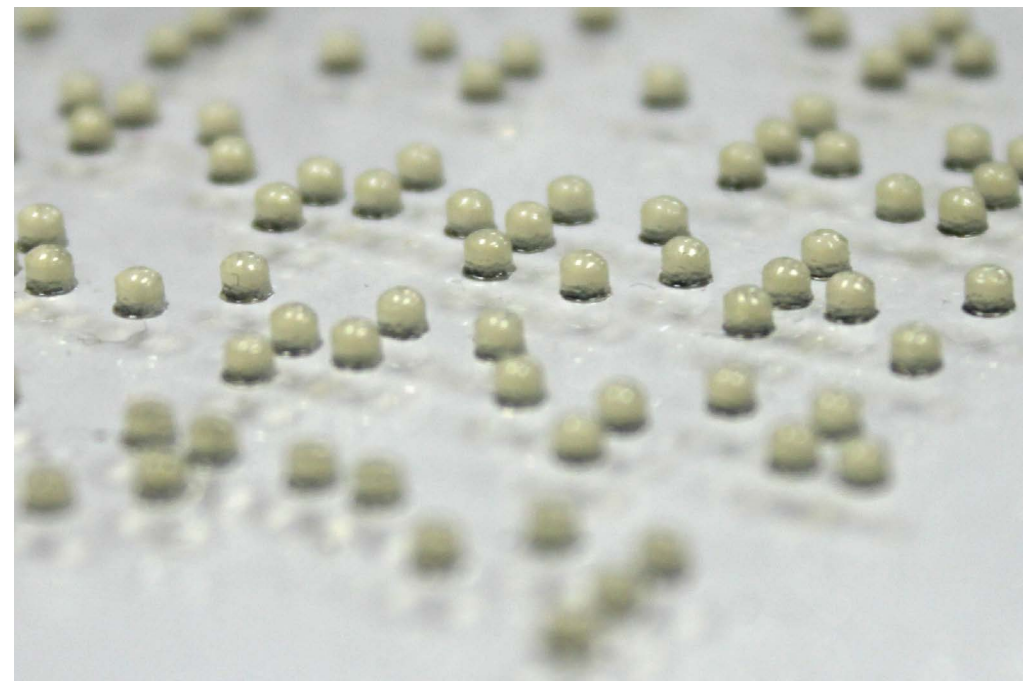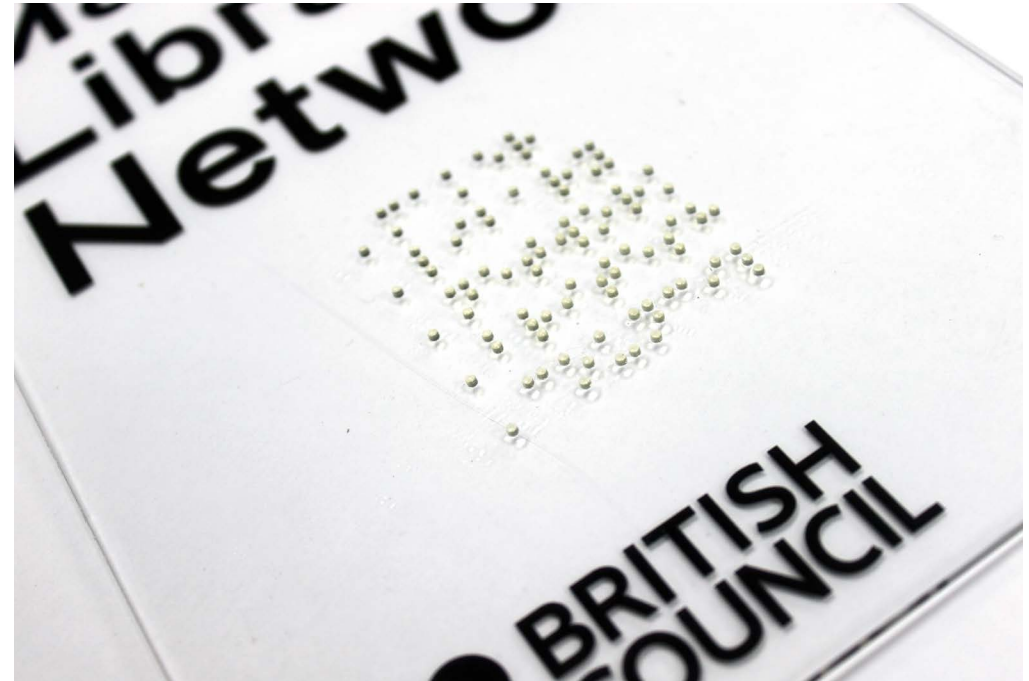
1.7/ Polka-dot Pattern: Fabric Samples 1 & 2

We have been looking into Braille as pattern design, and it only seemed logical to start with Polka-dot. We have created a "repeat phrase" with the idea that a sentence can be started from anywhere on the fabric and still make some kind of poetic sense. The exact phrase is "to the eye of the beholder of beauty to beholden" and is a reference to the haptic aesthetics and the quote "the beauty is in the eye of the beholder". This creates a series of different sentences that don't seem to have a logical end point when written continuously.

The first polka-dot fabric sample was a disaster, which thankfully means we have a lot to review. First of all the UV light reacted with the pre-treated fabric and turned it a deep shade of brown. The second problem came when the UV light began to darken the colours as it was cured. The settings we had the machine's UV light on, turned our beautiful blue pattern into solid black dots.

The second attempt was far more successful, we used non treated fabric and added a few layers of white to the Braille. This gave the dots a bright background in order to lesser the gradual darkening effect caused by curing and the layering of translucent colours. We still have a very pronounced issue with the dark blue "leaking" or using more ink than other colours, but overall the pattern has turned out well.

Yet once again we have run into more problems surrounding chipping, this has been due to the initial layers sinking into the fabric and compromised the dots. This could be counteracted with a block "underlayer" of ink or a binding agent, something that would harden the surface and make it less porous. This would also help limit the ink we see coming through the other side.

Future fabric samples will be considerably smaller, as the cost of this piece was quite high; over £20 on ink alone. Until we get something more consistent then a large range of smaller samples is preferable to one large artistic piece. That being said we are pleased with how this piece turned out, and as a proof of concept it definitely shows that Braille can be applied to pattern design. Still, a different kind of fabric that is far less porous might be more advisable for future tests.
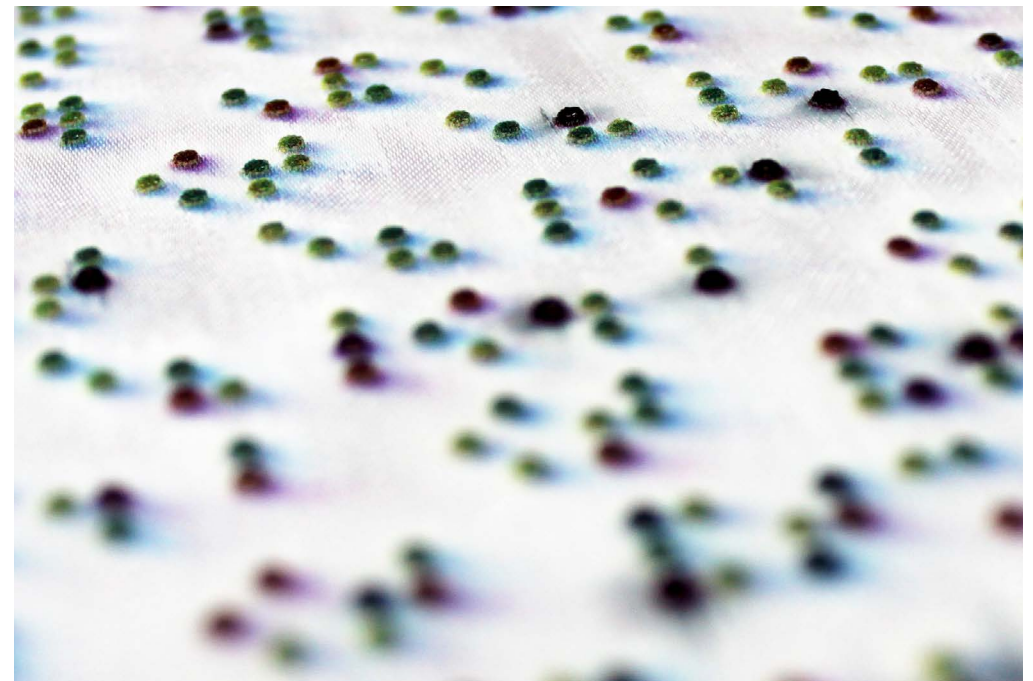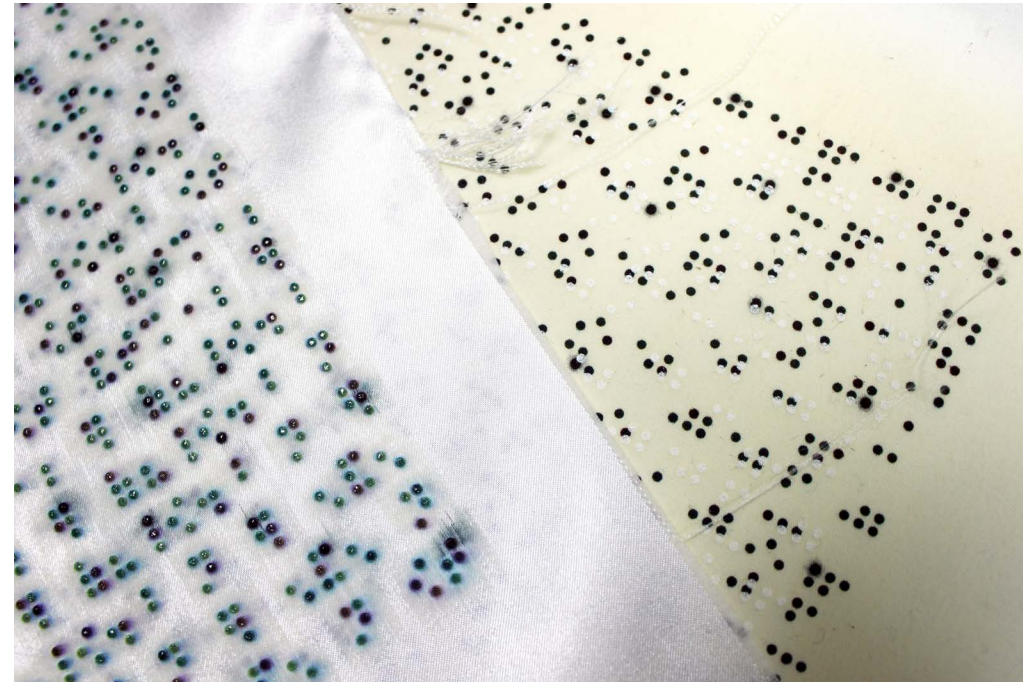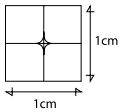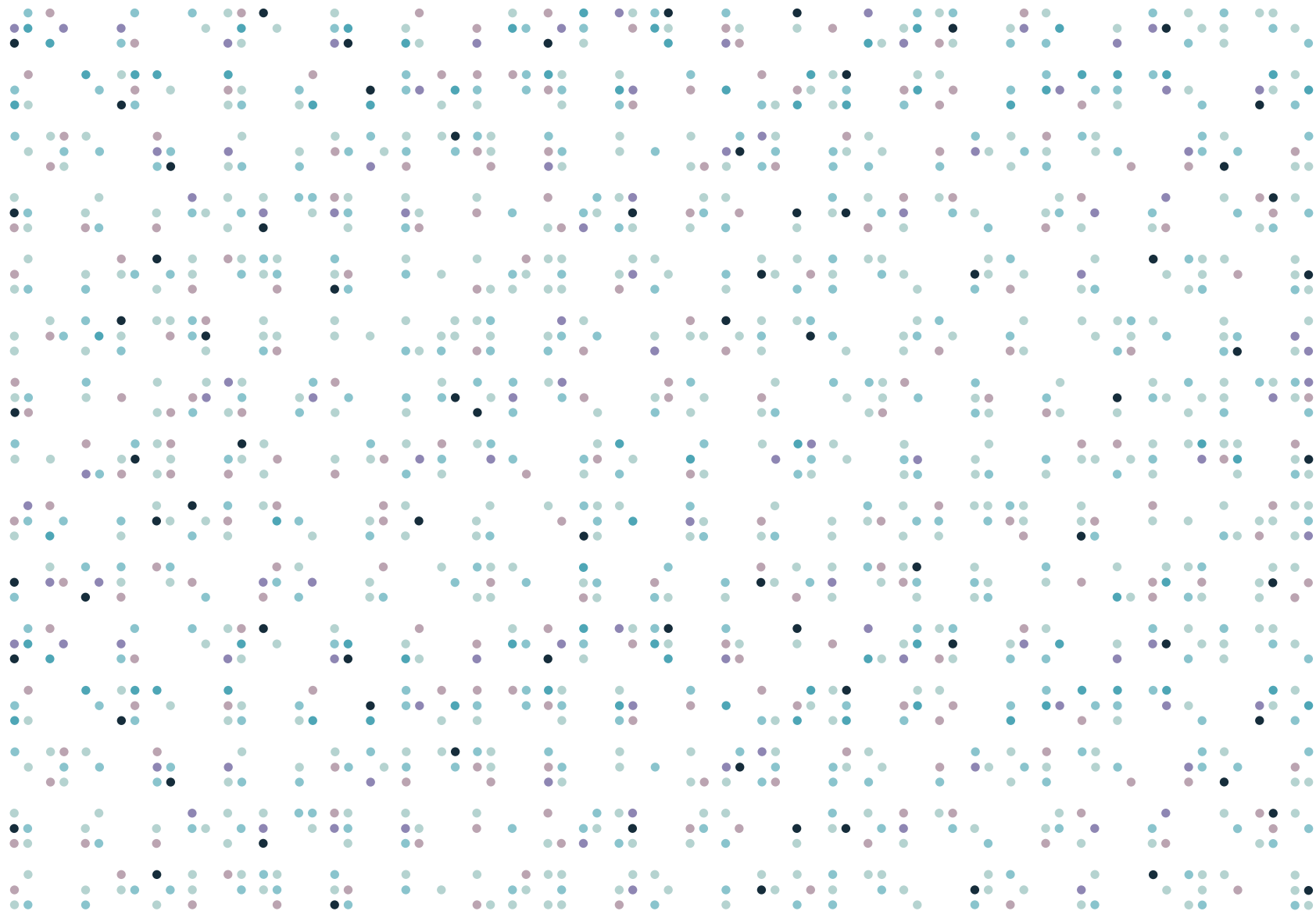
1.8/ Wood Sample:
Wood from the Trees

The aim with this piece was to create something which read one thing by touch, and another by sight. The word wood was meant to be raised and the wood trees was meant to be flat. Meaning that:

• Any dots that overlapped were printed dark and raised.
• Any dots only in the word trees were printed flat and dark.
• Any dots only in the word wood were printed transparent and raised.

