Braille Teaching and Literacy

A Report for the European Blind Union and European Commission

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Contents

Introduction

This report discusses findings from a two year project that ran between 2016 and 2017 and investigated the situation in Braille teaching and literacy in nine European countries. The project was led by the Danish Association of the Blind for the European Blind Union and involved Braille users working with the International Council for Education of People with Visual Impairment (ICEVI), service providers and others with an interest in supporting the use of Braille.

Work focussed on opportunities that children and young people have to learn Braille and to become proficient in its use. Examples of good practice were highlighted, as well as barriers and issues to further development. Funding was provided mainly by Danish Association of the Blind, with additional funds provided by the European Blind Union, ICEVI, the Danish order "Selskabet Kjaeden" and funds from the Rights, Equality and Citizenship Programme of the European Union.

The project was designed to support EBU's strategic plan, which states as a focus for 2019 that:

> Every child who can benefit from reading Braille (should have) access to good quality Braille teaching.

Therefore, the project started from the assumption that the ability to use Braille is essential for people with visual impairments; it did not set out to prove its value in relation to other forms of literacy. It was also concerned primarily with children who did not have additional impairments, such as learning difficulties, who might find literacy difficult. For the Braille readers who were part of this project, access to Braille is a lifeline for educational and professional success.

The work overall was co-ordinated by a Steering Group, made up of the following members (listed alphabetically):

Christian Bundgaard, Denmark

Cecilia Ekstrand, Sweden

Tarja Hännikäinen, Finland, ICEVI Europe representative.

John Heilbrunn, Denmark

Clara Ori, Italy

Erich Schmid, Austria

This report has been written and edited by Sarah Woodin and John Heilbrunn, using materials provided by the Danish Association of the Blind and members of the project steering group, including ICEVI. It reports on activities carried out and aims to highlight important aspects of good practice in relation to the current situation on learning and use of Braille. Important contributions are included from Ron Kupers, on the neuroscience underpinning learning of Braille and from Anders Rönnbäck and Kia Johansson on the assessment of children's progress in reading.

Background to the Project

Braille has been central to the literacy of blind and visually impaired people since it was first developed by Louis Braille in the 1800s. As a system of touch reading and writing that uses raised dots to represent letters of the alphabet, it is also used to represent symbols, numbers and music. Learning Braille also allows users to develop an understanding of the formal structure of language, including spacing, formatting and grammar. For some subjects, notably science, mathematics and foreign languages, Braille is essential in comparison with alternative methods, such as audio learning. Perhaps unsurprisingly, greater literacy through Braille has been shown to improve employment and life chances for blind and visually impaired users, even though employment rates remain disproportionately low for visually impaired people overall.

However the context for Braille learning and teaching is changing rapidly. Technological developments, especially the development of audio texts, synthesised speech and higher magnification, have opened up opportunities for blind and partially-sighted people to access much more written material. At the same time, concerns have been raised about over – reliance on audio and synthesised speech in education, resulting in a decline in Braille.

There is now greater recognition of human rights in law, for example, through the Convention on the Rights of Persons with Disabilities (CRPD)[1]. Article 24[2] recognises the right of disabled children to be educated in an inclusive environment and not segregated into special schools. This development also raises a possibility that children could have less access to knowledgeable Braille teachers as teaching becomes more generic.

However, the CRPD also explicitly emphasises the rights of disabled people to many forms of communication. Article 2 states:

> "Communication" includes languages, display of text, Braille, tactile communication, large print, accessible multimedia as well as written, audio, plain-language, human-reader and augmentative

[1] CRPD: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html#Fulltext

[2] Article 24 Education: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-24-education.html

and alternative modes, means and formats of communication, including accessible information and communication technology".

Access to Braille is also mentioned in Articles 9: Accessibility[3] and Article 21: Freedom of expression and opinion[4]. Requirements include the provision of Braille signage, availability of means of expression, role models, the employment of qualified teachers and the ensuring of training of professionals and staff working at all levels of education.

Further rights to access Braille and accessible information are set out in the European Council Directive 2004/27/EC – Article 56(a) with regard to packaging of medicinal products. Directive 2006/112/EC, allows Member States to apply a reduced VAT rate for some goods and services used by disabled people, including audio books and books in Braille. These examples of international measures are complemented by national laws and policies. However, existence of these measures is not a guarantee of implementation.

Aims of the Project

The project started with the following objectives:

- To map out existing good practices for efficient and high quality Braille training.
- To identify how a catalogue of good practice approaches can be developed on how to make blind and severely partially sighted children and young people proficient Braille readers, writers and/or users.
- To promote the availability of Braille in all relevant situations and environments in society including the educational sector and to enhance accessibility through the presence of labelling, signage etc.

The intended benefits and outcomes of the project included:

- Increased knowledge about various methods and tools to stimulate children and youths to understand and master the reading and writing of Braille both on paper and on electronic devices.

[3] Article 9 Accessibility: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-9-accessibility.html

[4] Article 21 CRPD: https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/article-21-freedom-of-expression-and-opinion-and-access-to-information.html

- Development of ways to ensure equal performance and opportunities in educational and leisure settings by using Braille in communication, games, practical notetaking etc.
- An overview of how to ensure that there are conversant and professional trainers and instructors in Braille reading, writing and thereby use of Braille in the main educational settings, in the mainstream school (special needs departments) and at special resource centres.

Main Activities of the Project

Various activities were organised in 2016-17. These involved finding out about the current situation in the countries that took part, through:

- Initial research on good practice;
- A questionnaire to ask participants from nine countries about Braille teaching and use by blind children;
- Country visits to find out more about good practice;
- Participation at an international conference;
- A final seminar to synthesise findings from the project.

Four steering group meetings were held during the course of the project to review progress and plan future work. Meetings were held in person and by Skype call.

Desk Based Research

There is a considerable literature on effective approaches to teaching Braille to visually impaired students. The project did not set out to review all of the aspects of this, but worked with Ron Kupers, an academic associated with the Department of Neuroscience at Copenhagen University to review aspects of Braille acquisition. The project also reviewed new developments in the assessment of Braille reading speeds developed in Sweden by Anders Rönnbäck and Kia Johansson from the Swedish National Agency of Special Needs Education and Schools. Articles from these authors are included in this report as appendices.

Questionnaires for Participating Countries

In 2016, questionnaires were developed and sent to five countries: Denmark, Finland, Iceland, Norway and Sweden. The Nordic countries were chosen for the initial group as these countries had a close and formal collaboration in a number of other areas and hence it was quite easy to link up with relevant resource contact persons. Also, the educational and social environments in the countries have some considerable similarities, meaning that it would make sense to "test the inquiry waters" in a known environment. A knowledgeable focal resource person was recommended by the organisations of the blind in these countries to coordinate the compilation of answers and this person was also given a free hand to address such institutions, organisations and resource persons who he/she thought would be able to provide the richest amount of information within the seven main fields of the questionnaire.

In choosing the respondents for the questionnaires, the resource person took account of who might have access to statistical information and an interest in taking the necessary time to compile the information on several entities in different political areas.

The steering group, together with two representatives from each of the Nordic countries, met for a two day workshop in October 2016, when the findings from the inputs to the questionnaires were discussed as well as a number of other issues. A number of conclusions and recommendations were drawn from this.

The questionnaire was validated after the first test run. The Danish Evaluation Institute EVA[5] made recommendations on how to make the questions more unambiguous and easier to understand for external partners. It was ascertained that the format and content of it was modelled from a Nordic perspective, where the relatively small size of the countries lead to a more coherent picture of the services and programmes guiding training, education and support of children and young persons with a visual impairment. The questionnaire was therefore reworked at the end of 2016.

In 2017, the revised questionnaire was sent to four further countries: Austria, Estonia, France and Italy. This circulation of the questionnaire to two small and two large countries confirmed that, whilst in the smaller countries, Estonia and Austria, the picture was fairly comprehensive and clear, it was almost impossible to gain a comprehensive picture and statistical data in Italy and France, where no coordinating and central registration systems existed.

The information returned by all of the participating countries was analysed together for this report by Sarah Woodin, using NVivo. Because of the revisions to the questions described above, some data has been re-organised differently from the original questions.

Country Visits

To supplement the information gained through the questionnaires, members of the project steering group met country representatives in Estonia, France in Italy in the autumn of 2017. The aim of these meetings was to gain more information on the use of Braille in each country, the barriers to its use and information on instances of good practice.

[5] https://www.eva.dk/evas-evaluation-areas

The meetings were set up and the participants invited by the steering group members in the country concerned. Together with the project coordinator, the meeting arrangements, the profile of possible participants, the practical transportation and catering was arranged. The steering group member involved had a fairly free hand to identify persons who could attend without too much difficulty or expense and who could take time off from work or studies. The common criteria for all country visit sessions was interest, enthusiasm and skills about Braille and the way it was promulgated and prioritised in the country. No schoolchildren were invited, but, especially in the Bologna session in Italy, a number of fairly young persons contributed their knowledge and thoughts on the usefulness of Braille and the extent to which they still were dedicated users. Participants were either involved in managing education, in training, were part of the national Braille authority or simply conversant with the situation facing children and young persons who were blind or severely partially sighted in the country concerned.

The Austrian steering group member advised that in an Austrian context, it would not be practical, nor render sufficient added information value to conduct a visit.

Seminars and Conferences

Project steering group members gave a presentation at the 9th ICEVI international conference in July 2017 in Bruges, Belgium.[6] This gave an opportunity to describe the project to a wider audience and to receive feedback on the work completed to date. Since ICEVI is the core organisation of teachers, trainers and other resource persons dealing with persons with a visual impairment, it was considered important that the project, which was partially funded and resourced by the organisation's European division, was duly informed of the findings and plans for the final part of the project. A fifty minute presentation on the project findings was followed by a twenty minute discussion on issues. The workshop on the project was well attended and the feedback given supported the assumptions and observations made so far and conveyed at the presentation.

A final seminar was also held in Frederica, Denmark to review the work completed and to plan final tasks. This event included presentations from country representatives, academics and teachers as well as opportunities to discuss the work of the project as a whole.

[6] 2017 ICEVI conference website: http://www.icevi-bruges2017.be/?q=31

Findings and summaries of discussions from the meetings are included in the report below. The more detailed review paper on Braille learning and processing is included as an appendix to the rest of the report, due to its length.

The next section of this report gives an overview of the findings from the country questionnaires.

Summary of Findings from the National Surveys

This section summarises the findings from the questionnaires completed by the nine countries in 2016 and 2017. Detailed answers and comparisons are provided later in the report in Appendix 1 and readers should look at this data for more information on individual countries. The main points are presented in seven sections that cover various aspects of Braille.

Introductory Information: Registration of Children

None of the countries collected national level data and statistics on the number of visually impaired children who might benefit from using Braille or who did use Braille. Statistics were collected for other purposes, such as to determine the number claiming welfare benefits or those eligible for services. This lack of comparable data means that the numbers of visually impaired children are not known accurately.

Section 1 Children Using Braille Publications

New technology has enhanced access to publications in terms of range of materials and speed of receiving them.

Recent years show a decline in printed Braille on paper in comparison with electronic publications. Although specialist libraries for people with visual impairments continue to produce books and articles on paper, the volume is declining overall and it is greatly outnumbered by electronic publications. These can be read with a braille display or through synthesised speech and are available through non-specialist sources.

Many children are expressing a preference for audio materials, especially for leisure reading.

Section 2 Braille Training

Information from the nine countries reflected a tension between the value of focussed training in Braille that could be gained through specialised teaching and assistance and the value of attending mainstream schools with other local children of the same age. In all of the countries, specialised assistance was made available to children who attended mainstream schools but there was uncertainty about whether this was sufficient.

Braille requirements varied greatly in teacher training. In Norway, for example, training involved university level courses, while in Estonia Braille did not form part of training for teachers of visually impaired teachers. Parents were also included in Braille teaching.

Most teaching covered use of a variety of means, including use of paper and Braille machines, Braille displays, note takers etc. Use of slate and stylus appeared to be declining, with only four of the nine countries stating that this was taught.

Six countries offered refresher courses, either routinely or arranged as needed, while in three countries this was not available. A further issue was the apparent lack of testing of Braille proficiency and reading speeds in all countries. This was an issue that was flagged up as in need of attention by several countries.

Section 3 National Braille Systems

Six countries had a contracted Braille system and three not. Of those that did, three had a policy and two an official position. Library books in contracted Braille were available in three countries.

Several issues were raised in relation to contacted Braille. Some students with learning difficulties found the system too difficult or found that it took too long to learn. It was also seen as difficult to synchronise contracted Braille with written text for sighted students in inclusive classrooms.

On the other hand, all of the nine countries used an eight dot Braille code and it was officially approved by eight of the nine countries (Estonia was the exception). Again however, reading speeds and literacy development were not monitored.

Section 4 Electronic Braille

Children were typically introduced to electronic Braille from age 5 upwards, although this varied and in some instances it could be as late as 11 to 12 years old. All countries indicated that when exactly this was done was decided in line with the needs of the individual child and in a few instances depending on funding available and the degree of fit with other classroom devices.

In most countries both paper and electronic Braille materials were available to children and the formats used in each instance were often the result of shared decision making between pupils, parents, teachers and producers.

Section 5 Availability and Use of Braille Machines

In all countries children had access to Braille machines for use at home and school. They had access to a range of different makes in some countries while in others choice was more limited. On occasions partial

payment was needed for use of a machine at home. In many countries repairs were free of charge but in others, users had to pay the costs of this, either as a matter of policy or because in practice it was difficult to get repairs done otherwise.

Section 6 Educational and Play Materials

There were examples given of organisations that had developed interesting age–appropriate and engaging materials for young children. These are discussed in more detail in the Good Practice section of this report. In some instances training in Braille was extended to classmates, or visually impaired children had access to materials that were usable by all children in a class.

Competitions and games were used to encourage the use of Braille in many countries. Playing cards marked with Braille were sometimes but not always given free to children.

In most, but not all countries, training for parents and educators aimed to help them understand how visually impaired children could play with sighted friends. Further information and guidance was also available through internet discussion and other support groups.

Although there were many encouraging examples given in relation to education and play, it is not clear from the data whether these are widespread practices or one–off instances.

Section 7 Braille Authorities

All countries had a national Braille authority that was formally constituted, although in Estonia this took the form of a working group rather than a constituted authority.

Comments on the Findings from Questionnaires

The statistics and figures on the number of visually impaired readers from the country responses are not easily comparable. Countries have developed different methods for different purposes and this resulted in different data. Similarly, there is not national statistical information that ensures full information about all and every order or provision of Braille, including format or media type. Mainstream schools with resource room printing facilities, national or regional printing houses, stand-alone embossing facilities with the individual pupils/students, just to mention some of the possible set-ups that might provide Braille, are diverse. Further, in the participating countries there are vast differences in

registration, coordination and funding opportunities that lead to a situation where hard evidence is very difficult to obtain.

Nevertheless, from the reports of countries, it seems that there are provisions in place to provide training in Braille, resources available and monitoring systems. Some encouraging examples of good practice are also given and these would benefit from being made more widely known.

However there are shortcomings as well, notably the lack of monitoring of children's progress in literacy and this gives an unclear picture of the extent to which literacy in Braille is being maintained. There are indications that Braille on paper is declining in the face of new technology, creating both opportunities and challenges. There were also suggestions of over–reliance on audio communications in some instances and questions about the availability of trained teachers. These issues require attention in the light of persistence of disadvantages experienced by visually impaired children and adults.

In almost all countries, there is a Braille authority. These have very different competencies and terms of reference. Some deal with much more than just maintaining the current nation Braille standard and look into other pedagogical issues such as graphics, 3 D production, research and development broadly, whilst others only deal with essential Braille issues. In some countries the Braille authority is run by organisations and institutions on their own merit (for example, Denmark) whilst in others such as France, the Braille format is determined by an authority funded by the public sector and certified by national legislation.

It seems to be a general point of view that a Braille authority is important to protect and foster ideas and development of the national Braille system. Countries within Europe that do not have such an authority have expressed an intention to establish one.

Visits to Participating Countries

To supplement the replies to the questionnaire circulated in April-May 2017, steering group members carried out visits to three countries: France, Italy and Estonia. During the visits, the aim was to obtain testimonies and experiences from Braille users directly: participants were asked about their practical experiences and advice for others. The aim was also to understand the points of view of visually impaired persons of various ages. Although only a small number of people took part, this enabled visitors to gain more insight into the situation as a whole and an impression of the extent to which policies were put into practice in reality.

Country Visit: Estonia

A meeting took place on September 15, 2017 with representatives from Estonia dealing with education and library services, the Ministry of Education and Research and the organisation of the blind. A total of twelve persons participated.

The situation here, as in other countries visited, was that statistics based on registration of benefits or other services specifically targeting persons with a visual impairment do not exist. Nevertheless, there was a general wish to improve registration of visually impaired persons as a useful tool for lobbying and advocacy purposes.

Support and assistance to children with a visual impairment and their parents are only given upon request and are not offered automatically.

Two-thirds of blind children go to specialised schools, whilst one-third attend a mainstream setting. This will change from 2018, and there will by then be no category of "specialised". The effect of this change on the future availability of specialist and specialised services for blind children was uncertain.

One challenge was a lack of harmonisation in the use of books, leading to what was considered to be a sometimes improper use of resources, when several books in a certain area were ordered and had to be produced.

These days, it was felt that focus was turning towards the rising number of persons with behavioural disorders such as attention deficit hyperactive disorder (ADHD), or on the autism spectrum, which has led to children with a visual impairment becoming more invisible. This has led to fewer courses for teachers dealing with blindness-related topics

and issues and a decreasing number of specialised teachers in this area altogether.

Programmes for parents were no longer being offered by the public sector, but were undertaken by NGOs.

Devices such as Braille note-takers and displays were subsidised by the social insurance system by up to 90 percent, unless the equipment was provided by the educational institution. Private donor arrangements for financing of equipment were one important source of financing.

Braille produced on paper was declining, while Braille in electronic format for display devices was increasing, especially with respect to scientific notation.

Braille material usually had to be ordered in advance and it was difficult to acquire it spontaneously from the Ministry of Culture library for the blind.

E-books have now become more frequently occurring especially within higher education. Generally, the e-school environment was perceived as challenging for visually impaired students, although certain work-around solutions did exist and they might solve accessibility problems to some extent.

As for decisions on Braille, these were currently taken by the Ministry of Education and the school for the blind. As there was no Braille authority in existence to undertake such responsibilities. This could very well be changed in the future.

Country Visit: Italy

The visit to Italy to meet Braille users and readers took place in Bologna on October 17, 2017. Three steering group members attended, including Clara Ori from Italy who undertook the practical arrangements and was involved with inviting the participants. A total of 16 persons contributed to the deliberations. The team, which was gender-balanced, consisted of persons aged from 21 to 62.

The notes below show that all the participants - almost without exception - had been Braille users from an early age and had used Braille during their school years and beyond, for as long as they were in academic settings. Fewer were very committed to using Braille today in their

everyday lives, although it was apparent that the vast majority had found Braille essential for their educational results.

Technological alternatives to Braille, in a stressful and ever-demanding environment, call for solutions and techniques that are quick and efficient rather than adherence to ideological beliefs and sentiments. The mix between use of Braille in various formats and environments and the use of other tools and methods was interesting and was explained clearly.

The discussion was very lively. It revolved around the personal experience of the participants, their use of Braille at various stages of life and their enthusiasm and belief in the paramount importance of Braille: from childhood, during education and beyond in employment.

To become familiar with subjects and topics that require accuracy and detailed understanding, such as foreign languages and science, Braille was considered a very useful and necessary reading method. One word that was used was "irreplaceable". Braille was also considered a great asset when undertaking recreational and entertainment activities.

Several participants repeatedly made the point that Braille on paper was the way to start learning. However using Braille on a display was very useful was in many ways as good as Braille on paper and was the way forward in maintaining skills and for use in a modern setting.

For employment purposes, Braille and speech often went hand in hand. While a "quick glance" at written material can be done through a fast speech synthesiser run-through, detailed and meticulous examination of a text for solid professional understanding benefits from examination through a Braille version.

The involvement of family members, especially parents, should start at pre-school age, and continue after that. As well as support with homework preparation, it should also focus on leisure and fun activities for blind children, such as writing letters and using playing cards and so on.

The quality and amount of training of teachers (including back-up teachers) was important and varied from region to region.

The extent of inventiveness amongst the participants on where Braille should or could be found was noticeable and spanned public and private

places, from marking of doors and geographical destinations to identification on products, transport, vehicles and service facilities.

Depicting Braille in public and in the mass media as something useful and not as something strange could, as one example showed, lead to a greater acceptance amongst parents who could cling to sight-based solutions. This was often the case, even if their child might have limited sight, when using magnification would only wear the child out and create frustration instead of usable skills.

Participants reported that mentoring and role models were very important to inspire and stimulate children and young persons to use and maintain Braille skills.

Country visit: France

The visit took place on November 15, 2017. People attending were two steering group members, four persons dealing with special training of teachers and members of ICEVI, a member of the board of the organisation of blind academics, a researcher in astrophysics (formerly a teacher at a school for the blind) and a school inspector who also worked as an employee at the Ministry of Health as well as serving as the President of the French Braille Commission.

Previously, the support systems in France were lodged in both the health and educational sectors, covering both practical and theoretical aspects of special education. Recent developments have led to more general knowledge on disability issues and needs and less focus on the specific needs of individual groups of children with disabilities.

The use of role models was considered very important for increasing awareness of and the use of Braille amongst blind children and young persons.

Due to restrictive rules on their registration, it has become more difficult to reach out and address blind children. It is more difficult to offer them services and Braille literature and to link them up with peers. This has led to the isolation of children. Similarly, it has been difficult for parents' organisations to obtain a comprehensive picture of the situation of families and their blind children because the necessary means to ensure full coverage has been severely hampered.

In France it seems that Braille is often perceived as a token of marginalisation instead of a means of performing and improving opportunities. However, if speech and oral input become the way

forward for teaching and learning, this means stepping back several centuries, as the written medium as an essential tool of knowledge and understanding is abandoned.

Progress in medical and surgical treatments has led to a decrease in the number of totally blind children. With a smaller group, members have become more negligible and invisible. Moreover, technology that allows text to be scaled up to font 48, opens up possibilities that, nevertheless, are hard to manage and benefit from in practice.

Braille should be learned by children at a young age while they have the time and willingness to engage in the process easily. Children with low vision nowadays might hardly learn Braille and if their condition leads to progressive decrease of sight, later on, when Braille became a necessary tool, they might be hampered in using it efficiently. They therefore often only got to learn (simple) uncontracted Braille and did not benefit from the opportunity to read Braille easily and quickly, which contracted Braille offers.

There was a decrease in blind Braille trainers who could act as role models for blind children and young persons. Although inclusion in mainstream schools was considered the way forward, role models were of vital importance as inspirational sources for children who are blind.

Braille on paper was considered the prime starting point for blind children in learning Braille. Later, technology for embossing Braille, for depicting Braille on displays etc. became an opportunity and an option that should be utilised, so that each task and situation should be assessed and the proper solution (paper or electronic format) should be brought into use.

Braille combined with the smartphone and low price displays like the Orbit display, which as being developed, were examples of how developing technology might enhance the use of Braille, too.

Braille should be found everywhere, in the public domain, in lifts, showing seat numbers and on toys and children's books to create a situation of equality and opportunity.

A comprehensive European network ought to be established to spread information about all facilities, goods and tools that might benefit visually impaired persons and improve their opportunities in life.

Good Practice in the Teaching and Use of Braille

Learning Braille

The project highlighted examples of good practice in a number of areas. As noted earlier, there is a lack of monitoring of progress of blind children's literacy, such that it may not be known where children need additional help. Rönnbäck and Johansson's paper gives details of a Swedish project that has addressed this issue (see Appendix 3).