Some children with relatively good partial sight will read Braille by sight and touch. In order to push children away from their reliance on sight, educators could print a flat word and emboss different ones. This will point out children who are "cheating" when reading Braille.

In some cases a child's sight might deteriorate over time, making over reliance on sight a problem. With others that partial sight might act as a crutch which will slow down their touch reading and could be considered a "bad habit". This gives this piece practical applications in teaching that could very easily be created using a printed Braille font and a slate and stylus.

Although the piece was very successful I have a few issues with it. The main problem was the colour, which reacted quite badly to the curing, darkening far more than we thought it would. But we also had a slight issue with inconsistent dot height, as the different colours required different numbers of passes. For instance, the flat Braille when printed first darkens more than if it were printed last, as it is exposed to many more sessions of irradiation.

Despite this the concept feels promising, and a flat print with a hand emboss is something easily achieved and accessible to educators. The piece also demonstrates the difference between a flat head and a domed dot, as the embossed layer which domes the Braille was not applied to the already darkened coloured dots. While still legible the domed dot is considered preferable and more comfortable, and in the accompanying images the difference becomes quite apparent.
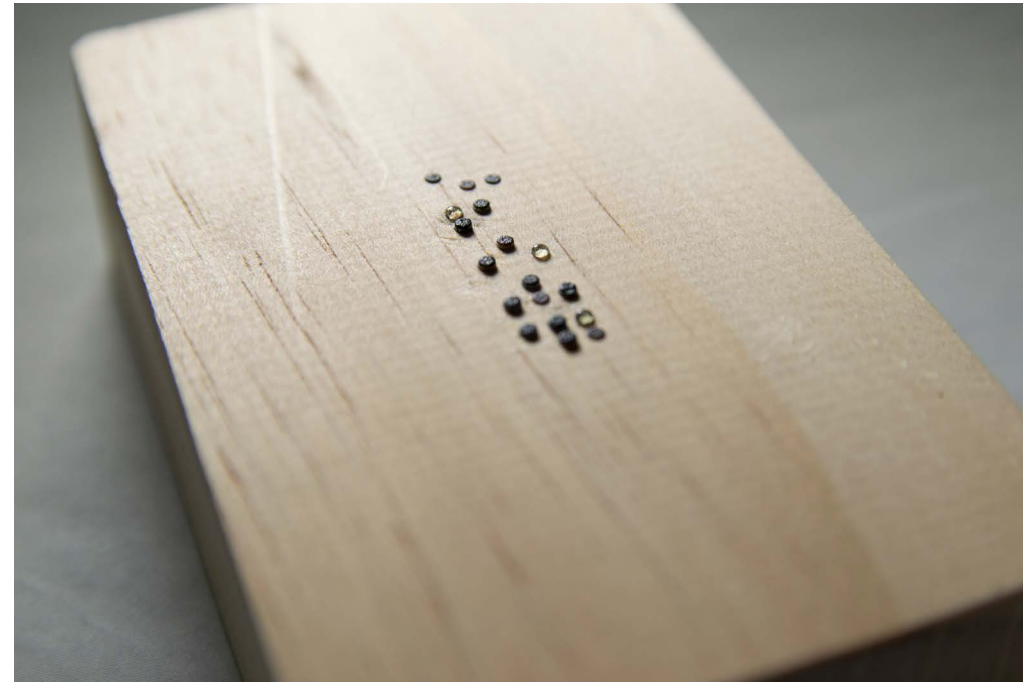
2.1/ Ice Braille:
Water Droplets & Acrylic

Temperature wasn't something we had originally planned to play with, but as winter set in we began to notice the shape of frozen drops of water. These droplets can create semi circle "dots" which we thought might translate well into Braille.

Finger sensitivity is a big aspect of Braille reading, it's something that's only learnt through practice and it can be a big hurdle for those with reduced feeling in their fingertips. Diabetes, calluses and a string of other conditions can reduce a person's ability to feel, so making Braille that plays with temperature, could help some people register Braille dots they other wise wouldn't be able to notice. This in turn might allow a new Braillist to get past this initial hurdle, at least until their finger sensitivity improves over time and with practice.

Not all Braille will be read in ideal conditions, there is a huge difference between reading a book in a warm room and a cold outdoor sign. These pieces (if easy to replicate) could help acclimate younger Braillists with harder to read Braille and push them to read faster, as they may not get long to read the dots before they melt.

There is something playful about Braille that will be destroyed when you read it, a Braillist may only get one or two attempts before the heat of their hands melts it to the point of illegibility. If the pieces can survive at least two passes of the finger, then I believe this will be more playful than frustrating, but if they are almost instantly destroyed then they will probably not work as teaching aids.

Long exposure to ice will numb the fingers, but short bursts of reading might kick start someone's Braille education in a fun and playful way. If this could be replicated in a home environment, it could be used by parents and teachers as a way of making Braille a bit more engaging to young readers. Imagine "orange juice Braille" or "bright food colouring Braille", reading .

After our first attempt a few things have become apparent:

- Dots on acetate slide as they melt, and porous materials like wood don't allow water droplets to form in the first place.
- Braille cells can't be made below a certain size, so this is only suitable for new readers. Dots and cells are small enough to fit under the index finger, but they are not small enough to be considered anything other than jumbo Braille.
- The ice freezes in less than a few minutes in the freezer, this is down to how little water we are using. However this means dots melt just as quickly.

I think that these initial samples have proven that the concept is feasible, but I still think my execution could be pushed further. The next step is to create slabs of ice that can have Braille dots applied to them. This bed of ice should increase the lifespan of the dots and prevent the sliding we have experienced with the acetate. The ease of which the ice dots can be removed from the asate, means that I can make the dots separately and layer them onto the ice. This also means I can create different coloured Braille to contrast with the ice slab

2.1.1/ Ice Braille:
Ice Slabs & Orange Juice

Although this method has been successful and the ice slabs have increased the dot life dramatically, it is hard to argue that this method is easy to reproduce. Between using knives to remove dots and making full sheets of dots to create a small selection of suitable ones, this method just becomes far to impractical for the pay off.

Despite this I am especially pleased with the vimto and orange juice Braille, which can be used as an ice lolly or drink after the fact. Taste may not become a major aspect of my work, but the playful nature of craft based Braille makes it a suitable area of exploration.

The next step will be cast Braille, which isn't as cheap or reusable, but could still be accessible. The cost of air dry clay can be as little as £5, and the cost of things like play doh can be even cheaper. If I can use a ballpoint pen or simple implement to create indents, then we might be able to develop an accessible method for making ice or wax Braille, one that doesn't need Brailling equipment.

2.2/ Wax Casting: Scented Candles

I started by creating a series of "wet clay casts" and one or two things quickly became obvious. Firstly the Braille dots were going to have to be bigger, as a clean cast just wasn't possible at this scale of dot. Secondly, removing the ice from a clay cast was near impossible as the cast itself froze solid. This means that the act of breaking the cast usually resulted in breaking the ice sample.

Thankfully the casts didn't go to waste and instead of creating ice we began to cast scented wax. At the beginning I had a similar problem with the dot size as the first few casts had shown that the wax dries too quickly to properly fill the small holes. However when we began making larger dots our pieces were noticeably more successful.

The first samples were a series of tiles that spelt out the word "wax". Each tile was cast from a different kind of scented candle, and although they are not the prettiest nor the cleanest things in the world, I still believe they have been a successful proof of concept.

Tapping into other scenes can be a powerful and playful way to engage a non sighted audience. By using scented wax as a kind of mnemonic device we can help a young child make associations that will not only help them spell, but help them connect the written word with objects and ideas. For example, the word cinnamon if spelt in cinnamon scented wax, might help a child connect that word with that smell.

We must note that they are not the cleanest things in the world and require scrubbing with cold water and a toothbrush when they are removed from the clay. Sadly the mess excludes edible Braille from this kind of casting, but now that we have a better understanding of the process, we can begin to make more substantial pieces.

The real strength of the casts is the fact that anyone could make them at home. Even the youngest braille learner could create the cast and have an adult pour the melted wax into the mould.

These are not really pieces to be exhibited, they are craft projects that are designed to be accessible to a wide audience. This is a teaching aid and an activity for young Braillists, but it's also a project that anyone regardless of ability could attempt.

It can be seen as a way for crafts-people to engage with Braille as a medium, and it would not be surprising to see wax cast Braille melts (or something similar) becoming a commercially available product, that is if a cleaner casting method could be found.

2.3/ Wax Casting:
Crayon Braille

Working with colour and the blind is always a bit difficult. Yet the blind live in a sighted world and they will be confronted with concepts of colour in their day to day lives. Even those completely unable to see will have an abstract understanding of colour, through object association and its integration into our language.

Yet most blind people are not completely unable to see. Indeed 20/200 vision is considered legally blind and this level of visual impairment allows for recognition of shape and colour.

With this in mind "toys" and craft activities that allow the partially blind to connect colour to Braille words, don't seem that far fetched.

We began melting crayons into crayon casts, each with the colour name pressed into the clay. Again I had to "oversize" the dots but we did find that the casts came out cleaner than the wax samples.

Initially we only cast half a crayon, this was designed to make removal easier and to allow two crayons to be held at once. If two half crayons are placed together, then they can be used to explain colour theory. For instance, half a blue crayon held together with half a yellow crayon could create basic green lines, if both are used on a page then the new colour might be recognisable.

To those with limited ability or trouble differentiating between certain colours, understanding colour theory can be problematic. But having physical objects that a young learner helped create, could give us playful way to explore the subject in a craft or art centric way.

It addition this craft approach allows teachers and parents to link Braille to their arts education, something integral to our discussion of artistic Braille which can allow a child to better engaging with their own written language.
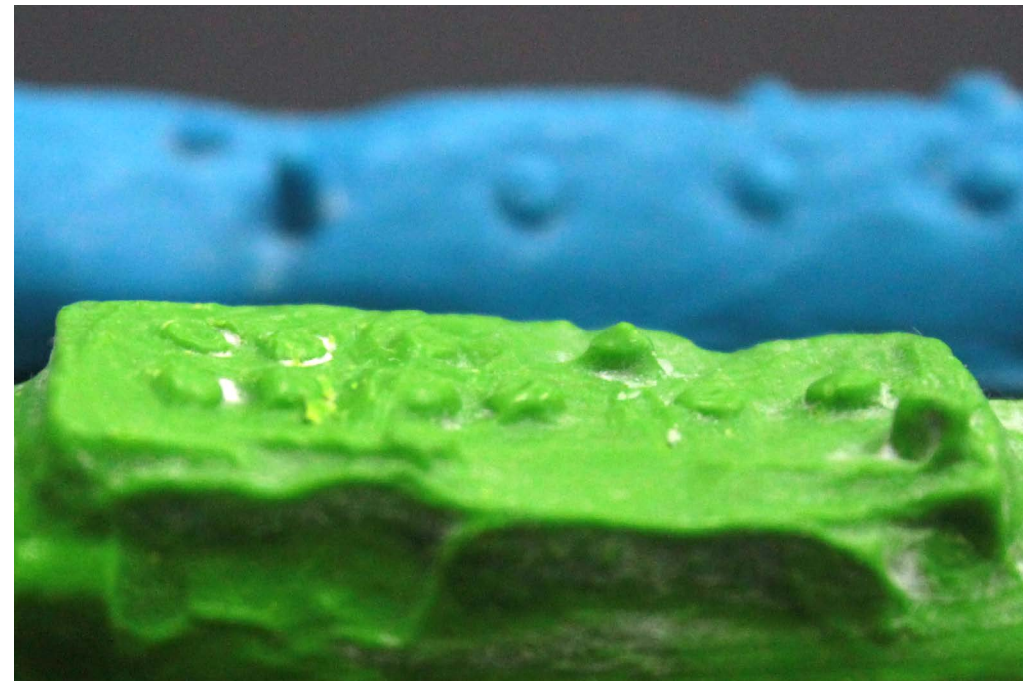
2.4/ Rice Paper Braille:

It is doubtful that this is an original idea, indeed it's hard to imagine that someone has done it far better that I have. Yet it deserving of inclusion and discussion, as although we won't be bringing this piece any further, we are aware that to an educator it could be a simple but engaging exercise.

At it's heart the exercise is simple, the material is cheap, the process is fun and above all it can be used to teach Braille writing. This last point turns this from a craft project into a teaching aid, a way of engaging a child with the art of writing by creating something out of disposable practice sheets.

The paper you work with is edible, imagine writing notes you can eat; worksheets that can become snacks rather than being resigned to the waste paper bin. It might not be a daily activity, but fun one off lessons can have a big impact to the right student, tapping into other senses that might engage them more than traditional learning.

As the embossing process requires no ink there is no risk of "contamination" so the rice paper is safe long as they aren't handled over the course of days, so this idea would only work for:

- Projects where the end product is disposable (practice sheets, worksheets, notes etc…)
- Projects where the results aren't going to be marked or stored for more than a few hours, meaning that they won't need to last or be handled by multiple people, only the ebosser (presumably the eater) would handle the paper.

As such I think this would be a brilliant way to introduce children to the embossing/writing process. Yet I believe it would become less relevant to older children who might benefit more from projects where they can keep and display their work.

Even so I think this has been a resounding success from the get go, that has proved my point at the very earliest prototype. Despite this I don't think it has the same originality of some of my other work, as it's hard to argue that embossing paper is a new idea in the world of Braille.

While there are a variety of applications for this technique (edible inks and tactile sugar illustrations to name just two) the area does not seem as relevant to our conversations about haptic and mainstreaming, as our other projects. This means that while it is right to include this, it should be treated as a footnote, a topic for a future exploration rather than something which will be developed over the course of our paper.
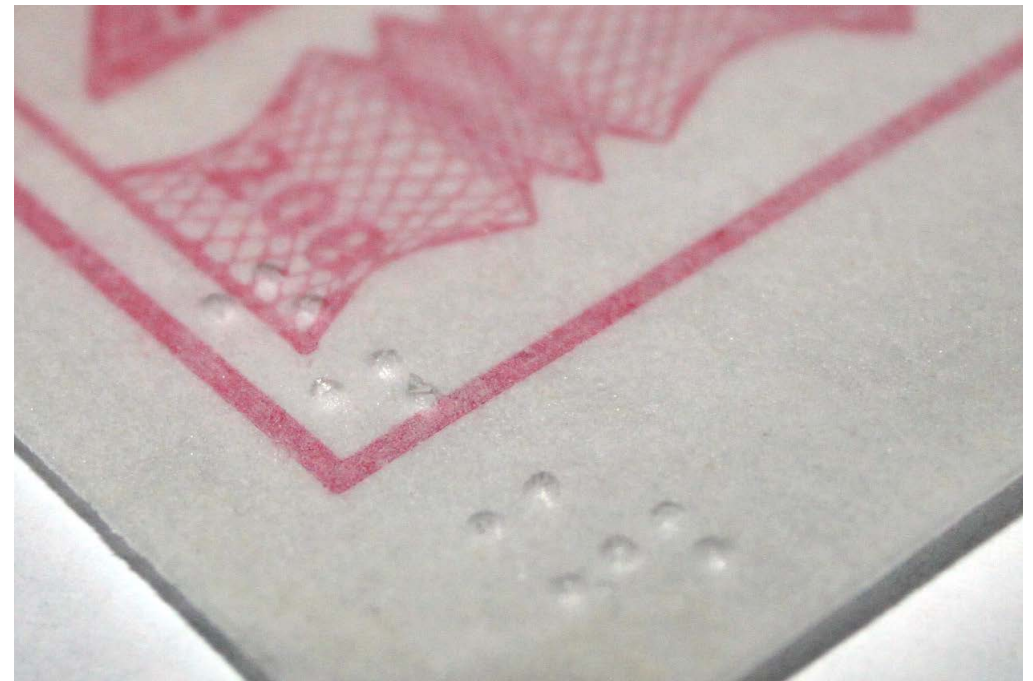
2.5/ Braille Stationery:
Printed Templates

In the earlier wood sample section, we noted an idea that warrants further exploration:

"a flat print with a hand emboss is something easily achieved and accessible to educators."

Originally the idea was flat printed Braille, where words were embossed after the original flat print. This means that you can have visual Braille that reads something else from the non visual version, preventing Braillists from reading by sight. But while this idea could be fun in certain circumstances, it has limited scope and feels a little exclusionary. The idea that half the information is designed to be unreadable to the blind is problematic, and outside of the niche application discussed earlier it is hard to find real application.

While the "wood from the trees" sample was incredibly successful, and played with some people's reliance on sight to read Braille, half the message was necessarily hidden from those without sight. So instead of having anything as complicated as a custom sheet we decided to print all the Braille cell dots filled in, essentially just creating patterned paper that can then be embossed. In this way we remove the secondary information and simply make beautiful cell inspired stationery to emboss. While you could just emboss store bought patterned paper, the fact that a pattern reflects the look of traditional Braille feels like a more sensitive approach, creating something without hidden messages, while tapping into the visual language of Braille.

These are basic samples, but opacities, random colours and dot matrix style images, could all be applied to templates for a greater range of quirky and interesting stationary for the blind. With some tweaking for specific slates and stylus brands we could even line up the dots perfectly, this would mean that the Braille embossing is coloured and that the dots themselves are actually coloured.
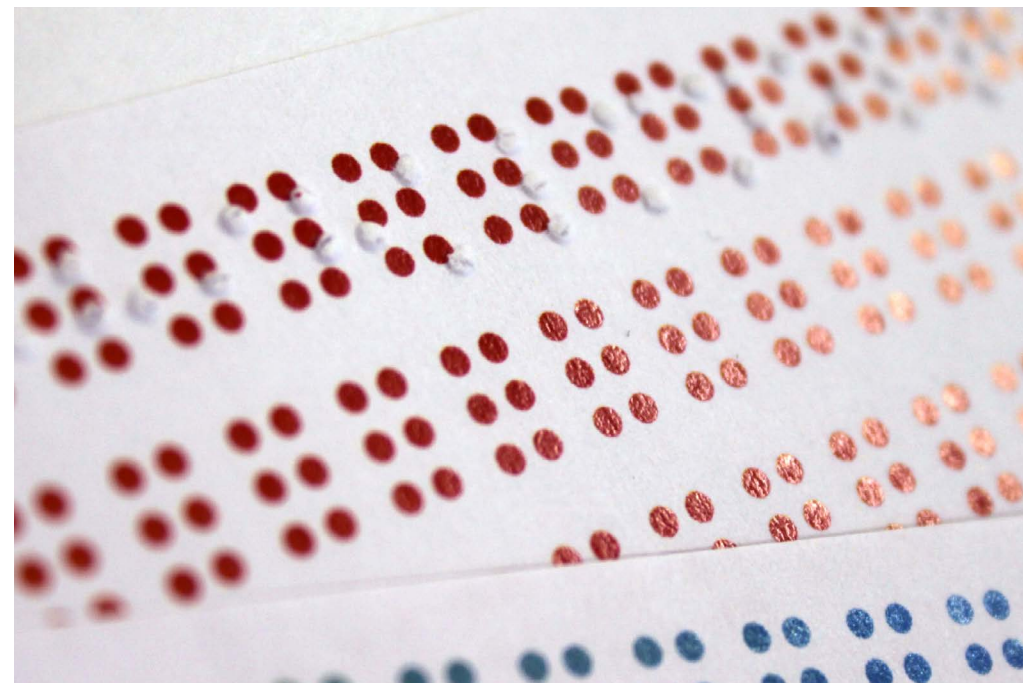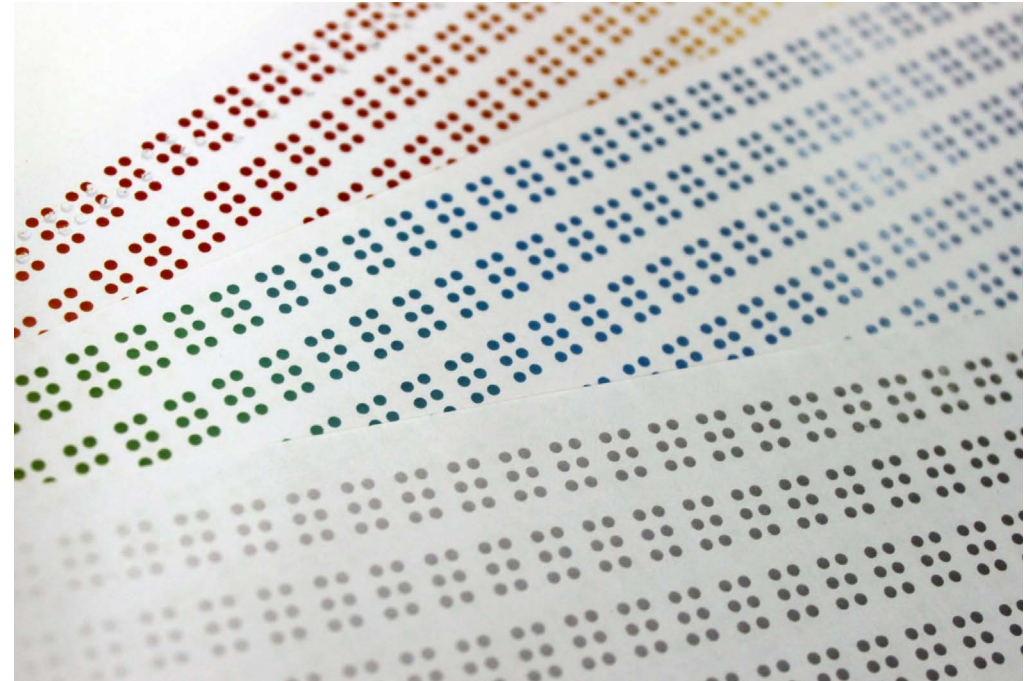
2.6/ Braille Stationery: Laser Cut Patterns

After working with printed templates we began to create laser cut overlays. There is a need to explore "Braille Stationery" that was better able to play with the tactile nature of the medium, focusing on material and interaction.

Overlays are unique to Braille, they capitalise on the striated form of cells and rows while taking advantage of the mechanical nature of Braille "handwriting" that still requires a slate and stylus. In this way there is far less variation in form when comparing Braille to traditional handwriting, and a certain amount of understanding about particular brands of slate and stylus can allow us to create products geared towards said brands, stationery guaranteed to work for any message on a particular device.

There are two distinct ways in which we have approached laser cuts, the first is geared towards universal or brand specific stationary, overlays that work no matter what the message is as long as it was created on a specific device. The second approach is far more bespoke, where each cut out only works for a particular message.

If we look at the patterns on the next page, we are able to identify some patterns that have holes for all six dots of a cell, and differentiate them from those which do not. These bespoke cuts actually display the alphabet, and show three basic cut out fonts. While the final blue pattern simply says the words "tea time" where tea and time are in different colours, each word would have a different coloured base material which allows us to have different coloured words in the same piece.

These templates allow us to create high contrast Braille by pairing opposing colours together. For instance a white paper base material, pairs well with a dark red card overlay. This allows us to create coloured Braille dots, or even use patterned paper to create detailed and highly visual Braille.