Clearly the availability of qualified and competent teachers in schools is important, so that children can learn Braille at an early age and in age appropriate ways. Kupers' article (see Appendix 4) describes scientific research into the importance of early learning for Braille literacy and ways that the brain processes information.

Readers are referred to these papers as further sources of expert information.

The availability of Braille is essential to the quality of life of visually impaired users because it underpins choice, control, freedom and personal development in daily life. Too often it is not used: good practice requires the availability of Braille in a wide range of public and private spaces and for many purposes.

Project participants generated examples and good practice recommendations for where Braille could be easily used to make a large difference. They also expanded on the advantages associated with this. The following lists are not intended to be comprehensive but to provide a starting point for developing further ideas about use of Braille.

Where and How Braille Could be Used

As a means of identifying objects

Braille is already used to provide information about objects but its use could be greatly expanded. Examples could include: labelling of medicines, toiletries and cosmetics, to explain products in vending machines, for food in supermarkets and shops, identifying personal gifts (who they are for and from), for distinguishing CDs and other items such as spice jars, that appear similar to one another.

For navigation

Examples include: for identifying places on maps, for names of streets on street corners, on bus stops to show route numbers, to indicate room numbers in hotels and other public spaces, on toilet doors, for theatre seats, airplane, train and coach numbers, lifts and floor numbers.

For gaining access to services

Examples should include: information on ATMs (automated teller machines), menus in restaurants and instructions on access procedures in a wide range of instances.

For activities with other people

Examples include: for playing cards and other games.

For remembering or putting things in order

Braille can be widely used for following instructions, such as recipes, shopping lists, for making presentations and speeches, for writing letters for or to a blind child, for looking up contact information such as phone numbers and addresses.

For personal development, including employment

Examples include: being able to work in wider fields, including work involving foreign languages, mathematics and other complex subjects. Similarly, it is also essential for reading, singing and playing music in a professional and competent way, especially if the music is complex. Braille permits users in being creative in other ways, such as by making tactile patterns and pictures through Braille with an embosser, perhaps combining it with colours or other elements.

Proficiency in Braille means being able to develop greater literary skills and being able to understand texts at a deeper level than is possible through audio methods alone. Braille also places less strain on the senses while also allowing the reader to create the internal imagined voices of characters.

Encouragement for Children to Learn Braille

Children also need access to good role models and encouragement so that they can understand the value of learning Braille in a context where their sighted peers may not understand its importance. Without this encouragement, children may not appreciate the importance of Braille until the best time for learning it has passed.

Some specific examples reported in this survey are very relevant here. As noted above, in Finland, children could order a ‘letter from Santa’ at Christmas time and embossed and printed Braille alphabets were available for classrooms where a visually impaired child was studying. Children’s rehabilitation services had also produced “A Braille Case”, which aimed at supporting pre-school aged children.

In Norway and Sweden there was a ‘Braille club’ offering Braille materials and tactile pictures for children aged 5-12. Also in Norway, training in Braille was run for sighted schoolchildren, where children who were Braille readers took part as teachers. Giving children a valued role in this way can underline the importance of Braille.

Overall, specific instances of good practice were few and far between. This does not mean that they do not exist and it could be that a more systematic investigation would reveal more examples. However, it does indicate that information about good practice is not easy to come by and that there is scope for further development so that teachers and others have access to ideas and sources of help.

Recommendations

The following recommendations have been developed from the work carried out in the project over two years as well as a consideration of wider developments in this area.

1. **Issue:** Access to Braille is essential. It is important to take advantage of developing technology and ICT to promote the use of Braille, including on Braille displays.

Action: To promote technological developments such as the Orbit display; this is much less expensive than general piezo-based and other technical display-based devices.

2. **Issue:** Good Braille proficiency and understanding comes with early stimulation and confrontation with training of touch and tactile stimulation from an early age.

Action: A coordinated and joint initiative to collaborate with a producer of toys, e.g. Lego, to develop a toy or game based on Braille letters that is so general, that it may be applicable in any country and may serve as a means of introducing Braille in a fun and creative manner.

3. **Issue:** Good Braille proficiency starts with being confronted with, practicing and handling Braille on paper. Sighted people are introduced to media with more than one line while learning to read and the same should apply to blind people. This gives an initial and important understanding of spatial and dimensional aspects and allows the blind reader to experience structures involving several lines. When proficiency has been reached, the Braille reader should be introduced to the braille from a Braille display.

Action: To ensure that blind people learn and understand the spatial and dimensional aspects of text, blind children should as a first step be introduced to Braille on paper. Likewise the Braille writer and the Braille stylus and slate are an indisputable and mandatory part of introduction to writing and reading skills. Later on in their education it is important

that blind children and youths are offered books in Braille in parallel where desired, both in paper and electronically.

4. **Issue**: It is important that, from an early age and onwards, that the immediate family – parents, grandparents etc. – are involved in and supportive of the use of braille as something useful, liberating and competence - building. Therefore, parents should be helped to understand that Braille is not a token of loss or defeat due to lack of sight, but as an asset that will improve possibilities, potentialities and abilities of the blind or severely partially-sighted child and, later on, is an asset when seeking job opportunities.

Action: National blind organisations should collaborate with parents' organisations to distribute a leaflet on Braille. This should contain information developed by a pan-European / EBU-based working group and give examples and messages that address the issue of involvement of family/parents in promoting the understanding of the importance of Braille from a very early age. Where applicable, small video clips, instructive podcasts and other modern and convincing media sources should be developed and offered in the promotion work.

5. **Issue:** Measurement of Braille speed and courses in improvement of Braille reading and writing should be a given part of training of blind and severely partially-sighted children according to well documented and arranged methods to bring the Braille reader up to speed and as much as possible comparable with their sighted peers.

Action: A manual with step-by-step measurement and improvement methods based on, for example, the Rydaholm experience (Sweden) should be prepared by an EBU Working group on Braille in a format that can be implemented in all countries. This kit should include the training material and an instruction booklet for trainers.

6. **Issue:** For training, reading Braille may under well-organised settings be combined with speech (e.g. speech synthesised reading of text) to enhance Braille reading speed and combine the benefits of the two reading methods. However, it is important to ensure that reading via

speech does not “take over” the field, which will lead to a decrease in literacy.

Action: The combination of speech and use of Braille should be carefully considered and balanced.

7. **Issue:** The competencies of supporting teachers of Braille in mainstream schools should be vastly improved. With teachers / trainers who have only a poor knowledge about Braille, the child will lose motivation and interest quickly if questions about Braille remain unanswered or are dealt with in a careless and ignorant way that shows lack of interest instead of motivating involvement.

Action: ICEVI should together with EBU (possibly through a dedicated working group on Braille) focus strongly on strengthening competencies amongst resource persons and teachers. This should bring Braille into focus again and ensure that support teachers in mainstream schools are offered improved training, perhaps through distance learning, to improve their knowledge about Braille.

8. **Issue:** The existence and promotion of mentors and role models who know and value Braille is important to stimulate and motivate new Braille users.

Action: In all organisations of the blind persons should be identified, and an EBU network should be established where exchange of ideas and experience could be undertaken.

9. **Issue:** It is important from the start of using Braille and beyond to highlight the importance and usefulness of Braille in all aspects of life from leisure, play, in everyday life, in the household, in communication, during studies and later during employment. Reference is made to the list given in the project report of ways Braille may be used and what makes Braille useful and adding valuable aspects to life and practical activities.

Action: Organisations should promote the visibility of Braille in the public sphere. Wherever there is printed information, Braille should be

available as well. There should be collaboration with toy manufacturers, the organising of writing competitions and promotion of Braille on goods.

10. **Issue:** Production of Braille books, magazines and any other materials should take the best of the technological possibilities such as high speed production, scanning, the availability of electronic source files, whilst, on the other hand, not offering books that fall short of proper editing, binding, etc. Books or other Braille material that contain errors, have poor binding or lack the proper facilities that offer quick and accurate indexing and searching facilities will lead to demotivation and less use of this medium. Trends on the part of libraries of the blind to down-scale or de-prioritise proper Braille production should be turned around and the responsibility of the units for preparing and printing Braille should be clarified and established clearly.

Action: The organisations of the blind in all European countries should, together with the authorities responsible for culture and education, ensure that national or regional libraries for the blind maintain this as a priority and focus on quality production.

11. **Issue:** Focus should be put on producing materials that are useful for motivating and sparking the interest of children and youth with regards to tactile inputs, such as maps, 3 D training and learning materials and tools that may be used for hobbies, leisure time activities etc.

Action *(I)***:** Organisations of the blind should lobby for the acknowledgement of Braille as the prime reading and writing format for persons who are blind, especially children and youths.

Action *(II)***:** A Braille authority should be established in all European countries that follows, develops and renders qualified consultation on national Braille formats and design. Likewise, efforts should be made to encourage the national decision-makers to formally acknowledge Braille in conformity with the principles and indications given in the UN Convention on the Rights of Persons with Disabilities, where Braille is highlighted as an indispensable tool for persons who are blind in terms of education, culture, signage, accessibility etc.

Action *(III)***:** EBU should establish a Braille working group that could monitor the status and conditions related to Braille and undertake the above indicated assignments.

Action *(IV)***:** EBU should in its newsletter and on its website establish a Braille area, where issues and ideas related to the promotion of Braille, usage, reading, writing etc. should be a focal issue. Likewise recommendations, ideas, and tool kits to be developed etc. should be placed here. If possible, the EBU should develop Question and Answer or other tools that could be used by national organisations in promoting and acknowledging Braille also on an official political level.

Appendix 1 Detailed Findings from the National Surveys

Each country provided answers to the questions asked. The answers are compared with one another, in contrast to the single reports on three countries that are discussed later. The following abbreviations are used for each country:

AT - Austria; DK - Denmark; EE - Estonia; FI - Finland; IS: Iceland; FR - France; IT - Italy; NO - Norway; SE - Sweden.

Introductory Information: Registration of Children

The initial question asked:

Is there in your country a registration based on classification criteria of children with a visual impairment, e.g. an official register?

Answers were as follows:

Yes	No	Not answered
AT: numbers are for those receiving money for welfare benefits. Age data not given. EE: from Estonian Social Insurance Board and Estonian Education Information System FI: National Institute for Health and Welfare (compulsory registration) Also from ONERVA (education system) and Skilla (Swedish speaking children) IT: Yes. No further information given regarding source.	FR: legal prohibition NO: no official system but numbers are registered SE: no official register but services collect numbers	DK, IS

In most instances numbers of blind and visually impaired children were collected for purposes other than simply counting the numbers of children who might need to learn and use Braille (with the exception of Finland). Statistics were collected to determine the number claiming welfare benefits and the criteria for eligibility and for allocating resources differed across countries. Numbers were also collected by education systems and by services. Italy did not indicate a source and Denmark did not answer the question.

Another difference was that most blind children have other impairments as well. Therefore not all children were registered as being visually impaired if this was not thought of as their main impairment.

Because of these differences, the figures for this question are not easily comparable and they can only be used as a rough indication.

Section 1 Numbers using Braille

Question 1.1 asked:

How many children use (read and write) Braille at school?

Answers given were as follows:

AT: 100 pupils

EE: 15 pupils aged over 7 plus an unknown number who have multiple impairments

FR: no information available

IS: 6 children

NO: about 80

SE: about 7 in each school grade (no total given)

DK and IT: question not answered

It is clear that the number of school age Braille readers is very small in relation to the total number of school children overall in each country. It is not clear from the answers given whether more children would benefit from learning Braille.

This does not mean that access to Braille unimportant for this group but it does mean that it may be more difficult to mobilise an influential voice in terms of access to resources.

Question 1.2 asked:

How many books for visually impaired children are published by the national library for the blind and visual impaired and from other agencies for leisure purposes and for educational matters in the years from 2010 and onwards?

Very different answers were given to this question. Austria[7] noted a much larger volume of books produced for educational compared with leisure purposes, with the numbers ordering them remaining fairly steady. Others (EE[8], FI[9], FR[10], SE) gave much higher numbers for leisure reading compared with education.

Countries were also asked about the differences in the number of paper and electronic books. In Denmark, Refsnaes indicated that books for blind children under 18 years were produced for leisure and educational matters, as electronic Braille. Biblus, the digital school library of the visually impaired gave the following figures in all electronic formats: 2012: 1784; 2013: 5119; 2014: 4308; 2016: 3403. For 2015, Nota gave a figure of 147 Braille books on paper and 78 as electronic Braille.

Norway gave an equal balance between the production of paper (992) and electronic books (1080) between 2010 and 2016. Sweden recorded much higher number of paper books for leisure (total of 2153) compared with 1408 electronic books from 2010 – 2015.

Iceland did not have a library for blind people but users could order materials from the National Institute for the Blind and Visually Impaired. Between 2013 and 2015, paper Braille books declined from 39 to 19 for leisure and 95 to 66 for education per annum. Electronic publications in total (no data available for books only) increased from 479 to 625, of which the number of leisure publications decreased from 15 to 6.

[7] Approximately 20 paper books and 10 electronic leisure books annually, compared with approximately 200 paper and 660 electronic books for educational purposes.
[8] Much lower numbers overall are given for Estonia, with a spike in numbers from single figures to around 150 (paper) and 40 (electronic) in 2014.
[9] Finland gives figures of 155 paper leisure books and 151 electronic books since 2010.
[10] Approximately 500 paper books and 60 electronic books for leisure annually compared with approximately 170 paper and 18 electronic books for education annually.

In Italy[11] it was pointed out that the use of paper Braille books for educational reading is similarly decreasing in favour of electronic books (used either with Braille displays or speech). Further, after primary school, students tended to use Braille only for those subjects that make it essential (sciences, foreign languages), whereas they read texts with speech for all the other subjects.

Respondents in this survey gave data available from national libraries where available. However, electronic books are frequently bought from publishers and this means data is not available about the wider picture of overall use. It is also not known whether these books were accessed through Braille display or speech.

Question 1.3 asked:

Are there any general figures regarding Braille publications indicating the number of loans to children and young person's less than 18 years of age?

Answers to this question were very variable and it was not clear that the question was understood in the same way in the different countries. Austria and Sweden[12] answered 'yes' without giving an indication of numbers. Denmark gave an average figure for downloads by blind people under 18 of 3403 a year, reflecting answers provided above. Nota gave a figure of 533 loans.

Finland noted 19 users borrowing a total of 79 books with a median average of three per person. Estonia, France and Iceland answered 'no' and Norway did not answer the question.

Question 1.4 asked:

Has there been a change over the past ten years in the ordering of books in Braille?

All answers noted a decrease in the numbers ordering books in Braille (AT, DK, EE, FI, IT, IS, NO) and France less contracted Braille.

[11] The regional Printing House of Catania, recorded the production of paper Braille books for educational matters decreased from 866 (in 2009/10) to 341 (2016/17), whereas digital Braille books production went from 129 (2009/2010) to 180 (2016/17).

[12] Sweden indicated that the number of loans was decreasing although publications were increasing.

Several respondents pointed out that there was now a greater preference by students for audio books (EE for leisure reading) and for electronic Braille in the case of educational books (EE, NO). In Denmark opportunities for downloading books had influenced demand.

The situation in Sweden was less clear cut in that organisations thought that changes in pupil numbers were another cause of fluctuation in numbers and one organisation only produced paper Braille resources so could not comment.

However, in line with greater digitisation of books and articles as a whole, respondents pointed to a clear pattern of increased ordering and preference for audio materials, especially for leisure reading.

Question 1.5 asked:

In which way, if any, have new styles or ways to produce books in Braille (e.g. through the use of automated translation and formatting programs) influenced the demand?

New technology was felt to have improved access to books. The main improvement noted was the possibility of receiving books faster (AT, FR) while Italy pointed to increased demand for electronic versions that could be used with smartphones or tablets. Improved availability was also felt to fuel demand (EE) as was the availability of automatic translation (DK, SE). The introduction of print on demand was considered to have considerably improved access (FI, SE). Iceland stated that these had not affected demand itself however.

Question 1.6 asked:

Are there one or more of the following braille production/lending facilities in your country? A national library with Braille production, a library based with / run by Organisation of Blind People, a library run by a school for blind people, a library run in a different setting?

Answers are listed in the table below, with questions in the left hand column:

	Yes	No	Question not answered
National library with	EE[13], FR[14]		AT, IT

[13] The Estonian Library for the Blind receives State funding

Braille production			
Library based with / run by Organisation of Blind People	EE[15], FR[16], IT[17]		AT
Library run by a school for blind people	AT, EE[18], FR[19], IT[20]		
Library run in a different setting	EE[21], FR[22], IT[23]		AT

These questions were not asked in the 2016 questionnaire; therefore there are no answers from Nordic countries.

Section 2 Braille Training

Question 2.1 asked:

How many courses have been held in 2014, 2015 and in 2016 containing elements of braille training, reading proficiency?

Not all countries replied to this question. Of those who did, the numbers remained relatively stable (except for FI) between 2014 to 2016, so an average (mean number) is given below. The following replies were given in relation to ages and number of pupils:

[14] Does not receive public funding.
[15] A national financed library (Estonian Library for the Blind) receives public funding from the state.
[16] No public funding received so far.
[17] Receives public funding; source not specified.
[18] The Tartu Emajoe School – a special state school for children with visual impairment - has a library financed by the Ministry of Education and Science. The School produces Braille and electronic study books for all blind school-aged children.
[19] For example the French National Institute for the Blind; however resources are only available to their own students.
[20] Does not receive public funding.
[21] Run by some regional organisations of blind people. Some received funding from the local government public library.
[22] Non-profit organisations produce school books but to date have not received public funding.
[23] Not publicly funded.

Country	Pre-school	6-9	9+
AT	0	10 courses Duration 30 days 18 pupils / year	13 courses Duration 30 days 24 pupils
DK	3-4 per course Duration 5 days Average 3 courses per year	6-12 per course Duration 5 days 1-2 courses per year	6-12 per course Duration 5 days 3 courses per year
FI[24]	3 courses per year Duration 5 days Courses are for parents (number not given)	Pupils attend course twice a year Duration 5 days	Pupils attend course once a year Duration 5 days
NO[25]	7 courses for children and parents Duration 3 days 34 children and parents	6 courses Duration 4 days 18 pupils and parents	5 courses Duration 4 days 72 pupils
SE[26]	3 courses 4-5 children participating in each course	0 courses. Instead, advisors visited local schools to advice teachers.	2 courses Duration 3 days 9 pupils in fourth grade, 6 pupils in fifth grade.

[24] Numbers provided are not broken down by age. In 2014 there were 8 courses for 36 pupils, in 2015 13 courses for 49 pupils, and in 2016 11 courses for 32 pupils. These courses were not only for Braille but included it. Numbers given are for children of all ages.
[25] In Norway, parents and teachers also often participate in courses.
[26] Details are given from one organisation, the 'Specialpedagogiska skolmyndigheten' (Special Education School Authority). Details about the length of courses not given.

			In 2015-2016 there were no courses; advisors visited schools instead.

Estonia and Iceland did not provide numbers for children of different ages. In Estonia blind children who attend special schools learn Braille in lessons throughout their school years at the same time as sighted children learn to read and write. Pre-school skills training, as well as teaching in schools, can be provided by the counselling or rehabilitation system. The number of training sessions is determined for each pupil and the requirements for services. Learning Braille is mainly one-to-one learning and based on individual needs. In Iceland courses are run each autumn for teachers and parents. Children are also assessed and steps taken if needed.

In France the situation was not known. Italy did not answer the question.

Question 2.2 asked:

In what contexts has teaching primarily taken place?

Details of where teaching was carried out are as follows:

Institutions / resource centres	Mainstream schools	Organisations of blind and visually impaired	Other
AT, DK, EE[27], FI, FR, IS NO, SE[28]	AT, DK, EE[29], FI, FR[30], IS, IT, NO	AT, DK, EE, FI, FR	AT[31], DK, EE[32], FI[33], IS[34]

[27] Both state and municipal special schools
[28] No information provided about whether training is available in other settings
[29] Individual study plans organised by counselling and rehabilitation services
[30] Provided by a support teacher in mainstream schools
[31] Digital learning material
[32] Project based initiatives, however these are quite rare
[33] Assistance also may be provided at home.
[34] Courses may also take place at home, where children and parents are taught together.

Several countries said that specialist advice was available to teachers and pupils in mainstream schools (EE, FI, FR, IT). In Norway and Sweden parents could join the special classes run for children.

In Italy, particular problems were noted in that assistants in mainstream schools often did not know Braille themselves and preferred to use oral teaching methods. Although some efforts had been made to increase the skills of teaching assistants, high turnover of staff presented an additional problem.

Question 2.3 asked:

Are there special requirements regarding the qualifications of teachers who undertake the training of visually impaired children in Braille? Are teachers offered training?

This question was not part of the 2016 questionnaire but it was asked in 2017. The four countries concerned (AT[35], EE[36], FR[37], IT) all indicated that specialist training was required for teachers of visually impaired children. In Austria and France, training in Braille was an explicit part of the curriculum and in France it was necessary to pass a test in its use. Although specialist training was required for teachers of visually impaired pupils in Estonia, Braille was not a specific part of the training requirements. The Italian respondent also did not indicate this to be the case (see also the specific issues raised with regards to teaching assistants in Italy for Question 2.2).

Therefore there appear to be shortcomings in the training of teachers of visually impaired children in at least some European countries. On the other hand, in Norway reported that there is university level training for teachers of Braille, indicating differences between countries.

Question 2.4 asked:

[35] One weekend a year there is a conference for teachers in mainstream schools.
[36] Teachers in special schools need a Master's degree and to have a first degree or equivalent in special education. This also applies to those working in counselling and rehabilitation services in mainstream schools. There are no formal requirements in terms of Braille skills.
[37] Health Ministry degree : Certificat d'aptitude à l'enseignemntgénéral aux Aveugles et déficients visuels : 300 hours training in total, with 40 hours for Braille and 40 hours for contracted Braille. For the national education degree, teachers of visually impaired pupils must pass a test on Braille and specific ICT.

Are there in your country courses or classes (e.g. evening school or weekend gatherings) where parents and pedagogues in kindergartens are offered knowledge about and skills in the use of Braille?

In Denmark, parents participated in all the Braille courses, full time for younger, and part – time for older children. Similarly, in Norway, education for parents that often included Braille ran alongside children's courses. Training was also held in Norway for educators and others responsible in primary schools,[38] as well as courses for teachers in public and primary schools.[39] Courses in a student's local area were also available, with approximately four courses of one day each year for a total of approximately participants on each 5 on each course.

With a smaller population, in Iceland parents, teachers and sometimes visually impaired children attended the same course[40].

Three countries (AT, EE, FR) indicated that sometimes informal courses were organised. In Austria a weekend conference for parents and teachers in mainstream schools was organised once a year. Estonia indicated that courses were mainly project based and organised by organisations of blind and visually impaired people. In France, informal events were sometimes arranged by teachers. In Italy there were no courses.

Question 2.5 asked:

Is there a planned strategy and clear division of responsibility to teach the various groups mentioned under question 2.1 and 2.3 Braille?

This question asked about two different issues and most respondents provided a partial answer. Norway indicated that children had a legal right to learn Braille and to use reading devices. Teachers also had responsibility for developing individual plans. Other replies mainly addressed the question of whether there existed a division of labour in the teaching of Braille.

The replies are summarised as follows:

[38] The author notes six courses, each being for 3 days with 46 participants in total.
[39] The author notes 20 courses at resource centers. Each course being for 5 days with a total 361 participants.
[40] In 2016, eight courses had been run, each lasting half a day. The author notes that specialist staff also keep in touch afterwards to offer additional help if needed.

Clear division of responsibilities	No clear division of responsibilities
AT, DK[41], FI[42], FR, IS, NO[43], SE[44]	EE, IT

Question 2.6 asked:

Does training of children in Braille take place in writing and reading applying (a number of different means)?