The overlay does mean that the Braille dots effectively lose height, preventing this technique being used on particularly thick material. But in regards to traditional card or paper, the loss in height is so minimal that it causes no issue in the legibility of the dots. In addition the more generic patterns will have holes or gaps not filled by dots, for the simpler patterns this should not interfere with the legibility of the Braille, as holes are very hard to pick up by touch at this size, but the more complicated patterns might need to be more carefully glued down to work effectively.
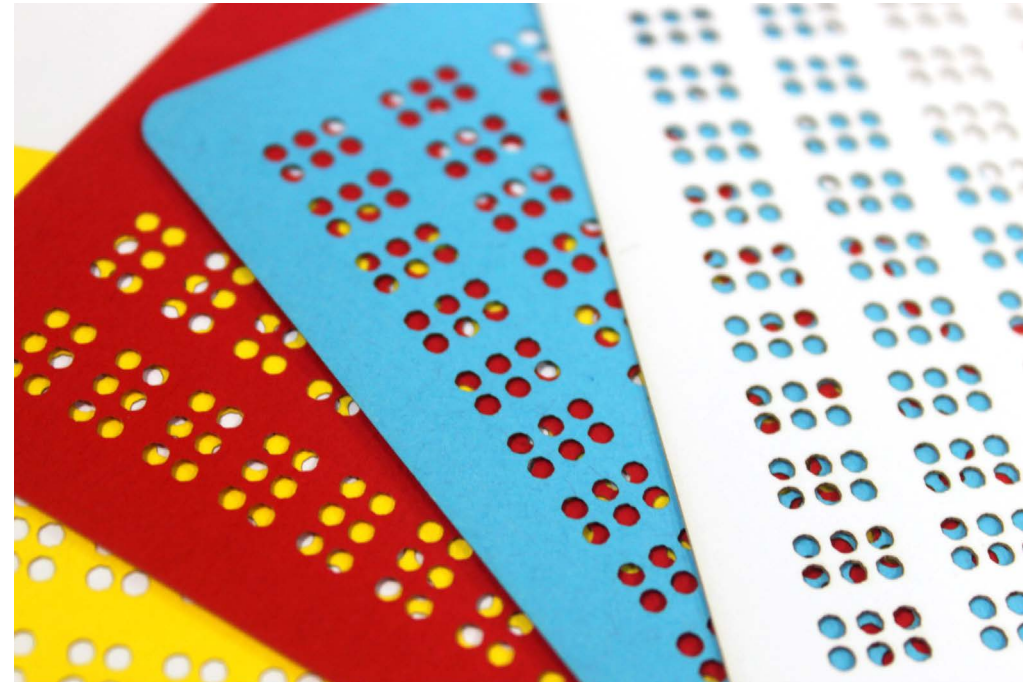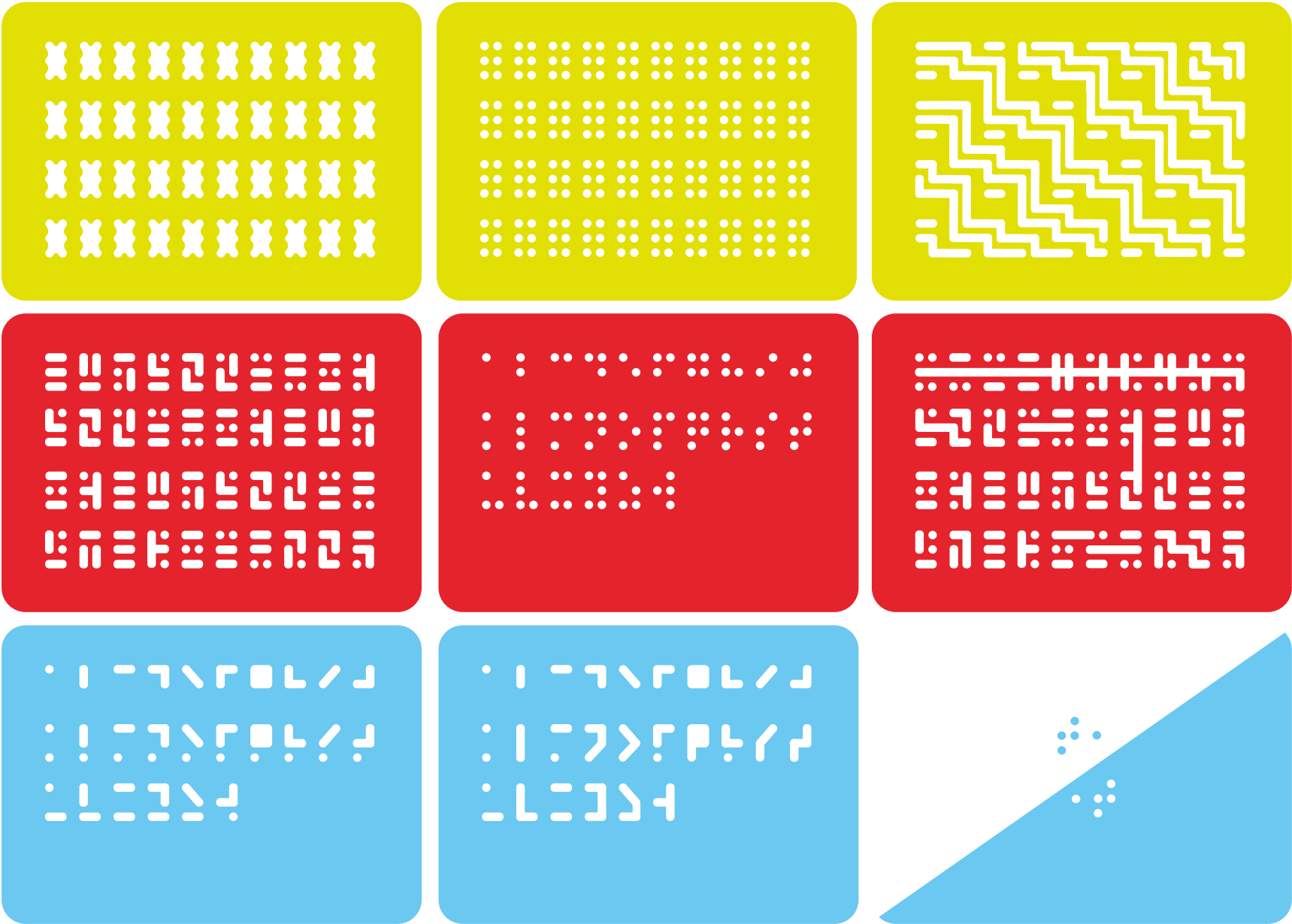
2.7/ Two Material Braille:
Tinfoil & Sandpaper

The laser cut overlays also open up new avenues in regards to the use of different materials. By using highly thermal conductive materials (metals) in conjunction with less thermal conductive materials (paper or acrylic) there is a possibility, that we could create dots that feel colder than the surrounding material. This in turn might make the Braille easier to read at lower heights.

There is also an interesting idea that if highly thermal conductive dots were cut out and placed into holes of less thermal conductive materials, then we might create "flat Braille" that works off our ability to sense temperature rather than pressure. While I am highly sceptical about any kind of 2D Braille I do think temperature could be a way to increase legibility, and using different materials rather than heating or cooling plates, seems like a far more cost effective way of creating signage.

We used tin foil as the base material and card for the overlay, creating foil dots that feel marginally cooler than the card. While there is some difference in temperature registration it is not particularly pronounced, and I think it's clear that tin foil would not be conductive enough to be read in two dimensions. Even so the concept is very interesting and there is a noticeable difference between the feel of the card and tin foil. In this way two material Braille can allow for an exploration of texture as well as temperature.

While sandpaper is clearly an extreme choice, it is one that demonstrates the point rather effectively. If we pair rough and smooth materials we can create Braille that contrasts in more ways than merely colour. While I would not advise using sandpaper for books we could still pair materials like card with more "tacky" materials like rubber or textured materials like fabric. By experimenting with different pairings we might find materials that allow for a more legible Braille, or at least more interesting ways in which Braille might be felt.
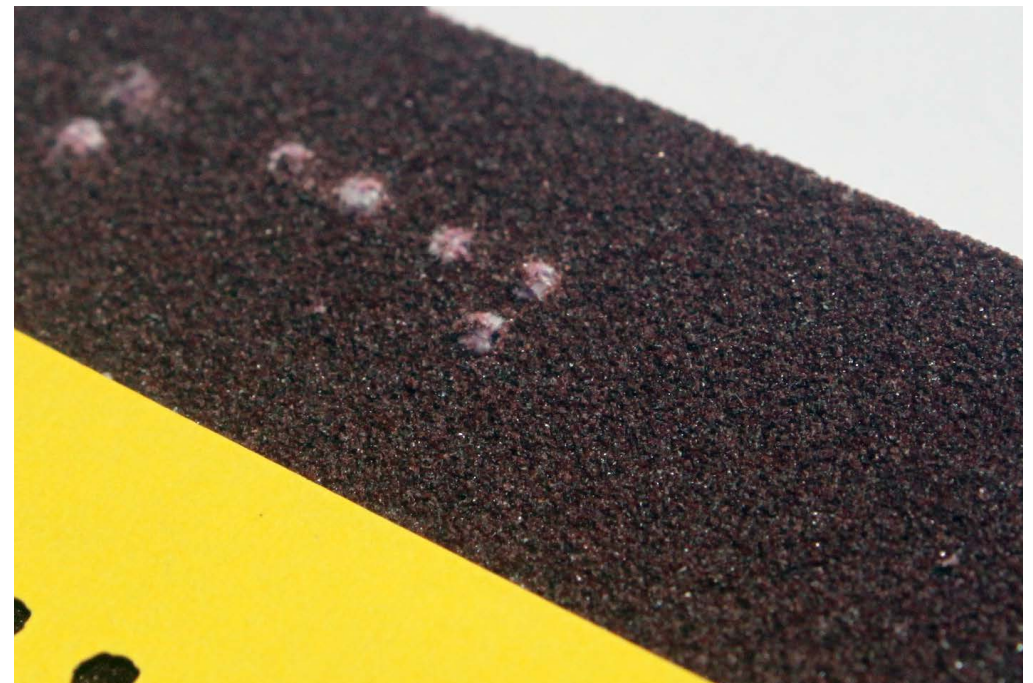
2.8/ Braille Ambigrams:

An ambigram is defined as: "A typographical design consisting of text modified in such a way that it can be read in multiple orientations, as in mirror image, inverted, or when rotated." by the oxford english dictionary.

Think of the word "pod" if rotated 180 degrees it still reads "pod". Some versions say different things when they are flipped for instance "mom" saying "wow", but the basic principle is the same. These are very basic examples that illustrate the concept, but there are more advanced versions that play with ambiguous handwriting to make new letter forms.

Calligraphy works beautifully with this art form, as the non distinct shapes and flourishes can often allow a different word to be read when said word is flipped. It also allows non symmetrical letters to be integrated seamlessly into the designs, which has been shown to great effect in the film adaptation of the Da Vinci code and shows like Derren Brown's "Truth or Dare".

Braille doesn't have the luxury of ambiguity, if a Braille cell is flipped it can only mean one thing. This makes it hard to approach ambigrams, as only a few very specific words or phrases will ever properly work. Yet in theory the flipped words will always read something, even if it is gibberish.

Take for example the word (strand), in Braille it becomes a three letter word (st)(r)(and). If this is read upside down (and) becomes (y), (r) becomes (w) and (st) reads (st) as upside down the cell is identical. This means that the full word read upside down becomes (y)(r)(st), which is nonsense but still readable as characters.

The trick is finding characters or words that work upside down; words like (s)(t)(ar) read the same upside down as (s) becomes (ar) and (t) reads the same upside down.

This is not technically grammatically "correct" as in grade 2 this should read (st)(ar) rather than the three letter version we have used. But there should be a certain amount of artistic licence is allowed in cases like this, similar to that which is given to traditional poetry and wordplay.

While at first glance this may not seem like a craft project, I do think it has potential as a teaching resource. It won't be something used everyday in the classroom, but trying to encourage learners to make their own ambigrams could be a fun and challenging exercise.

Even the fact that (t) and (s) both read the same when upside down, and (w) turns into (r) are just interesting pieces of information that stick in your mind. Snippets of general knowledge that might help some learners engage more with their own language and writing.

The examples I've listed illustrate some interesting ideas. Some characters like (sh) become (u), so the word shush becomes ushu. While this isn't very useful as a traditional ambigram, it could be very interesting for something like a continuous pattern design.

I also found that certain letters become kinds of punctuation. The letter p becomes the symbol for "number" and when a-j follows that it becomes 1-0. This means that the word top (to)(p) becomes (NUMBER)(0) as (to) becomes (j). Similarly ora (o)(r)(a) becomes (CAPITAL) (w)(ow) or Wow, as (a) becomes a capitalisation symbol.

2.8/ Braille Ambigrams:

There are only ever going to be a few example of this kind of grammar based ambigram, but the fact that punctuation can work at all, opens up quite a few possibilities to play with. Even the act of trial and error gives you a new kind of appreciation for the ways in which Braille can be used in fun and interesting ways.

On a similar note, Braille allows whole words to be represented by one letter, meaning that (y) can mean (you) on it's own. (y) becomes (and) upside down meaning that we can have the phrase (you and) as an ambigram. This can be applied to other "one word contractions" like (w) meaning (will), which when flipped becomes (r) meaning (rather).

There are also two letter contractions, where a contraction symbol turns a single letter into a different word. For instance the letter (t) becomes (that) when on it's own in a sentence, however, it becomes (time) when the contraction symbol (dot-5) is in front of it. This means that the word (t)(ea) becomes (dot-5)(t) or (time) when flipped. Meaning that (tea time) is an ambigram when presented on two lines.

Once again the letters and words that have a secondary linked meaning, are few and far between. This means that while this is a very interesting exercise, the outcomes will always be limited. Yet in many ways I believe that the process is far more valuable that the outcomes, it feels a bit like building a puzzle or trying to recognise patterns in code.

On top of that the unique grammar and very contextual nature of the writing system, means that while there are many restrictions there are still lots of ways it can be played with to turn it into something that couldn't exist in any other medium.
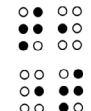
In many ways this is at the heart of my research, it embodies the idea of Braille as Medium. The pieces that come from this exploration can only exist in Braille, nowhere else would the word (you) read (and), or the letter (d) become a question mark.

It becomes a unique exploration of Braille characters and in many ways it could be seen as a kind of Braille calligraphy, a niche take on letter forms that allow for playful one off pieces. These might not have a widescale application but it's enough that they work once as stand alone expressions of language.

In short this exercise plays with the accidental quirks of a system. In many ways you could equate it with puns, playing on fun crossovers of language, to make something interesting or quirky. There isn't a "point" to them as such, they are just another way to enjoy our language and create something that helps us identify more with our writing.

Much like poetry, puns, calligraphy and other art based expressions of writing, these ambigrams can help give writers a sense of ownership over their language, giving Braillists a better appreciation of the eccentricities that make their system unique.

m ing	n ed		
in i	ow o		
s ar	the n		tea / time
sh u	e en		

|	
s t ar	shall us
sh u sh u sh	you and
u sh u sh u	that very
W ow	child child
o r a	out out
t ea / DOT 5 t time	that that
to p / NUMBER SIGN j 0	for for

2.9/ Beaded Braille:

Beading can be an intricate art, but the scale and shape of many beads lend themselves well to Braille. I am by no means an expert or indeed even proficient as a beader, and yet I was able to create a Braille phrase in a very short amount of time. Given this I have no doubt that a professional or even a more proficent amature could create far stronger and more intricate work than this.

That being said the beads seem to have worked well and while they feel different from traditional Braille I don't doubt the legibility. It is important to note that we sew beads from top to bottom in order to create a directional dot, one that has no hard edges when felt from left to right. While this may only seem like a minor point it is something that allows us to imitate the semi sphere dot shape of traditional Braille, and prevent uncomfortable or inconsistent edges interrupting the flow of writing mid sentence or indeed mid letter.

The phrase we used reads "tea time" and part of the pieces further development involved dying the fabric in tea. This is an example of how we might stain or scent fabric to engage our non visual senses, and smells that tap into the meaning of the piece might be a way of creating more expressive work.

While this is only a basic example of both beading and scented fabric work, it does illustrate the basic concept. It is also worth noting that the fabric would be more legible if it were stretched, making this technique more suited to things like cushions designs or decorative pieces, yet at the same time the piece we created was still fairly legible despite the natural movement of the substrate.
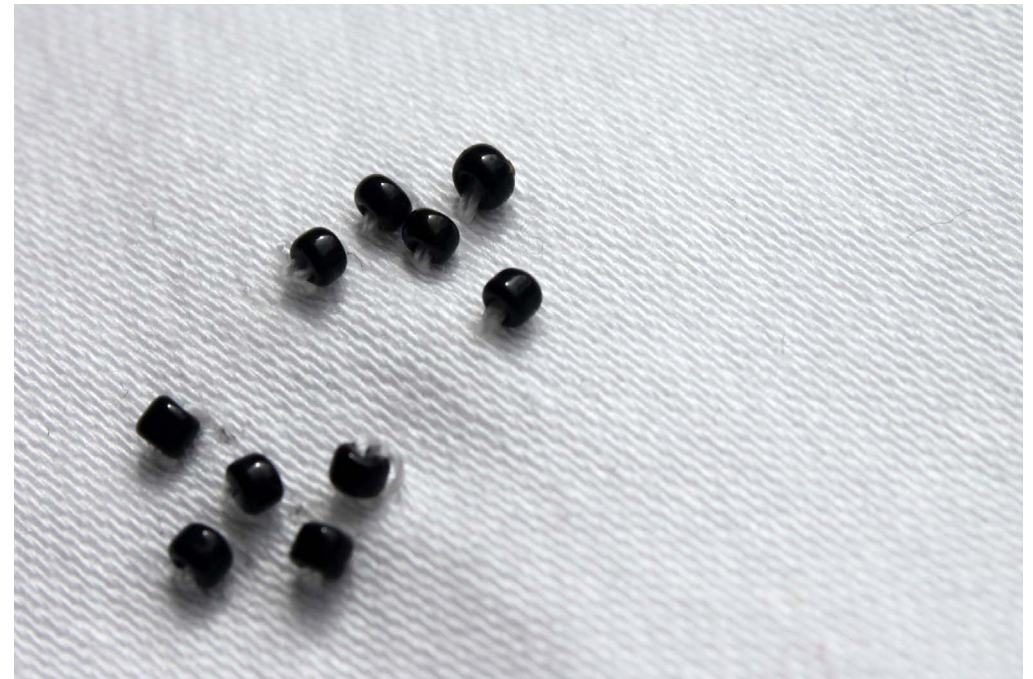
2.10/ Pearl Braille:

While rather simple, these self adhesive faux pearls are the perfect shape and size for Braille. On top of which they are cheap, widely available and require very little technical skill to use effectively.

Once again this isn't a technique that lends itself to large scale writing, but as a way of creating simple phrases or even single words it can be very effective. What's more it's a way of "writing" Braille that doesn't require a slate and stylus or any more expensive machinery, allowing those who are completely outside this area to approach Braille. Indeed even the nature of self adhesive dots make the process quicker and more accessible, furthermore unlike a slate and stylus you aren't required to write backwards and back to front.

This technique could be thought to share a similar artistic space as scrapbooking and card making, a creative or minor commercial outlet that allows non specialists to create functional and practical pieces. Yet at the same time these pieces have a unique and considered aesthetic that while not "high art" is no less valid an artistic intervention.

Adhesive pearls allow anyone to approach Braille, and while I doubt they will hold up to the kind of pressure of traditional embossing it still has valid application. In many ways it is comparable to rice paper Braille, in while it is not particularly revolutionary it's easy of adoption make it a worthy point of exploration and conversation.

3.1/ ABC Teaching aids
for Contracted Braille:

Over the last few years I have noticed quite a few misconceptions about Braille, the main one being that a Braille word are a direct copy of a non Braille word. Few people know about contracted Braille and it has lead to a few examples of "Braille fonts" which just teach the basic alphabet.

Although Braille ABC fonts are not a bad thing, they are something that could certainly be done better. The fact that they perpetuate a misconception that Braille is just a direct translation, feels like something of a disservice to the medium. With that in mind we have tried to create a teaching aid, designed to help sighted and non sighted users learn about contracted Braille.

My aim was to create something that worked with a slate and stylus, while still giving the sighted a better understanding of the medium, something that worked as a teaching aid but where costs had been kept deliberately low.

The final piece has managed to achieved most of these aims, it works with any A4 slate and stylus/ Brailler and can be easily cut into tiles. All Braillists or Braillists-to-be will have this equipment readily available, and the only other things that's required is a regular a4 colour print. This would bring the total cost to around 35p, or the cost of card and a coloured print. We wanted something that anyone with equipment could Braille, by having the embossing process done by the end user I was able to avoid having to ship a physical item. This reduces the costs and allows it to be easily and quickly distributed, at least to anyone with internet access.

The tiles are in a logical order, with the symbols for ABC coming first, followed by punctuation and "two letter contractions". Meaning that the pages will work as a poster or "cheat sheet" where context gives you an idea of what the symbol could mean. They also work as titles that can be cut out and stuck together.

The smallest sheet is set up so that when any tile is placed next to another, then the spaces between those letters should be correct (at least for english standard Braille). This means that you can rearrange them to make words and alter the context of certain symbols. For example the letter "K" on it's own becomes the word knowledge, but when used with other letters it reverts back to the letter K.

The bigger sheet keeps the Braille the same size but the larger tiles allow them to be moved around more easily, especially by younger children. It also creates more space to type on, allowing the visual elements to be bigger for those with partial sight, or educators with less than perfect vision.

If you combine these tiles with blue tack or sheet magnets, then you have a reusable resource that a Braillist can arrange and rearrange in order to create their own words. This bypasses the need to write with a slate and stylus which can often slow down early stage learners; as to write words by hand you have to write them backwards and back to front. This means that learning to read Braille can often come before learning to write it.

This resource is meant for young and new Braillists who are moving on to contracted Braille, but it is also there to help non-Braillists check work and quickly gain an understanding of the medium. We can't always guarantee that a teaching assistant will know Braille and parents and teachers may have to learn the system as the child does. The fact that each meaning of each symbol is on the same tile, means that even when they are used in unfamiliar ways a sighted person can quickly check that a word is spelt right or that a sentence makes sense.
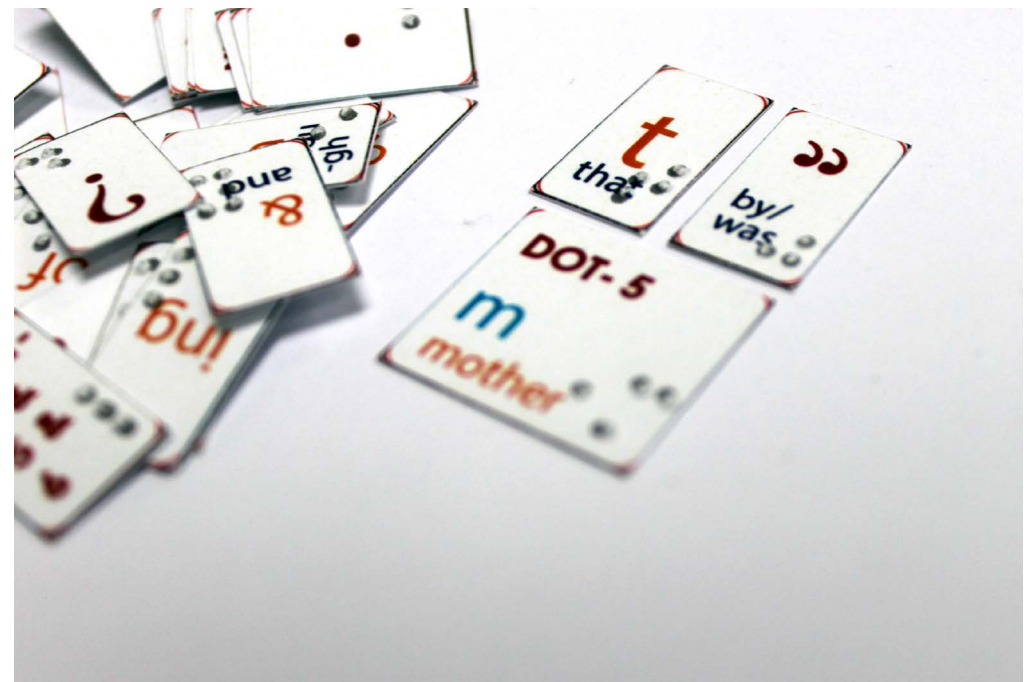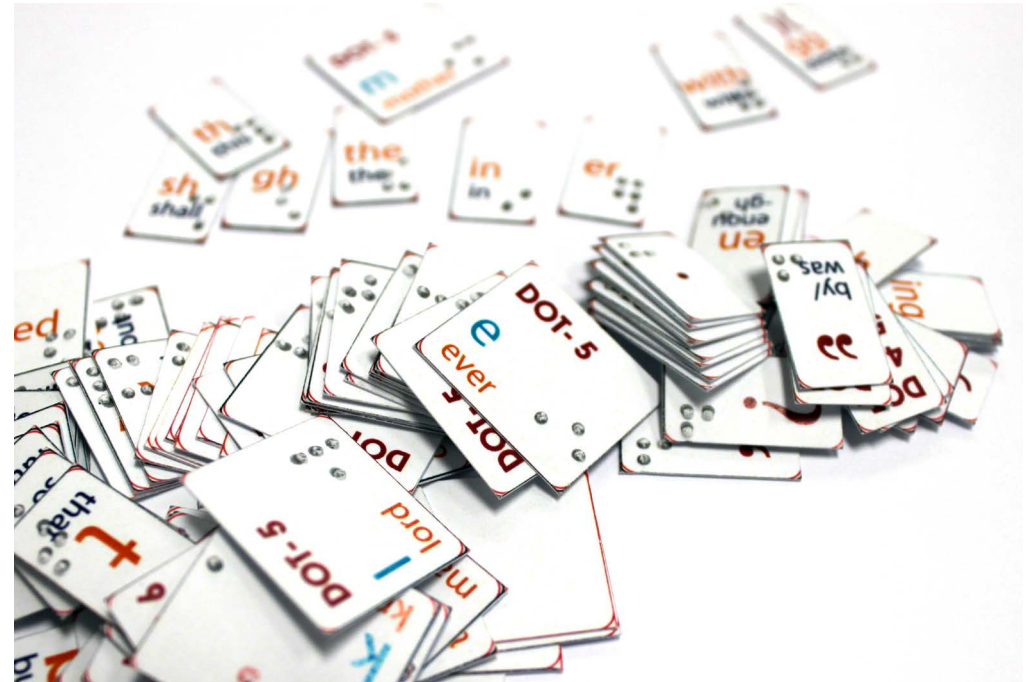
3.1/ ABC Teaching aids
for Contracted Braille:

As much as I value the work I create on the UV printer, I realise that the majority of artistic Braille is "craft" based. Things like teaching aids and home made pieces tend to be a lot less refined, yet they are personal expressions of someone's language, and in many cases the pieces a blind individual makes might be the only creative explorations of Braille that that person regularly interacts with.

Think of a clay sign for a child's bedroom, cakes with edible ball bearings or Braille poetry boarded with shells or textured objects. These are not "high art" but they are legitimate artistic interventions; they help establish Braille as more than just a way to understand information, and they can push a disabled person into areas of the arts they might not have considered.

Creation plays a critical role in a child's development, artistic practices like drawing and painting are common pastimes that have well documented benefits for young people. A blind child still has all these basic needs, they just need different ways of exploring them; one of which might be Braille.
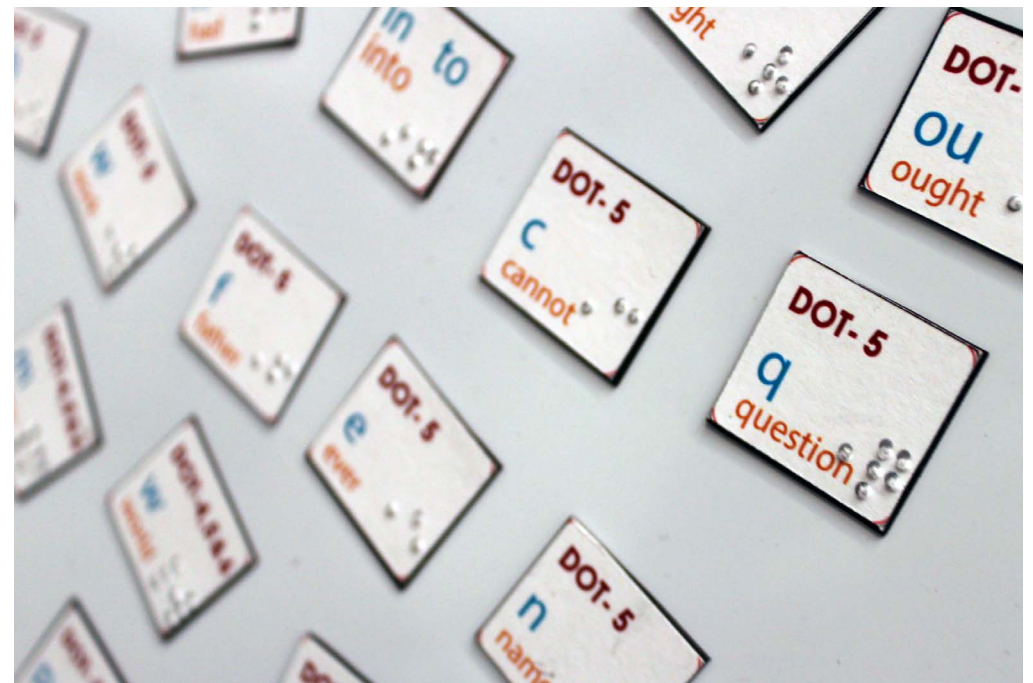
3.1.1: Wooden Tiles and Magnet sheets.