Answers are summarised as follows, with the means of teaching listed on the left hand side:

Means of teaching	**Yes**	**No**	**Question not answered**
Slate and stylus	DK[45], FI, IS, IT	FI, FR[46] NO, SE[47],	AT, EE
Paper and braille machines	AT, DK, EE, FI, FR, IS, IT, NO, SE		
Braille display	AT, DK, EE, FI, FR, IS, IT, NO, SE		

[41] Refsnaes stated that pupils in school did used mainstream rather than special materials for their school classes, which were prepared specially for Braille. The responsibility was shared between the local school, the local advisors and the resource centre. .

[42] In Finland, FFVI mostly took care of parents' courses. Resource centres Valteri (Onerva and Skilla) took care of training teachers and assistants for pre-schoolers and for 1st to 9 th grades. They also passed on some general guidance for parents during children's support courses.

[43] The child's teacher and the local counselling office were responsible for making an individual educational plan for the child.

[44] A clear allocation of responsibilities by different agencies at different ages of the child.

[45] All methods are used in Denmark, depending on the needs of the child.

[46] Now hardly ever used.

[47] Information is given about slate and stylus but now replaced largely by smartphones and other technology.

Braille note taker	AT, DK, FI, FR, IS, IT, NO, SE	EE	
Printed Braille letters in a printed matrix	AT, DK, FI, FR, IS, IT	NO, SE	
Recorded spoken text	DK, FI, IS, NO, FR[48]		AT, EE, IT, SE
Other means	AT, DK, FI, FR, IS, SE		EE, IT, NO

Question 2.7 asked:

Is there a system for offering update and maintenance of Braille skills?

Three countries (AT, EE, IT), stated that there were no opportunities to update and maintain skills. However, the Italian respondent pointed out that children use Braille on a daily basis and this practice consolidates their proficiency in reading and writing in any case.

Other countries (DK, FI, FR, IS, NO, SE) stated that there were opportunities for further training. In Finland and Iceland this was offered routinely, while in the other countries (DK, FR, IS[49] NO, SE) this could be offered based on assessment results or if requested

Question 2.8 asked:

Are there some fixed ways to assess between courses whether the child does obtain and maintain a proper Braille skill level after the course? Is testing carried out and what is done if results are not satisfactory?

Two countries (NO, SE) indicated that children were tested in national assessments, through adaptation of materials into Braille. In Denmark children's progress was measured at the resource centre although this

[48] Where recordings are sent with Braille books but not generally seen as part of Braille teaching.
[49] In Iceland courses were mandatory rather than optional. They could be requested by a teacher and often tailored to each student.

was not an official test. Sweden was the only country that explicitly mentioned that tactile reading development was measured (see also the paper by Rönnbäck and Johansson in this report, Appendix 3).

Other countries (AT, EE, FI, FR, IT, IS) stated that there was no testing of proficiency in Braille reading. Where children struggled, respondents considered that this would probably be left to a teacher to pick up. Assessment of reading speeds was lacking in almost all instances.

Section 3 National Braille Systems

This section asked respondents for information about national Braille systems with reference to two main issues: use and availability of contracted Braille and use of the eight dot code.

Use of Uncontracted and Contracted Braille

The answers to several questions are summarised in the chart below, with questions listed on the left hand side:

Question	Yes	No	Not answered
Does national Braille include a contracted system?	AT, DK[50], FR, IT[51], NO, SE[52]	EE, FI, IS	
Is there a policy on contracted Braille?	AT, DK, SE	FR, IT, NO	
Is there an official position on contracted Braille?	AT, DK[53]	FR, IT, NO	SE

[50] Contractions are used from starting school.
[51] However, it is no longer used.
[52] However, no books are produced in contracted Braille
[53] The Danish official position is to carry out individual assessments.

Are library books available in contracted Braille?	AT, DK, FR	EE, IT, NO	SE

Countries were also asked about barriers to the use of contracted Braille where it was part of the national system. Most did not reply to this question but some stated that the system was too complex. This was because some students with learning difficulties found it difficult (AT, DK) or that it took too long to learn (FR). In particular, in inclusive classroom settings learning contracted Braille presented problems with synchronising materials between blind and sighted students and between students using Braille at different levels (DK, NO).

Use of the 8 Dot Code

Countries were also asked several questions about the 8 dot Braille code. Answers are summarised below, with questions on the left hand side:

Question	Yes	No	Not answered
Is an 8 dot code used?	AT, DK, EE[54], FI, FR, IT[55] IS, NO, SE		
If so, is it officially approved?	AT, DK, FI, FR, IS, IT, NO, SE	EE	
If so is it taught to	AT[56], DK[57], EE[58], FI[59],		

[54] Initial steps towards it have been taken.
[55] Only for electronic Braille.
[56] For electronic displays rather than paper.
[57] For both paper and electronic displays. : At the Centre for the visually impaired – Refsnæs, 8 dot braille is available to all children unless they ask for 6 dot. It is used on tactile illustrations, electronic documents and paper.
[58] For electronic displays rather than paper.
[59] For electronic displays. Introduced during 1st and 3rd grade.

children?	FR[60], IT, NO[61], SE[62]		
Is there knowledge of reading speeds with 8 dot Braille?		AT, EE, FR[63], IS, IT NO, SE	DK[64], FI

The main issue apparent here was lack of checking on the progress of children's reading speeds. This issue was picked up at other points during the project (see also Rönnbäck and Johansson's paper in Appendix 3). Of course there is an issue about how such assessments are used and whether they result in help or exclusion, but it indicates an important lack of parity between sighted and visually impaired pupils.

Section 4 Electronic Braille

Section 4 was concerned with children's access to and use of electronic Braille. All children had access to this in the countries surveyed but there were variations in certain aspects.

There were some considerable differences between the formats of the questions asked in the 2016 and 2017 questionnaires for this section. Therefore discussion of the results of the questionnaire do not follow the order of the questions asked in each questionnaire; material has been restructured in order to give a logical sequence to the material as a whole.

Question 4.1 asked:

When is the visually impaired child, where appropriate, generally introduced to electronic braille?

Iceland noted the youngest age, at 5 years and in Denmark, children were introduced to electronic Braille as early as possible, usually at 5-6

[60] Used in special schools and in inclusive schools where children have access to extra lessons. It is used for both paper and electronic materials.
[61] Not used for paper.
[62] Not used for paper.
[63] Some information is available but only for adult readers.
[64] As noted previously, testing was carried out in Denmark but this was not official.

years old. In Austria this was at age 7 and at around 8-9 years in France, although this could also be later at 11-12. In Estonia children were generally introduced at around 9 -10 years. No specific ages were given by Finland[65], Norway[66] and Sweden. All countries except Austria stated that decisions about electronic Braille were made in conjunction with an assessment of the individual child.

Italy noted a general lack of national data on this issue but pointed out that digital material is made available for pupils aged 10 – 11 while one Italian organisation stated that children had access as soon as they were ready.[67] The France author indicated that the age at which electronic Braille was introduced also was subject to funding availability.

Question 4.2 asked:

Is there a national pedagogical strategy regarding the necessity of having teaching material available on paper in order to obtain understanding and skills when also providing the text in electronic braille?

A summary of answers is below:

Yes	No
DK[68], EE[69], FI[70], IS, IT, SE[71]	AT[72], NO[73], FR

No further details about the actual strategies and policies were provided by authors in answer to this question.

Question 4.3 asked:

[65] Finland mentions general training at school Grades 1 and 3 and more specific training at 5th and 5th grades
[66] The author mentions that the child has an evaluation at Grade 1 or 2 and many children will have equipment for simple tasks at Grade
[67] Noted by the Federazione Nazionale Istituzioni Prociechi
[68] However decisions are made on the basis of individual need.
[69] All schoolchildren first learn Braille on paper
[70] Children may be taught both systems in parallel if this is judged beneficial.
[71] Both formats are offered in parallel from the first year of school.
[72] Braille on paper may not be offered after electronic Braille has been introduced to children.
[73] However the author states that pupils may textbooks in both formats until the 7th grade of school.

Will educational materials continuously - after electronic Braille has been introduced - be offered in Braille embossed on paper?

Answers were as follows:

Yes	No
EE[74], FI[75], IT, IS, NO, SE	AT, DK[76], FR[77]

Question 4.4 asked:

Who determines what formats (Braille on paper or electronic Braille) the visually impaired child subsequently should utilise for writing and reading Braille?

Typically, decisions about the format were made by several parties rather than being the result of one person or organisation acting unilaterally. Countries indicated the following actors were involved in decisions:

Country	Child	Parents	Teachers	Producers
AT			X	
DK[78]	X	X	X	X
EE	X	X	X	
FI[79]	X		X	
FR[80]	X	X	X	X
IS[81]	X	X	X	X
IT	X	X	X	X

[74] If needed by the child.
[75] This depends on the subject and the child's needs.
[76] Most educational materials are only offered in electronic Braille. However beginners' materials are printed on paper, as are pictures unless they can be described.
[77] To some extent this depends on the school and the pupils.
[78] In most cases the producer decided on electronic braille or paper. However, the child, teacher, the parents or the teacher could talk about their preferences and recommendations.
[79] Teachers include both classroom teachers and consulting teachers.
[80] Rather than the producers, the resource centre staff, who may include an ophthalmologist or orthoptist may give their opinion.
[81] Decisions were always taken jointly.

NO[82]	X	X	X	X
SE	X		X	X

Question 4.5 was asked of the four countries included in the 2017 questionnaire (it was not asked of Nordic countries in 2016) as follows:

In determining what kind of electronic Braille devices the visually impaired child is offered, is there a general strategy that guides such choices or does this depend on a concrete individual assessment?

Three of the four countries indicated that decisions were based on an individual assessment of the child (AT, FR, IT). In Estonia, not all devices were suitable for the Estonian language so here the availability of devices was more likely to guide decisions. Other influences on choice included technical specifications and the degree if fit with other classroom devices (FR). In Italy, the availability of equipment also influenced choices. Here, the author also noted that there was a preference for speech software rather than devices because this was more likely to be immediately available.

Question 4.6 asked:

Are there dedicated courses designed for learning the use of electronic Braille devices?

The following answers were given:

Yes	No	No, but training is part of other courses
DK[83], FR, IT	AT, FI[84]	EE, NO, SE

Question 4.7 asked:

Does there exist appropriate national software, which ensures correct representation of files on Braille displays?

[82] Children are involved when they are old enough. Producers are affected by shortages in funding and more often electronic books are chosen.
[83] From the beginning of school.
[84] Training is based on individual needs or students are given manuals and quick guides.

Most authors noted that the code is standardised (AT, FR, IT), while two stated the existence of national software (FI, NO). Sweden pointed out that the national Braille authority had identified this as an issue.

Question 4.8 asked a number of questions on the use of smartphones and training in using them. Questions and answers are summarised below with questions on the left hand side:

Question	Yes	No
Do young people use smartphones?	AT, DK, EE, FR, IT, NO, SE	FI
Do they use Braille displays with them?	AT, DK, FI, FR, IT, NO, SE	EE
Do they use typing in Braille format with smartphones?	AT, DK, EE, FI, FR, NO	IT, SE
Is structured training available?	DK, FI, NO, FR[85], IT, IS, SE	AT, EE[86]

Section 5 Availability and Use of Braille machines

Question 5.1 asked:

Are all visually impaired children granted a Braille machine: at home, kindergarten, pre-school and in the classroom and in other places?

All countries indicated that all eligible children had access to a Braille machine for use in all places, including at home and in pre-school and classrooms. In four countries (FR, FI, NO, SE) machines were sometimes available to children in kindergarten if it was seen as appropriate. In Estonia, machines were free to use in the classroom but users had to pay 10% of the cost for use of a machine at home.

Question 5.2 asked:

[85] Not available in schools but through resource centres.
[86] However, the author states that the first steps have been made at special school for VI children and the first training course was due to be will be carried out by the Estonian Federation of the Blind in 2017, financed by a project.