I recently attended a conference where I showcased this piece in a couple of different ways. I created one on a "magnet sheet" along with a laser cut version. Now while I doubt most people have laser cutters in their own home, I do think it showcases the versatility of the aid. I also think that a similar effect could be achieved quite easily with thick card or plastic sheeting, which wouldn't be as durable but would be much more accessible to produce.

The magnets cost me around £5 for 5 A4 sheets, making them a pretty reasonable purchase compared to the cost of a lot of other teaching aids. This brings a full set of magnetic tiles to ~£1.15 if you include printing.

However while it is very cheap it does require time and effort to produce. The tiles can be stuck and embossed relatively easily, but the larger set has 97 separate tiles all of which need embossing, gluing and cutting out. I also found that the smallest tiles were impractical to work with, and while I did create a magnet set for them, I doubt they would be any good as fridge magnets due to their size.
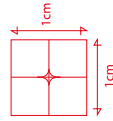
Overall I think this is one of the most successful pieces I have designed. It's cheap, versatile and useful to a wide range of people approaching Braille for the first time. While I doubt it will dramatically change the world, I do think it has the potential to do some real good, especially if I can make it widely available. To that effect I have contacted the RNIB and am in the process of finding a suitable platform where others can download it for free.

Braille contraction reference chart (dominoes/cards). Each card shows a print word or contraction, a large letter, the braille dot pattern, and the word it represents.

Print word	Letter / sign	Word
a · 1	a	the
but · 2	b	
can · 3	c	
do · 4	d	
every · 5	e	
from · 6	f	
go · 7	g	
have · 8	h	
just · 0	i	
· 9	j	
know-ledge	k	
like	l	
more	m	
not	n	
people	p	o

Print word	Sign	Word
quite	q	
rather	r	
so	s	
that	t	
us	u	
very	v	
it	x	
you	y	
as	z	
will	w	
for	ar	for
of	ch	of
child	&r	
and	&	
still	st	
shall	sh	
with	gh	
the	with	
ing		

Contraction	Word
enou-gh	in
were) (	
ch	
and &	
bb cc	
ow ou	
ed er	wh
th wh	which
the with	
en gg	in

Sign		
CAP-ITAL SIGN		
NUM-BER SIGN		
—		
!	to	
" ?		
" ?	his	by/was
be		
DOT-4 & 5	DOT-4 & 4 & 5	DOT-4 & 4 & 5 & 6

Dot-prefixed contraction cards:
Sign	Word
DOT-5 c	cannot
DOT-5 d	day
DOT-5 e	ever
DOT-5 f	father
DOT-5 h	here
DOT-5 h	had
DOT-4,5 & 6 h	had
DOT-5 m	mother
DOT-5 m	many
DOT-5 n	name
DOT-5 o	one
DOT-5 p	part
DOT-5 q	question
DOT-5 r	right
DOT-4 & 5 s	spirit
DOT-4,5 & 6 s	some
DOT-4 & 5 t	time
DOT-5 t	under
DOT-4 & 5 u	upon
DOT-5 u	under
DOT-5 w	work
DOT-4 & 5 w	word
DOT-4,5 & 6 w	world
DOT-5 k	know
DOT-4,5 & 6	the
DOT-5 th	those
DOT-5 th	there
DOT-4 & 5 th	those
DOT-5 the	their
DOT-4 & 5 the	these
DOT-5 ou	ought
DOT-5 wh	where
DOT-4 & 5 wh	whose
DOT-5 ch	through
DOT-5 character	

3.2/ Braille Games:
Wooden Etched Balance Board

While working with the laser cutter on other projects, I decided to create some etched Braille and examine the quality we could achieve using a machine not necessarily set up for "Braille Etching". I wanted to create something playful but substantial, some kind of toy that worked on a sense I had not worked with before, namely balance.

I ended up creating a "seesaw" with little wooden weights on each end. This meant that while reading the etched Braille a user had to be careful not to press too hard, as tipping the seesaw to much one way would result in the weights falling off.

The version I created only says "balance" but as the design is relatively simple, I could easily create multiple replacement top sections, each with a different word to read. I could also create wider hole sections to make the seesaw more unstable and therefore harder to read without tipping. This means that you could have "harder" words for those who want the game aspect to be more of a challenge.

This piece was done on a whim, but I really enjoyed the concept and I feel that the execution is already pretty strong. While I don't wish to pursue this as a commercial game for the blind, I am incredibly happy to have created a game concept unique to the medium of Braille, a game aimed at Braillists where sight actually removes the fun and challenge of the game.

The etched Braille itself is adequate but not exceptional. I would have prefered the etching to be deeper and I realise that "hard" etching results in a cylindrical rather than domed Braille. At this height the hard edge isn't really noticeable even when read by touch, but it is certainly something that would have to addressed I wanted to use this laser cutter for Braille etching in the future.

Realistically any Braille done this way would have to be sanded into domes, which is less than ideal as I will lose both height and consistency. Yet I know high quality etched Braille already exists and what's more it is widely available commercially. If I were to use etching again it would probably be better to pay for specialist work rather than sanding down, sacrificing convenience and control for a higher quality Braille.

3.3/ Unrealised Piece:
Rubix Cube

One or two of my projects have been shelved due to cost or time restraints. While it's unfortunate that we were unable to finalise these pieces, we still created finished files for all of them and hopefully might realise some at a later date.

Despite not being "finished products" the issues and ideas that these pieces address are still worth discussing. Each confronts a different aspect of our research and some deal with areas that we haven't been able to discuss in my other work.

Right from the start we decided to focus on adapting everyday objects for the blind, rather than creating entirely new pieces. This cuts production costs and is one of the main growth areas we have identified for UV printed Braille.

On top of that these pieces address issues of poor translations within adaptation, while helping demonstrate the need for aesthetically sensitive disability aids. Translations are especially relevant in regards to adapting objects in a non disabled world, where ugly adaptation can perpetuate the myth that disabled participation requires the world to be made uglier.

3.3: Rubik's Cube:

One of our earliest at adaption focused on the Rubik's cube, using either high contrast Braille or Braille that matched the colour it represented. This would add another tactile element to the puzzle while still featuring colour as a central theme.

What isn't immediately obvious to the majority of the general public, is that the majority of the blind are actually able to see colour, with the definition of legally blind still allowing for quite a bit of vision albeit with very little definition. This means that blind disability aids can and often should feature colour, as well as a consideration of high contrast combinations to assist those with some form of partial vision.

The thing that first attracted us to the Rubik's cube wasn't it's iconic connection with colour, in fact we were compelled to approach it because of another disability toy called the Braille Cube[1]. This completely white version of the Rubik's cube has Braille on all faces, but has no colour to differentiate by sight. In many ways it shares the same aesthetics of apple products, and the minimalist and clean feel of the cube is part of what has made it so successful.

Despite that it simply doesn't account for the blind communities connection with colour, and while it is hard to deny that the object is beautiful and indeed well designed, it can still be said to have lost something of the rubik's cube identity, by taking a step back from the culturally iconic colours of the original.

Sadly the flatbed is too shallow to allow for direct printing onto the cube, so we would have to create sticker sheets or break the cube open in order to use my ink printing. Despite this I do think there are other more "home made" ways of adapting a rubix cube, embossed colour paper is an option, but durability would certainly be an issue. Acetate is probably a more viable option which might not interfere with the colour. The glue would also need to bind properly to the stickers or plastic, while being durable enough to withstand constant handling.
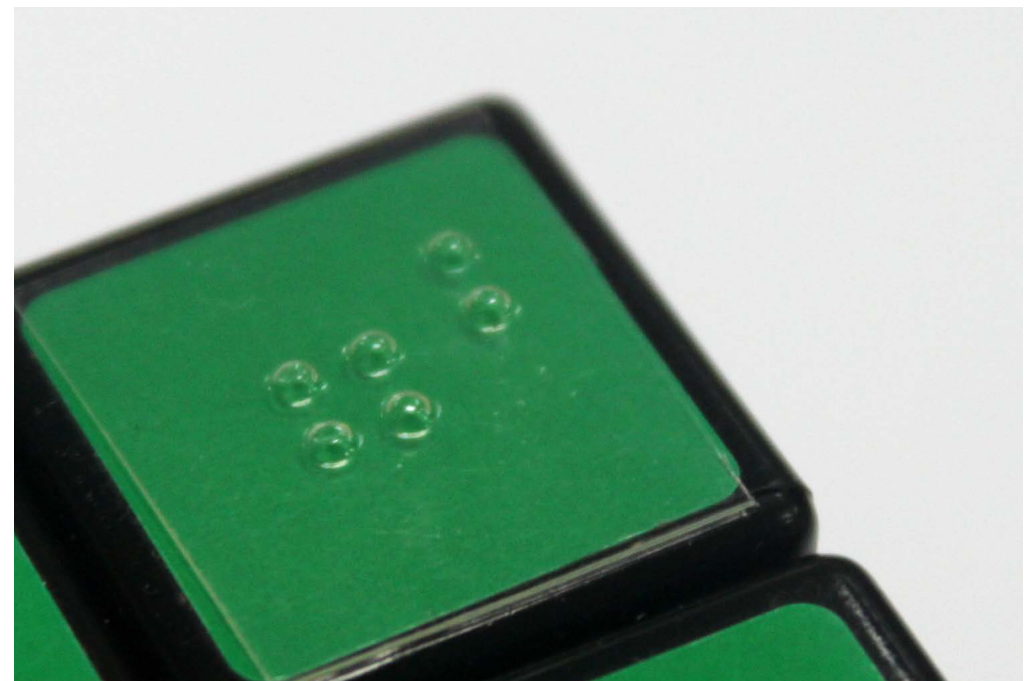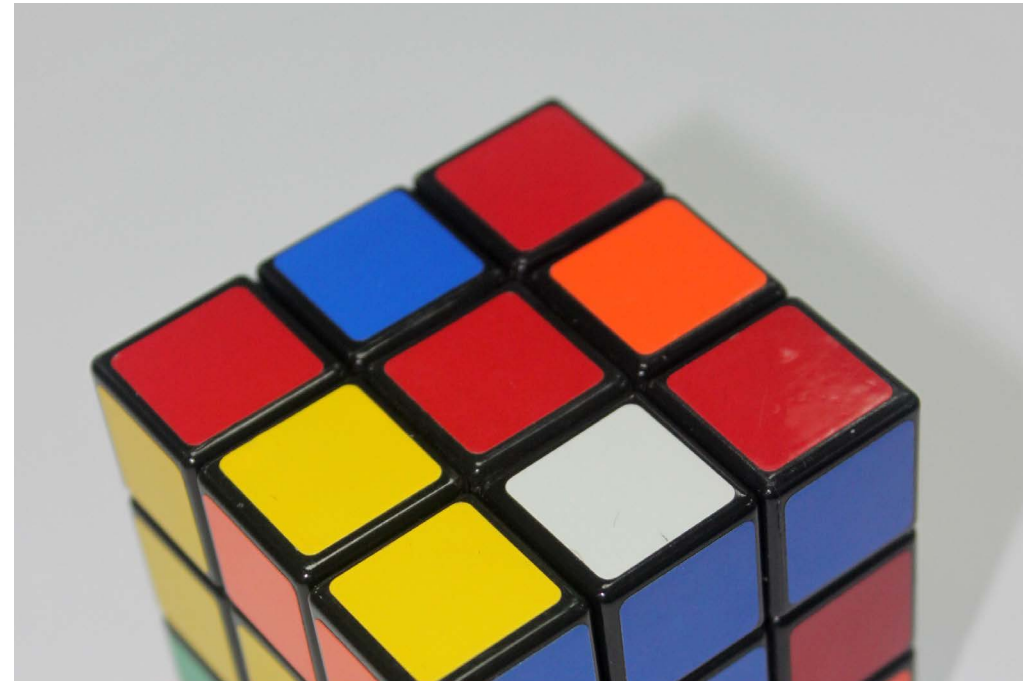
1. Braillecube.com. (2017). Braillecube. [online] Available at: http://braillecube.com/ [Accessed 16 Aug. 2017].

3.4/ Unrealised Piece:
Eight Sided Dice

Continuing with our theme of adaptation, we decided to adapt dice. Gaming is a topic close to my heart and I already own multiple sets of dice intended for blind and partially sighted users. These dice are well designed, durable and most even have a consideration of visual contrast for the partially sighted. However most of this consideration is black on white or white on black, which while no means bad, isn't pushing colour to it's full potential.

On top of this six sided dice or "d6's" are plentiful, while dice with more sides are less common for the partially sighted. This limits the range of games the blind may access, with RPG games like Dungeons and Dragons requiring upwards of seven varieties of die. There are manufacturers of larger dice for the blind, and even kickstarter[1] campaigns for print your own versions, all of which are well considered and very well implemented, if not particularly pretty.

This is the crux of the problem, the range and colour combinations available to the sighted, make dice for the blind look ugly and cumbersome in comparison. We were aware from the start that we were not going to be able to create something marketable with the UV printer, nor were we going to be able to create something comparable to the quality as Chessex dice[2]. Yet we still believed there is something "more" that can be done with colour and Braille on dice, even if we are only able to address the conversation and are not able to contribute effective visual examples to the conversations.

We first looked at "blank" eight sided dice, and a quick set of measurements proved that each side would support the two Braille cells that would be necessary to adapt it. While smaller D6 can get away with not using Braille, larger dice require it. The more dots we use the less easy it is to recognise the number quickly.

Eventually the concept became a Braille number with a different colour or hue which linked to the number above and below it. All of these are relatively high contrast because we have chosen dark colours on a white background. It is also possible that there could be a version which had different high contrast background for odd and even numbers.

The file was never printed due to the time it would have taken to adjust each side manually, while the printing would have only taken minutes per face, the actual adjustments between faces would have taken much longer, and it would be difficult to guarantee a flat printing surface each time.

In addition to this, there were already many high quality alternatives to UV adaptation for custom die manufacture. Processes like 3D printing already allow for the exploration of colour we are discussing, even though neither process can achieve the high quality of commercially available tactile dice, and no process on this scale can effectively offer the variety of colour and availability offered in the non tactile market.

Despite that the idea of linking numbers to colours is still worthy of exploration, it something that can allow for quicker recognition not just for low vision users, but for sighted users as well. Indeed we do see this in some commercially available die, where the highest possible role is a different colour to indicate a critical hit in certain gaming systems.

1 Kickstarter. (2017). RPG dice for the visually impaired. [online] Available at: https://www.kickstarter.com/projects/1704875037/rpg-dice-for-the-visually-impaired [Accessed 8 May 2017].

2 One of the largest gaming dice manufactures in the world.
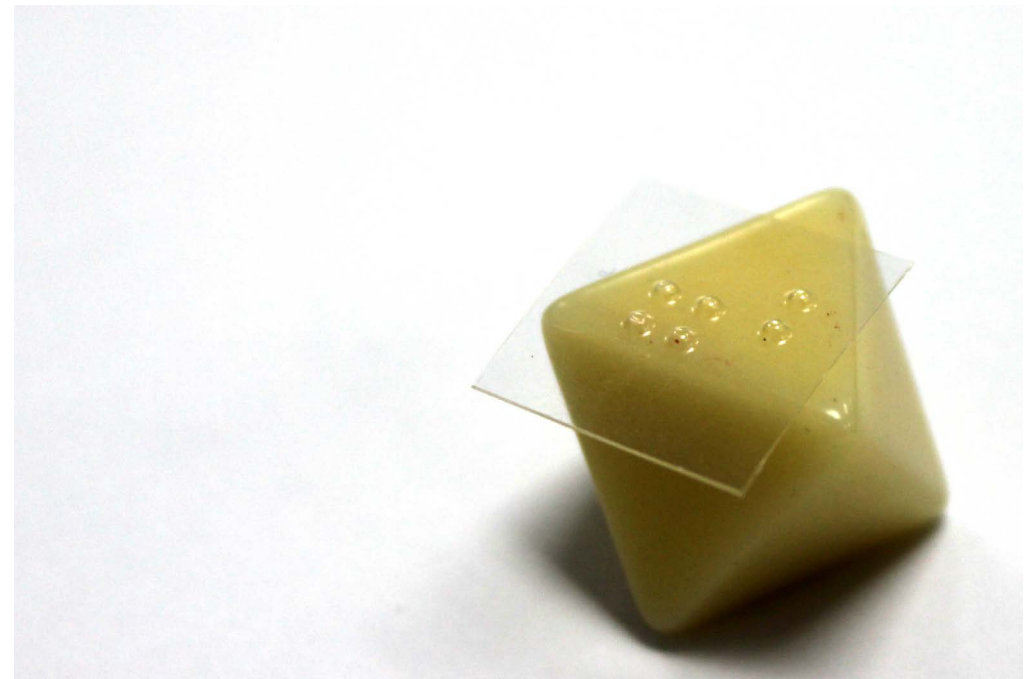
3.5/ Paper Craft Dice:
High Contrast Braille

While creating UV printed dice was not a viable option, creating paper dice was far easier. These dice don't address our initial issue with modern Braille dice, that is to say they are not particularly colourful, well weighted or plentiful. Indeed paper craft dice could be said to be inferior to traditional dice in almost every way, especially in regards to haptics where the dice feel worse to role.

What they do offer is an accessible craft project with numerous benefits for a young audience. Firstly I must note that I created these paper dice in order to demonstrate the colour theories I had worked on for my of my unrealised pieces, they were designed to crudely demonstrate high contrast and coloured dots in a quick and easily prototype-able way. Yet at the same time when viewed as pieces in their own right they can be seen to have numerous merit worthy applications.

First of all D8's for the blind are not particularly common place, indeed ordinary eight sided dice are not particularly known for being household items, at least not in the same way a D6 might be. For games or activities that require you to use a D8 it simply might not be an option for the blind to buy a plastic version, and custom die can be expensive or hard to come by commercially. In this way an easily crafted Braille paper D8's fills a potential niche.

Similarly, paper craft dice can be simple projects for young Braillists, part of a wider project to craft their own accessible board game, or a way of creating objects for play that focus on developing Braille literacy. A similar approach could be taken for any kind of game, where instead of simply adapting the game for a blind audience, we instead encourage a more participatory experience; one in which integrate art education into play, where we pair craft and Braille as ways of engaging more impactfully with both.

While the pieces themselves are simple, they are part of a wider conversation around not just building a world for the blind learners, but working with blind learners to help them create. There is value in the young approaching the arts, and it stands to reason that the opportunities we deem valuable to the education of sighted children, should be echoed in some form for the blind. We could approach sculpture or more tactile mediums in art education, but we just as easily work with a slate and stylus to create pattern design or haptically engaging work unique to the mediums in which the blind are already actively engaged.

This doesn't mean that those with absolutely no vision should be encouraged to pursue drawing, but I see no reason why they should be stopped if they show a genuine interest in being able to work in the mediums of their peers, especially since modern technology like swell paper and tactile printing would actually allow a blind child to touch and review their own work.
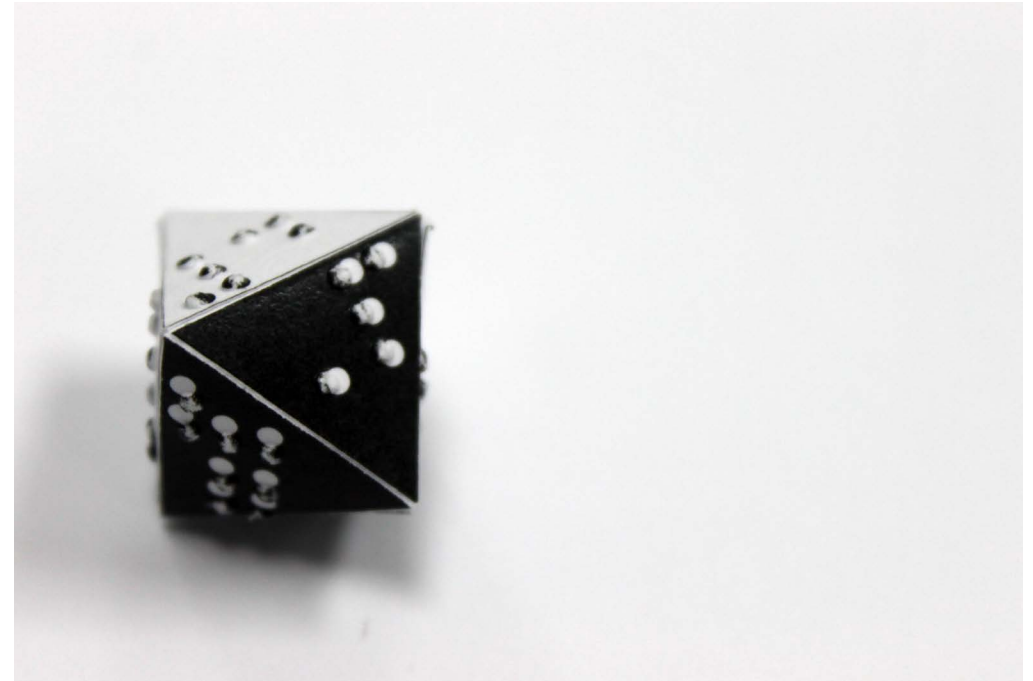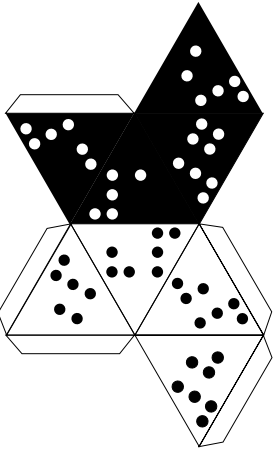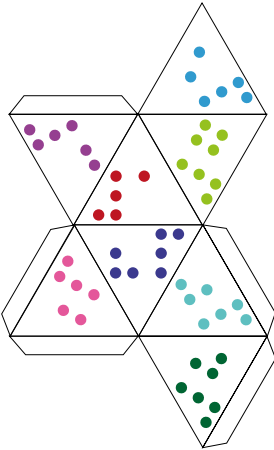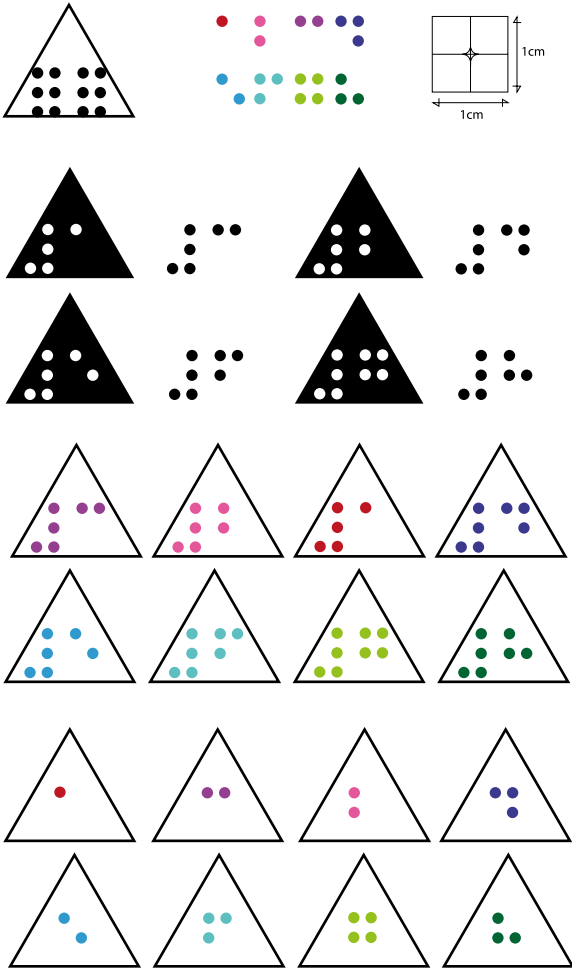
3.6/ Unrealised Piece: Paint Pallet

This was one of our more ambitious ideas, one that would have required a lot of time and money to produce. The idea was to create a paint pallet that allowed those with little or no capacity to distinguish colour, to paint using a wide range of similar but different colours.

The idea of painting for the blind might seem a little obtuse, but as we have already mentioned, the term blind doesn't necessarily mean an absence of vision. We also believe access for the sake of access to be a worthy goal, and many blind art enthusiasts may wish to approach painting for any number of reasons. This would allow for a greater level of control even if the painter is not necessarily able to assess the quality of their work.

In theory this pallet could be used by someone with absolutely no vision, to create either "paint by numbers" style work with raised tactile images, or abstract expressions where there is a theoretical understanding of colour and a similarly vague use of composition and form. While these paintings couldn't be viewed by the artist, they could still be enjoyed by others.

With this in mind I couldn't rely on "dark green" or "light blue" for a pallet that shouldn't rely on any knowledge of colour, light or indeed any kind of sight. Instead we must look for equivalents, object associations which connect experiences and ideas to the concept of a colour. In this way blood and ruby red are notably different to someone who has never seen colour, even if the shades were indistinguishable for someone with a visual understanding both.

The black book of colours discusses this idea of colour association becoming an abstract understanding of colour, those with no ability to see colour must make sense of colour through other senses and an understanding of what items are connected to that colour. In the same way that we can not see the wind we are able to feel it, recognise its effect on other objects and understand its existence not by observing the wind itself, but by understanding the thing we can observe or feel.

Similarly in the complete absence of sight colour must be understood through other senses and abstract theory. We understand that red can culturally signify luck or romance, there can still be that connection to colour for those who can't see it, and these connections are arguably more important because of their use as replacement for a visual understanding.