Is there qualified repair/maintenance services of Braille machines?

The following answers were given:

Yes	No
AT, DK, FI, IS, NO, SE, FR, IT	EE, IT

Some countries added provisos to their answers. In France it was pointed out that not enough people are trained in carrying out repairs, so it was difficult to get a machine repaired. Italian organisations gave two different answers. On the one hand a repair service was said to exist but on the other the Federazione Nazionale Ist. Prociechi stated that a repair service was only available for Braille printers.

Question 5.3 asked:

Must the end-user contribute to the payment in order to get a Braille machine repaired/maintained?

Stated answers were:

Yes	No	Question not answered
AT, FR, IT	DK,[87] EE, FI, FR, IS	DK, SE

In France the official position was that repairs were free. However repair costs were only available once every five years. In practice sometimes people had to pay for the service.

Question 5.3 asked:

What are the types of Braille machines used in your country?

All countries stated that Perkins Braillers were mainly used. Denmark identified the Pronto and Hims U2. Estonia and Sweden also identified the Tatrapoint Brailler and Italy the Braillo 400. Iceland stated that Papenmeier, Focus, Hims and Baum were used.

[87] In Denmark, because the user borrowed a machine from the authorities, they did not have to pay for maintenance or repair.

Section 6 Educational and Play Materials

Countries were also asked about the production by national libraries of Braille materials on paper and for electronic devices for different ages and interests. This section underwent revision in the second year of the project, with Austria, Estonia, France and Italy asked somewhat different questions compared with the Nordic countries in 2016. Therefore the material again has been restructured slightly to allow comparisons.

Question 6.1 asked:

Does the library for the blind and visually impaired or the resource centre(s) produce supplementary Braille materials adapted to different age groups and assumed interests?

This question overlaps with the material in Section 1; however, here the degree to which products are individualised to the ages of users is reported on, rather than the production of materials as a whole.

All countries answered ‘Yes’, except for Estonia, where the information was not available.

France noted that payment was needed, although it was not clear whether this was for information about the materials or the materials themselves. Several examples of age appropriate materials and support were given: in Finland, children could order a ‘letter from Santa’ at Christmas time and embossed and printed Braille alphabets were available for classrooms where a visually impaired child was studying. Children’s rehabilitation services had also produced “A Braille Case”, which aimed at supporting pre-school aged children. The author noted a need for further materials that could be used with classmates. In Norway and Sweden, there was a ‘Braille club’ offering Braille materials and tactile pictures for children aged 5-12 years. A book club provided reading suggestions for teenagers in Sweden. Other countries did not provide examples.

Question 6.2 asked:

Are competitions or other types of playful activities organised in order to challenge and stimulate the visually impaired child to handle Braille?

Answers were as follows:

Yes	No	Question not answered
AT, DK, EE[88], FR[89], IS, SE	DK, AT, NO	IT

Estonia and France mentioned specific competitions and other games were encouraged as well. In Austria and Estonia Braille playing cards were given to children with visual impairments. In Finland, Italy, Norway and Sweden playing cards were not given free to children but they were available to buy. Finland also mentioned that teachers were encouraged to add Braille to games.

Question 6.3 asked:

Is it given priority that the visually impaired child meets other persons as role models (young, adults) with a visual impairment who can demonstrate the benefits of using and handling Braille proficiently?

Answers were as follows:

Yes	No
AT, DK, FI, FR, IT, IS[90], NO, SE	EE

With the exception of Austria, those countries that answered yes gave examples of when this took place. In several instances it was the organisation of the blind that mainly organised contact with role models (FR, IT, IS, NO). This could present organisational problems in France, where pupils might attend schools all over the country. Because contact often took part at specific times, for example during summer camps (NO) or when attending Braille courses, it was sometimes quite brief rather than sustained over time. Sweden and Iceland stated that contact was

[88] A contest on reading and writing of Braille is organised on White Can Day by the Organisation of the Blind

[89] Le poinçon magique (the magic stylus) is a dictation competition in Braille

[90] Iceland noted that not much is done but there is an attempt to co-ordinate contact with role models via the Blind Union.

not sufficient overall. Although Estonia answered 'no' to the question, it was with the caveat of being not officially organised, so suggesting that there may be some *ad hoc* or informal contact.

Question 6.4 asked:

Are instructions/training offered to parents, other family members and educators/teachers to make them understand how the blind child may be able to play with sighted friends, if Braille is added to toys or other materials in a proper manner?

A summary of answers is as follows:

Yes	No
DK, EE, FI, FR, IS, NO, SE	AT, IT

In most of the countries that answered yes to this question, this training formed part of the courses run for parents and teachers. France also mentioned internet based discussion groups as a source of support to parents and teachers, and the availability of an internet gaming platform[91] for visually impaired users. In Estonia, information was made available when parents and teachers applied to the counselling service.

In Norway, courses were also offered to the classmates of blind pupils. During this training, Braille readers also often gave instruction, together with the teacher, in how to play games, how to use a Braille machine and read Braille.

It was not clear from the answers whether these initiatives were widespread in each country or whether they were 'one – off' instances.

Question 6.5 asked:

Has there been developed a catalogue of ideas on where in the home, etc., Braille can be used so as to demonstrate its relevance (e.g. on appliances, kitchen utensils, spices, on medicine, selection of boxes and drawers)?

Answers were as follows:

[91] For example the websites http://www.enfant-aveugle.com and http://accessijeux.com/

Yes	No
DK, FI, FR[92], IS[93], NO, SE[94]	AT, EE, IT

Further details about the publications or why they had not been developed were not given (but see elsewhere in this report).

Section 7 Braille authorities

Countries were asked[95]:

Is there a Braille authority / board / body in your country?

Answers are summarised below:

Yes	No
AT[96], DK, EE[97], FI[98], FR[99], IS, IT, NO, SE	EE

[92] Professionals show parents how to do this during early intervention sessions.
[93] In Iceland there is not a catalogue but children and families are given ideas at home.
[94] Written information on how to do this is made available.
[95] This question was not originally asked of the Nordic countries in 2016. However each does have a Braille authority so the additional information has been added here.
[96] Austrian representatives on the board are from the Austrian Society for the Blind, Teachers and the Braille Production Centre.
[97] Members of the Estonian working group on Braille are from the Estonian Federation of the Blind, from special schools for visually impaired children, from the Institute of Estonian Language and from the Estonian Ministry of Education and Research.
[98] The Finnish expert body is constituted every four years by the Ministry of Education and Culture. In 2016 the authority was actively revising the Finnish e-Braille notation of mathematics (Finnish version of AsciiMath)
[99] The CEBF has been working on the standardisation of the French Braille code with other French-speaking countries. And it produced « the French standardised Braille Code for the transcription and adaptation of printed texts (in French: CBFU), in use since 2007. The maths code is specific to French (last update January 2007). The chemistry code has been available since June 2008. Now, since 2009, the commission CEBF is deliberating on a modernisation of grade II French Braille with delegates from Canada.

Although Estonia answered ‘no’ to this question, the author gave details of a working group that has been responsible for the development of Estonian Braille and further information on its work. For the purposes of this report it has therefore been allocated to the ‘yes’ group as well as the ‘no’.

All countries with a national authority included members who were Braille users, service providers and teachers. In all instances the organisations funded the costs of participating in meetings themselves; it was not clear whether specific funding was allocated for the purpose but France and Estonia noted that they were not government funded.

With the exception of Estonia, the bodies were formally constituted in some way. Meetings were held when required or if problems arose (AT, EE) and once or twice a year (FR). Finland’s body was officially constituted every four years.

Section 8 Additional Issues

Countries were asked about additional issues they wanted to raise and several did so (FI, FR and IT).

In **Italy** there was concern about the timely and sufficient availability of materials. In particular it was pointed out:

“It is estimated that out of 250/300 primary school blind children, only half of them receive teaching material in Braille, and not always at the beginning of the school year as for sighted children.

To ensure that blind people don't lose proficiency in Braille over time, the use of Braille displays should be fostered: speech is too often preferred to Braille displays due to economic reasons, with terrible repercussions for Braille literacy.”

Finland also drew attention to shortcomings in the educational system in relation to children with visual impairments:

“The national core curriculum for education was renewed in 2016 and now programming is a part of the curriculum. There are so far no guidelines for how programming should be taught to visually impaired children. That is an issue that needs to be discussed.”

For **France** problems of international communication were identified as particularly problematic:

“Regarding maths and scientific notations, I am sincerely sorry when I think of the many notations used throughout the world, many countries having created their own: French Braille notation in all French speaking countries, Nemeth in the US and Greece (maybe more), Russian, etc.…. Latex in Germany…”

Appendix 2 Detailed Notes on Country Visits

This section contains additional details about the country visits to add to the reports above.

Estonia: Country Visit September 2017
A meeting was held on the 15 September to discuss Braille teaching in Estonia. The findings from the questionnaire completed by Estonia were also presented.

Participants

Kairi Elmits (Teacher Helen School for the blind, Tallinn, Braille teacher at the school and counselling children at main stream schools)

John Heilbrunn (Denmark, DAB, EBU Project, blind)

Tarja Henikainen (ICEVI Europe)

Priit Kasepalu (EBU Vice President, blind), knowledgeable about layout previous head of the library

Riina Kitting (Tartu School, managing teacher for the blind), head teacher at the school

Marja Kiwihall (Estonian Library for the Blind, produces fiction, audio books in Daisy format)

Anne Kóiv (Tartu School for the Blind (state run)), Braille teacher for children and for adult blind persons (co-producer of a handbook on Estonian Braille)

Erki Korp (Director of Tallinn, Helen School, Tallinn, run by the local authority (both deaf children, children with speech challenges, kindergarten and up, 8 children plus 18 children)

Monica Lóvi EBU (Estonian Blind Union, VI, teacher)

Tiiu Rahuoja (Ministry of Education and Research), support state schools of children with special needs, producer of educational education material, braille books

Jakob Rosin (EBU board member, technology journalist and advisor, blind)

Mari Sepp (managing director EBU) interested in accessibility

Kerli Tinnosaar (Board Assststant EBU)

Comments on issues mentioned in the Questionnaire

Participants discussed the salient points from the questionnaire and clarified some relevant issues.

In Estonia, there is no special registration for welfare benefits, apart from insurance registration of people who receive social benefit. It was considered that registration of persons with disabilities could be improved.

The Estonian rehabilitation system focusses mainly on medical health. In some instances, health personnel, or parents of young people might contact the rehabilitation centre, the Tartu school, for assistance.

The education system provides support and assistance to children from age one and a half until they are 21 years old. It also offers help to parents and teachers. This assistance is not offered automatically, and it is only put in place if parents or teachers apply for support.

Most blind children go to special schools, and about a third to mainstream schools. From January 2018, the concepts will change, and there will be no such category as "specialised" facilities. Everything will go mainstream. It was not clear at the time of this meeting how this will affect the specialised facilities and what kind of specialists and services will be available for blind children.

Financial support to schools was considered to be not sufficient. Money given is not mandatorily used for specific children’s needs, so the money may be moved to other areas and purposes.

Decisions on the format of books are taken by special education teachers, assistant teachers, children’s parents and, for older students, by students themselves. Ordering of books is processed through the Ministry and the Tartu school. One challenge is if teachers ask for various different books within the same subject (there is no harmonisation). Pictures and graphics are not made or are not utilised appropriately in the classroom.

The small number of blind children per year is far surpassed in number by children with behavioural dysfunctions: attention deficit hyperactive disorder (ADHD), autism and other conditions.

The number of courses for assistant teachers and the number of days for training was being reduced and fewer teachers were being sent to such courses. There was felt to be no proper specific training programme nowadays for families and parents in Braille. Where courses were offered to the parents, they were organised by NGOs and by the specialised school.

Use of Braille in Estonia

Several trends in the use of Braille were noted. Eight dot Braille is used for reading more than for writing. Printed Braille was always in six dot.

Previously, children got Braille books on paper. More recently, the electronic format had become increasingly dominant. For scientific subjects, Braille on paper was still used, but when using scientific notation, electronic Braille was used.