While we didn't produce this piece, the conversations surrounding it are far too interesting to simply ignore. While the pallets practical application is limited, the work's connection to colour theory is something that is hard to discuss without the analogy that it creates. We already conect paint colours with objects in the sighted world, though we do this in order to differentiate between shades and subtle variations. So it is only natural to use this to explain an understanding of colour by association, which can sometimes feel like quite an abstract concept.

Much like the Rubik's cube it is the conversation rather than the piece that is most important. We also believe embossed acetate could be a viable craft alternative for this kind of adaptation.
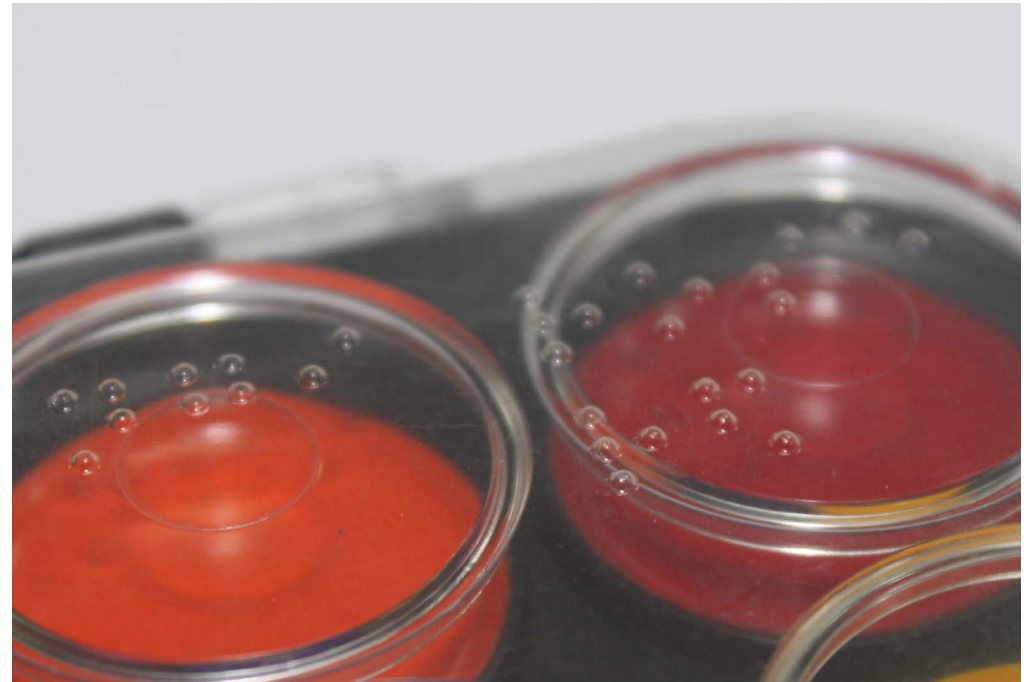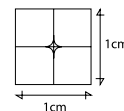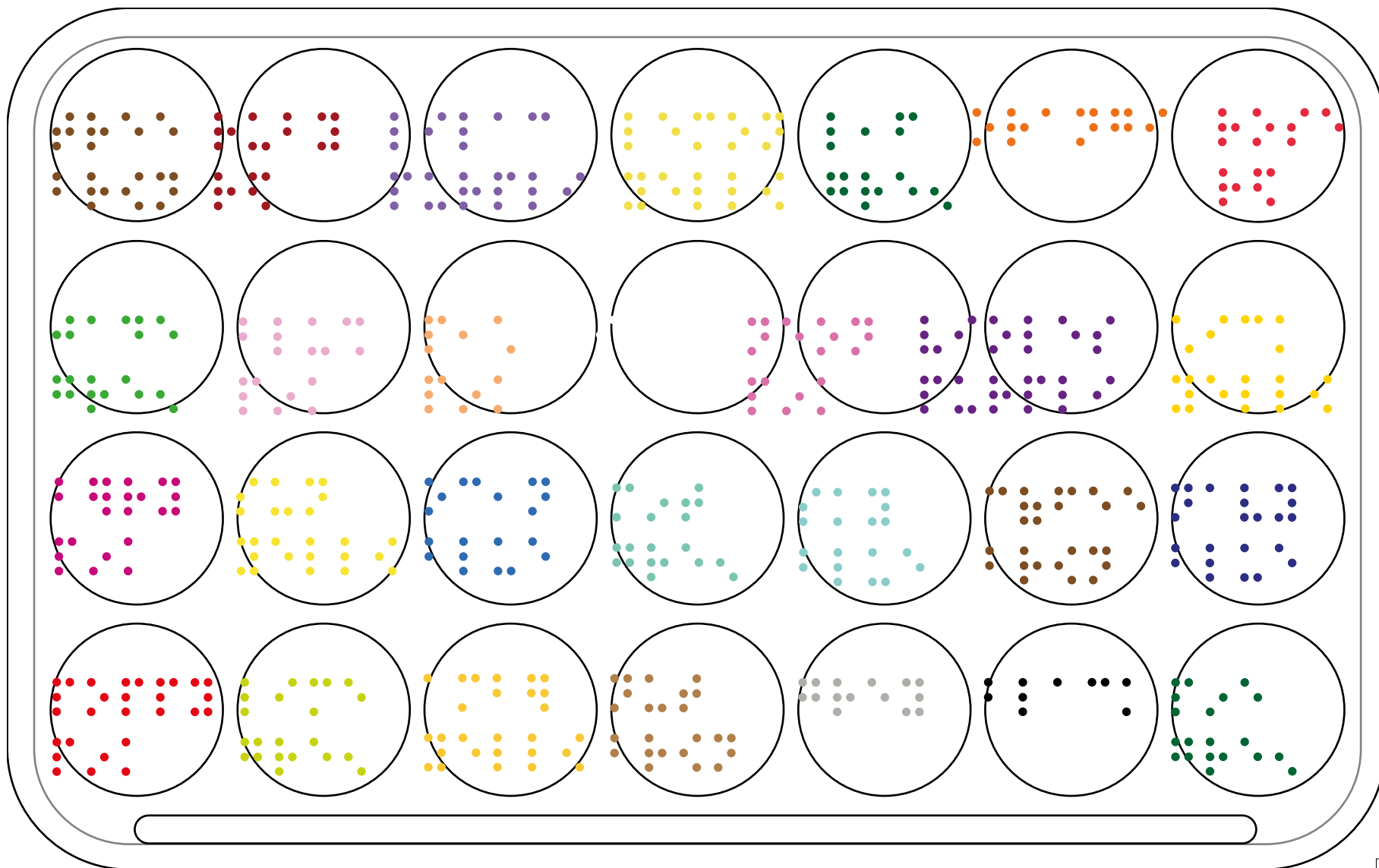
3.7/ Unrealised Piece:
Tactile Colour Cubes

This piece was designed to build upon the idea of colour association, linking bright primary colours to both Braille characters and haptic experiences. The blocks themselves are teaching aids for the very young, and while they are very simple they are intrinsically touch based ways of understanding colour. This coupled with the fact that the unoccupied space surrounding each coloured circle was perfectly able to accommodate a single Braille cell, made the blocks seemingly ripe for adaptation.

At the same time as preparing the files to adapt these cubes we were developing the Braille D8. This lead to the uncomfortable realisation that despite the idea being quite interesting, the time and inability to guarantee a level surface after one side had been Braille, made the technique unsuitable for this kind of adaptation. While we might have been able to "jerry rig" a kind of make shift stand, the potential damage that could be caused to the UV printers print heads, prevented us from going ahead with production.

I stand by the idea that colour blocks with Braille cells could be a useful tool for very young children, but I don't believe this method of production is suited to this kind of work. In addition, without a complete understanding of our own inks print toxicity, we wouldn't as yet feel confident in giving our UV Braille to toddlers or those who might put our pieces in their mouths.
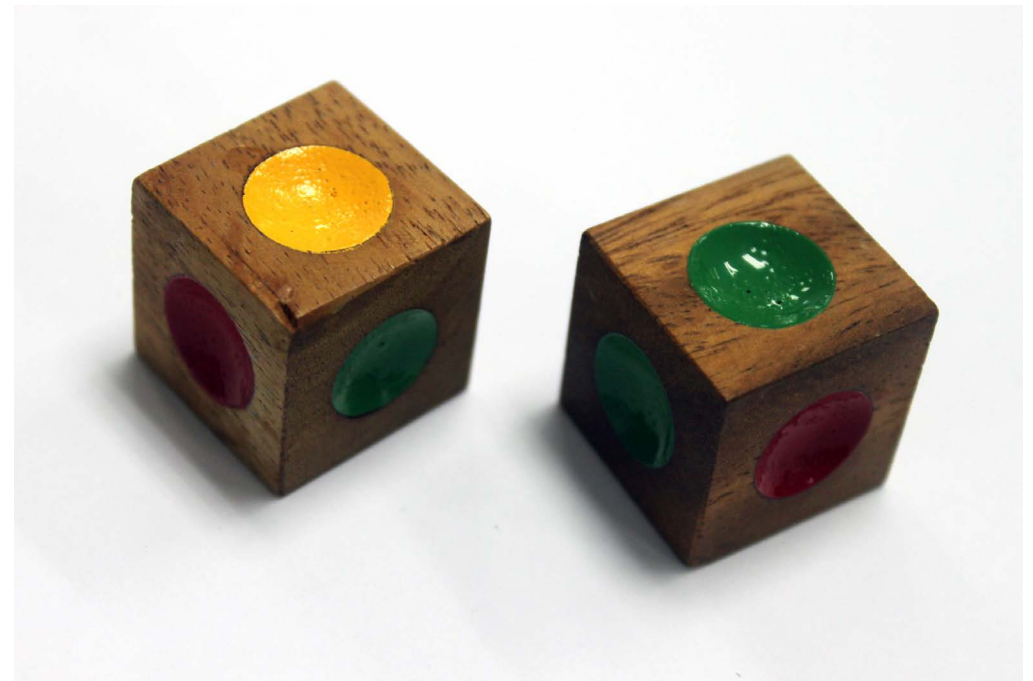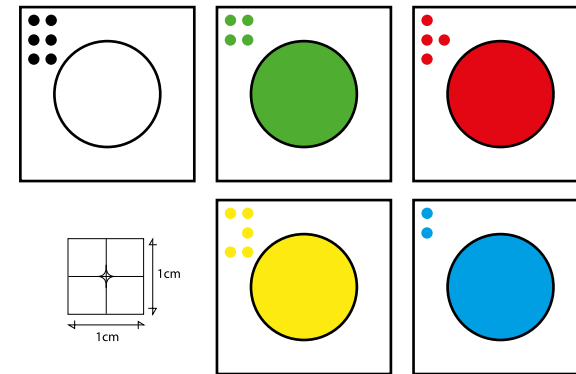
3.8/ Unrealised Piece:
Worry Stones

These is the only piece we regret not being able to produce. The worry stones play with texture, colour, light and they even have a deep and integral connection to the haptic. This connection isn't solely down to the addition of Braille, but rather the personal nature in which a worry stone is felt, carried and played with.

In short worry stones are designed to be felt while in quite a vulnerable but often very receptive state. In this way it is one of the most relevant objects we could possibly adapt with Braille, as it integrates itself perfectly and compliments the other aspects of the stones form and function.

The connection to light was also a unique selling point of agate as a substrate, as this meant that we could not only play with colour and texture, but opacity. Much like working with gems or glass we are able to create Braille that reflects and refracts because of its background material. For those with limited sight this could create a kind of glittering of colour, a way of playing with their limited vision to create something that reacts to the world around it as you adjust it.

Sadly time and cost prevented us from bringing this piece to fruition. In the future it may be something we revisit, but until then it is still worth discussing as one of the best theoretical examples of Braille product design we have personally come across. We are no means the only people addressing this industry, and indeed we have found sellers of clay Braille stones or "pocket pebbles[1]" which demonstrate both an understanding of the haptic and of the importance of colour even to a blind audience.

1. Etsy. (2017). Set of THREE Braille Pocket Pebbles - 1 to 5 Letter Word - Inspirational Words - Comfort Words - Handmade - MADE to ORDER. [online] Available at: https://www.etsy.com/listing/110962012/set-of-three-braille-pocket-pebbles-1-to [Accessed 16 Aug. 2017].

3.9/ Paracetamol packaging:

While discussing the idea of poor Braille translations, we began looking at omitted details. These omissions attempt to reduce the length of the writing while retaining the sentiment, this often results in aspects being mis translated or entire passages being left out altogether.

One of the worst examples of this reductionist practice is pharmaceutical packaging, where a box containing over a thousand words might only have five or six translated into Braille. To illustrate this we created an copy of a paracetamol box, leaving out everything a blind person could not see or read. Then we translated the Braille into non tactile lettering, to create a stripped down box that illustrates just how little information we give to the blind.

Ask yourself this, is this enough information for medication. If the answer is yes then why are we overloaded with thousands of words where twenty might do, why is our visual landscape cluttered and made ugly by reams of apparently unnecessary jargon.

If your answer was no then ask yourself, is it acceptable to give the blind a potentially dangerous reduction in information? A reduction that misses out everything from advised dosage to expiration dates, from health warning to side effects.

I personally believe the answer is both yes and no. While this translation has some very negative omissions it could be argued that the glut of information offered by the sighted information is unnecessary. A fuller discussion of this piece and the ramifications of thoughtless omissions is available within the accompanying paper in chapter 2.2: Translation: Braille as medium rather than replacement.