Jakob, a 22 year Braille reader and writer, thought that contracted Braille augmented speed and, in the end, was not difficult to learn. Contracted Braille was developed by one person in Estonia, but has not so far been tested and propagated further. He argued that there is no need for a Braille authority: a hand book on braille has been drafted. The Ministry of Education and the specialised schools meet to make decisions maybe once a year. However a board could develop a way to propagate Braille and make official decisions about its use.

Audio books were used for novels, but not for text books. E-books were becoming more frequently used, especially in higher education, where they might be the main source for reading, using the speech synthesiser on the computer.

The e-school system in Estonia had a large number of accessibility issues for the comparatively few blind students. There were ‘work around’ methods that, if known and applied, might solve problems. It had been found that developers were not inclined to change existing systems to make them more accessible.

Braille displays and other equipment bought by students were ninety percent financed by social insurance. If they were provided by the school, there was no subsidy. Philanthropic organisations sometimes paid for devices and equipment for individuals.

Repair and maintenance of equipment, for example, Perkins Braillers could be undertaken, but payment was problematic, and no systems were in place. There was an amount of "dormant" equipment at the school for the blind.

Participation in the Curriculum

There was a general national curriculum, a simplified national one and an individual learning programme for some children. To the national programme, special topics such as orientation and mobility, activities of daily living and Braille might be added if the pupil had learning difficulties and the simplified curriculum was followed. There was a counselling centre in every county, where it was decided if a blind child should follow the normal or the simplified curriculum.

In mainstream schools, blind children might be exempted from certain subjects, for example, physical education. Teachers might exempt or modify children’s training, with final decisions taken by the head teacher. The study plans were not always accurately recorded and concrete modifications were not always registered.

Exam materials were transcribed at the centre and then returned to the school to be handed out on the day of the exam. Ordering of materials in Braille had to take place some considerable time before the time that they were needed. For spontaneous use, the assistant teacher should provide Braille versions. However, in practice it was not easy for production to take place in such situations.

Braille embossers might stand dormant. The library for the blind was managed by the Ministry of Culture, and it was therefore not easy to ask the library for assistance in producing Braille textbook materials at short notice.

The number of blind children in mainstream schools was small, and demand was therefore at present small; however it might increase, as the term "specialised" was removed and methods of (learning by doing) became more predominant.

Role Models and Social Contact

In a small country with a small community, meeting other blind people was very helpful. Camps were organised by various organisations and were typically project based.

Meeting other blind people through the internet was also important to the blind people present at the meeting. Online contact was a first step towards meeting people physically in person. Pen friend systems also encouraged the exchanging of experiences and could be stimulating for children and parents.

Developments and Issues

Today, audio books could be downloaded through the internet cheaply, comfortably and in a portable way. People developing blindness late in life found it difficult to acquire Braille skills. Braille apps were very useful in that they allow people to write much faster. Alternatively, using a braille display with a smartphone would enhance literacy.

Italy: Country Visit October 17, 2017

Meeting at: Francesco Cavazza Institute of the Blind, Bologna

The following notes stem from a meeting that was conducted in Bologna, Italy, as one of the countries that was targeted in the EBU Braille project.

Technology, alternatives to Braille and a stressful and ever-demanding environment call for solutions and techniques that are quick and efficient rather than clinging to ideological beliefs and sentiments.

The notes below show that all the participants - almost without exception - had been Braille users from an early age and had used Braille during their school years and beyond, as long as they were in academic settings. Fewer, it seems, were very committed to using Braille today in their everyday life, although it seemed that the vast majority had found Braille essential for their educational results.

The mix between Braille in various formats and environments and the use of other tools and methods was interesting and seems quite evident.

Steering group members attending were: Clara Ori, Cecilia Ekstrand, John Heilbrunn.

Interpreter from Unione Italiana dei Ciechi e degli Ipovedenti (UICI): Patrizia Cegna.

A welcome was given by the Vice President of the Institute of the Blind, Francesco Cavazza

Participants

The following people took part in the meeting, which focused on the use of Braille. As well as details about the participants, issues that they raised and felt to be important are listed below.

Mr Michele Borra, 64, (teacher), Braille user, Vice president of the Francesco Cavazza Institute of the Blind.

Mr Irid Domnori, 27, blind, grew up with Braille (trained to become peer counselor),

Ms Badia Benlaamiria, 28, used Braille since 2008 when she became blind; has used Braille during education but does not use Braille daily.

Ms Kedrit Shalari, 28, learned to read and write Braille as a child and used it for studying foreign languages presently.

Ms Fortuna Russo, 30, learned Braille when three years old. Used it for foreign languages. Abandoned it due to lack of availability of books. Had a Braille display, but did not use it a lot.

Ms Paola Sema, 40, blind since birth. Learned Braille before primary school, had used it for educational and entertainment purposes, also at university to study languages, where Braille was essential. Used it with a Braille display to write telephone numbers. Felt it was important to write properly.

Ms Marta Ghelli, 32, blind. Learned Braille at primary school. Used it during secondary school for foreign languages, when working as a teacher and for personal purposes.

Mr Giulio Cevenini, 24. Started to use Braille in primary school. Used a slate and stylus, later the Braille machine and the computer and later also speech synthesis. Felt Braille was essential for mathematics, for university studies, to make it easier to check writing and to be able to do instantaneous correction. Said it was irreplaceable.

Ms Paola Gamberini, 55, born blind. Used Braille for studies, first classics and then philosophy. At that time no devices were available to compensate. Later, she encountered services in educational counselling where Braille was important for her job. Said it cannot be as accurate using speech outputs. She had used a new programme developed for

studying ancient Greek thoroughly (BrailleKoiné) since 2009[100]. Software was available in Unicode on the web. Speech is not useful for use in such study.

Mr Vito Lapietra, 62. Had always used Braille since primary school. Used it for entertainment purposes. Fostering Braille through technology during education (Braille display without speech to keep it consistent with paper Braille). Essential for foreign languages and to write text and for mathematics. Even Braille displays make use of "real Braille". She stated that the size of the dots on display equal to that on paper makes braille on displays successful. She used it to play cards and to contact people. Stated it was important to safeguard Braille.

Ms Giulia Poggioli, 21. Learned Braille at 7 years old. Continued using Braille when studying Latin and Greek. She used both Braille and speech output extensively. Also for entertainment Braille was useful, and she could join friends for gaming activities.

Mr Andrea Prantoni, 61. (President of the local branch of the Italian Union of the Blind and partially sighted in Bologna). Learned Braille in primary school. He started at an institute for the blind and used it all the way up in university and when he worked as a programmer. Braille made it easier to work with the software at the bank where he had employment. He used speech, but for articles he preferred a computer and Braille display. Listening to speech was good for a quick glance at a document. He stated that it was essential to raise awareness amongst mainstream teachers, so that institutions for the blind can address the need to help blind people become proficient in using Braille.

Mr Fernando Torrente, 60. Learned Braille when a child. Used digital Braille and sometimes voice output. For reading complex texts Braille was preferable and it made understanding better. He stated that it was the true instrument for reading. He used Braille for managing projects at this institute.

Ms Irene Balbo, 42. Learned Braille from a kindergarten teacher when she was five years old. It was “the only thing that she loves forever”. She used a device that made it possible to play with Braille, trying the configuration of Braille cells. This is also something that sighted friends could also play with. Now, the computer was useful for handling Braille. Braille and speech go together. Nostalgically, Braille on paper can be

[100] Handimatica http://www.cavazza.it/drupal/?q=it/node/281

wonderful. Finding Braille anywhere unexpectedly made her very happy. A Braille display was good for switchboard operators. In order to spell correctly, Braille was essential. Braille should not be associated with something sad, but on the contrary, with positive feelings and thoughts.

Mr Sabato De Rosa, 55. Braille was the “inseparable mate of his life”. He learned Braille from three years old in kindergarten and presently used it at work to provide assistance within assistive technology. Braille displays with assistive software were provided. He pointed out the following important advantages: 1: To combat illiteracy; 2: for orientation in space "train with the stylus in the rectangle, training understanding of space”. 3: a method to make the brain more flexible and to promote imagination.

Mr Gabriele Battaglia, 43, born blind. Learned Braille at the age of seven. He spoke of the real magic of Braille when encountering Braille at the display together with the computer. He loved the 8 dot braille and used it with playing chess.

Topics discussed were as follows:

Attitudes - Family and parents

Children were more involved with Braille than their families. Parents were more likely to accept Braille when children are born blind. There was more of a problem in families where children lost their sight gradually, or where sight was so poor that heavy magnification was needed to read text in print. It was difficult for parents to understand that children became much more worn out when having to read text that was so greatly magnified. They should not start with using the computer with speech.

To get the family emotionally and practically involved, including the children studying Braille, it was considered important to train teachers and parents and to share the interest. Useful activities included practice in writing letters, involvement in inclusive education, parents helping their children with homework, using playing cards, writing messages and other opportunities for play.

There was someone in the team who taught Braille to teams of teachers and parents when children were at pre-school age. Teachers were taught the relevant sequence for learning Braille. However, this was not the case all over Italy. In certain areas this worked quite well, while in other regions there were not enough qualified teachers.

The basic Braille courses for teachers and educators in Bologna were not considered sufficient for children to become conversant. There was a lot of interest in courses during the early years of children's education. However, this interest decreased when computers came into use.

Relevant and important uses of Braille

Participants discussed important uses of Braille. These included: marking on medicine packets, on use expiry dates, maps, shampoos in hotels, cosmetics, food products in supermarkets, rooms numbers in hotels, for door maps, toilet doors, vending machines, names of streets on corners, ATMs, theatres, planes, train seat numbers, bus line number at bus stops and menus in restaurants.

Role models, motivation, peer counselling

Presenting Braille as a useful way of conveying information was considered essential for encouraging its use. For example, showing that frustration can be diminished and useful things achieved through the use of Braille. Testimonies should be handed on to children and young people. Braille should be more visible; it should be shown in the mass media, not as something strange, but portrayed in many situations. This should ensure that parents perceive Braille as useful.

Reading speed

The reading speed of children was sometimes measured. Most blind children in Bologna also had other additional disabilities. Therefore they only measured reading where the results were expected to be very good. Generally, blind children seemed to read slower, especially if they had other disabilities.

Silent reading tests showed that sighted people read faster than Braille readers. Reading aloud, the speed was supposed to be the same for both groups.

Updating and improving existing Braille skills later in life

The opportunity to update and improve skills does not exist in Bologna. People had to practice on their own. As there was no Grade 2 (contracted) Braille, no Braille improvement was possible.

Choice of Braille or not

It was considered that advisors and counsellors should be able to give those with residual sight the proper tools to understand when Braille would be a useful way to handle texts.

Participants pointed out that no-one should be forced to choose Braille.

France: Country Visit November 2017

Notes on a meeting held on November 15 2017, at Groupement des Intellectuelles des Aveugles et Amblyopes (GIAA), Paris.

Participants

Marie-Renée Hector, Natalie Lewi-Dumont, Francoise Magna and Ludovic Petit de Mange, GIAA.

Christian Bundgaard and John Heilbrunn, DAB.

NLD: assistant professor training special teachers and itinerant and class teachers on visual impairment, literacy member of ICEVI. (Sighted)

MRH: (teacher, former chair of the GIAA (Association of Blind and Partially Sighted academics) (now vice-chair) Vice-secretary of the Confédération Française pour la Promotion Sociale des Aveugles et Amblyopes (CFPSAA), also a member of ICEVI. (Blind).

LPM: researcher in astrophysics, former teacher at the national school for the blind, Institut National des Jeunes Aveugles (INJA) Involved in "issues regarding accessibility" as advisor. (Braille reader and also large print reader, partially sighted).

FM: mathematics teacher at the Institut National des Jeunes Aveugles (INJA), now a school inspector and an employee under the Ministry of Health. President of the French Blind Commission that decided on the Braille norms (CEBF). She knew Braille, but read it with her eyes.

A few persons were not able to attend due to other engagements.

Service Systems

There were two school systems (the educational and the health systems) that both has input. However, their ways of training teachers were very different from each other and the qualifications were very different. In France, the health-based system had been quite effective for

practical issues, while the educational programme (CAPPEA) had been better at theoretical and pedagogical issues.

Recent developments had emphasised less distinction between sensory impairments and general disability issues such as autism and similar areas. There was therefore not the same attraction to knowing and mastering the special theory and practical ways of teaching the blind or deaf. People were trained as general teachers and then taught special education in general (not focusing on needs of children with certain disabilities).

However, participants stated that it was necessary to know about how to activate or get information related to specific disability issues.

Other Issues Raised

Examples were discussed of the use of Braille and role models in using it. These were considered to be very important for increasing awareness and increasing use. Young students did not always have the opportunity to know about what has happened in the past.

Information

France has no statistics on blind children, which is in line with French regulations. Therefore, points of view could become very subjective. It was not known how many children learned Braille at primary level. Parents' associations also did not know the picture and many families with blind children were not members and not reachable. For this reason, many children became very isolated. Magazines were produced, but, for historical reasons, it was not allowed to get information about subscribers and find out more about them. It would be necessary to reach out to all schools to obtain a proper picture.

The Value of Braille

There was a problem that children with minimal residual sight refused to learn and use Braille. An issue in France was that people should understand that Braille was not a mechanism for marginalising people, but a means of performing and improving opportunities.

Learning and Using Braille

Participants said that for children, one had to be more strict and insistent on their learning and using Braille. The younger the children were, the easier it was for them to play, sense and use Braille. If not, children

would grow up functionally illiterate. Participants pointed out that we cannot go backwards three centuries and use oral cultures instead of using the written medium as an essential tool.

Compared with the past, there were fewer children that became completely blind, due to the development of medical and surgical treatments. The group of people concerned therefore was smaller and became more likely to be ignored. Also technology now enabled scaling up to font size 48 which, although possible, was practically very difficult to manoeuvre in a useful way.

In some places in France parents were taught to understand and use Braille. These courses took place on a very individual level and according to individual interest and demand. Generally, there was very limited training for parents. If a child was partially sighted, there was not a clear strategy for teaching him or her Braille. It happened according to an individual plan. Parents relied on the advice of people and experts that did not always have an understanding and love of Braille. Braille was often considered as a token of failure rather than a means of opportunities.

Regarding reading speed, comparisons had been made for adults using displays of various lengths. The test has so far been a one-time event and has not been available for children.

Partially sighted children at elementary school do not learn Braille, and later on, if they start learning Braille, they only study Grade 1. Participants thought it should be learnt at an earlier age, before 8-9 years of age. It could then be learnt more easily.

Young children made concerted efforts to learn Braille, including contractions. They had the time and the motivation. Young persons got a sense of progression in mastering and acquiring skills gradually. For adults, lack of time became an impeding factor.

The question of contracted Braille and how it ensures efficiency was discussed. Generally, it was not well known by older blind people.

Role Models

A consensus in the meeting concerned the importance of and awareness of role models. There were a decreasing number of blind teachers who could act as inspiration to children and role models were not present in mainstream schools. As the prevalence of blind children

was decreasing, the number of teachers with special skills and knowledge about blindness and related skills was also decreasing. Inclusion was the best solution, but meeting other children and young people through competitions and the opportunity to meet skilled teachers was very important.

Use of Technology

Technology could be an opportunity and an option. Some used paper versions while others used electronic displays. Now it is possible to emboss what is wanted, to use this for some purposes and use the display for other purposes. Some things were easier to show on 8 dot electronic format (scientific). However, the tools to convert and modify materials seemed unknown to many teachers.

However, for children, Braille (text) on paper was the prime and mandatory starting point for learning how to write, in order that they could sense the texts and learn spelling. Some blind children got a Braille machine through a grant for use at home, and there might also be a Brailler at school. It was difficult to carry a machine back and forth from school to home.

Braille as a method of input on an iPhone was one useful up-to-date tool that might be chosen. It combined modern technology and was a great personal tool.

The Orbit display might be a useful way to overcome financial constraints on acquiring electronic access to Braille. A number of interesting methods for measuring reading speed in various countries were noted.

Examples of where Braille would be useful and practical

Participants identified several uses of Braille: on lifts, on doors, on seat numbers and anywhere where it would be handy and provide information on equal terms with sighted people as much as possible. Braille should also be used on toys and small children's books.

Information Sharing and Publicity

Dreaming Fingers (Les Doits Qui Revent) and Mains en Or make special Braille editions of books, but they are not provided for mainstream

vendors. This implies that this is presented as a fringe and not a mainstream facility.

UNILOCK (magnetic) was produced in the UK but was not necessarily well known and made available in other countries or regions. The amount of demand was an issue however, which might impede the development of solutions.

All new developments on techniques and facilities to make good Braille and graphics available should be publicised by an extensive European network. There was a need for information on where to buy goods and sharing of opportunities. This included personal and commercial methods and ideas.

Participants discussed how to fund such networks. Language barriers might easily be overcome with technology. A unified European agency could coordinate and enable an altogether higher demand for goods and services. Disability identity and a corresponding identification card should be general and acknowledged all over Europe.

In France, with Health Ministry training, Caegadv (aveugle et deficiente visuelle) there was a continuing opportunity to train for a certain disability area. If people met a need to qualify for a specific disability area, they were offered this.

There were not a sufficient number of trained teachers, but their knowledge was better compared with people from the general educational system. A problem was to ensure that the educators understood that focusing on specific areas such as visual impairment was necessary, which is due to the fact that they meet visually impaired persons fairly seldom. There was concern that financial resources for the national school for the blind were in danger of being reduced drastically.

CFPSAA had the role of meeting the authorities to defend the rights of visually impaired people, but due to a lack of resource persons, they did not seem able to undertake this task to the extent that they should be expected to and would like to.

Appendix 3 Anders Rönnbäck and Kia Johansson: Developing decoding skills and fluency in braille reading

Senior Advisors: The Swedish National Agency for Special Needs Education and Schools, Resource Centre Vision

Introduction

In Braille reading instruction competence of general literacy learning must be combined with what is unique for development of tactile reading, where specific instruction during several years is needed (Holbrook, 2008; Koenig & Holbrook, 2000).

Acquisition of Braille reading implies challenging factors both at the individual and on the environmental level. On an individual level the reading acquisition depends on the child's cognitive, tactual and motor ability (Kamei-Hannan & Zell Sacks, 2012). Insufficient knowledge about the Braille code and its nature among people close to the child is challenging on the environmental level. So is a very limited access to the great amount and wide variety of text exposed in all areas of society. The overlearning of letter shapes required for automaticity in the decoding might be delayed or might not happen at all.

A national resource centre gets the advantage to supervise the development of Braille reading in the whole country. Results from yearly reading observations made it clear that the reading performance for a majority of students could, most likely, be improved. A method of training with its focus on decoding was chosen. The primary aim of this method was to improve the reading ability in sighted students with reading difficulties (Petterson, 2006).

A method for decoding training

The training method referred to here has a clearly defined structure with short sessions and high intensity. The material for decoding consists of study sheets filled with single letters, two letter combinations (consonant – vowel, vowel – consonant) and whole words, presented in columns. The words vary in length and consist of three to eight letters.

The material was adapted for Braille reading - all text was produced for linear presentation and in double-spaced lining. The text was uncontracted and focus was on rapid letter recognition, that could to

some extent, be compared to the Mangold braille program (Mangold, 1989).

A training session

A reading session includes six elements presented on six different sheets of paper: single letters → two letter combinations → whole words → whole words → two letter combinations → single letters. There are several versions of each element to prevent the reader from memorising sequences of letters and words. Ending each session with reading letter combinations and single letters is a way of making the student leave with a feeling of success. A session should take place in a quiet environment, with only teacher and student present.

In the teacher's manual are strict instructions, including exact wording for how to prompt the students' reading. The student is told to read aloud as quickly and correctly as possible from each of the six sheets of paper for one minute. The one-minute-reading is a way of transferring the sense of intensity and focus - prime characteristics of the original training method. As a way of maintaining the reading pace, the teacher is told to say the word after five seconds of hesitation and to mark it as incorrect. When a sheet of paper is finished in less than one minute, the exact reading time should be specified. Numbers of correctly read letters, words and misreadings, as well as the exact reading time are noted in a form. The documentation helps to make the reading progress clear to teacher and student, and it creates an element of competition on an individual level.

Periods of intervention

A recommended number of training sessions per week is three or four, and a suitable length of a training period could be four weeks. This kind of intensive practice requires periods of interruption. However, too long interruptions might influence the reading performance negatively. There is a risk that the recently reached level of performance will be partially lost, before the next training period starts. A recommended pause between periods of training is three weeks.

Goals and evaluation

Before this intensive training starts a word recognition test (WRT) is performed, where the student reads single words aloud for one minute. The test starts with two-letter words and word length progresses up to seven-letter words. Number of correctly read words are documented and serves as a “base line” for the whole intervention. Teacher and student agree upon a reasonable and challenging goal for the upcoming four weeks’ training. The same WRT is then used to evaluate the outcome of each training period.

Conclusion

This described method of basic decoding training could preferably be combined with other methods with slightly different approaches. Research has shown that guided, oral, repeated reading of prose is effective in promoting reading fluency and furthermore comprehension (Savaiano & Hatton, 2013). These two methods in combination could be considered an effective approach for practice when trying, to some small extent, to compensate for the lack of overlearning in braille reading acquisition.

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Appendix 4 Ron Kupers: Braille Reading and the Blind Brain.

(Note: the entire article with references may be acquired upon request to John Heilbrunn. the text below has been shortened and somewhat simplified to adapt it to the project report format and purpose).

Measurement of Braille reading performance

Measuring Braille reading speed is a controversial topic. It is important, though, for a better understanding of the perceptual factors that influence reading speed. Braille reading speed has traditionally been measured in number of words per minute, however, it has been argued that this may be problematic because mean word length varies from passage to passage. It was stated that number of characters/sec is a better metric because reading speeds are constant across text sources when measured in this unit. The conventional estimate of mean reading speed of adults is about 100 words/min, although some have claimed that experienced Braille readers can achieve rates between 200 and 400 words/min.

Possible explanations for this difference in performance may be due to the type of Braille used, context effects or individual factors. For instance, some researchers compared word-recognition times for contracted and uncontracted words of high and low familiarity. Although contractions slowed recognition, they resulted in faster recognition for words of high familiarity and slower recognition for words of low familiarity. The same researchers also studied context effects in Braille word recognition and found, not surprisingly, that words of high familiarity were recognized more rapidly in context, whereas words of low familiarity were recognized more slowly. Among the individual factors that may influence Braille reading speed figure tactile sensitivity, finger size, age at testing, age at which Braille was learned, number of years reading Braille. In a study from 1999, only the age at which Braille was learned proved to be significant.

Phonological processes in reading print and Braille

Three interrelated but distinctive phonological processes play a crucial role in the development of reading in sighted persons, and are affected

in dyslexia: *phonological awareness*, *verbal short-term memory* and *lexical retrieval of phonological codes.*

Although information about the role of phonological processing in Braille reading is hardly available, a clear relationship has been shown between phonological awareness and Braille reading accuracy and comprehension. Veispak and co-workers (2012) showed that phonological measures are strongly related to reading performance in both print and Braille readers, but there seems to be a fundamental difference in the way specific phonological skills interact in support of the reading process. First, pseudo-words rely on phonological awareness in both blind and sighted readers, but word and story reading are only associated with phonological awareness in the group of Braille readers. Second, verbal short-term memory is highly related to all reading accuracy measures in Braille readers, while it is not related to any reading measure in print readers. Next, phonological awareness explains unique variance in pseudo-word reading accuracy in the group of print readers, while in the group of Braille readers it explains unique variance in all the reading accuracy measures. Finally, lexical retrieval of phonological codes, assessed by a rapid automatic naming task, explains variance in all the reading speed measures across both groups, but it is only in the print reading group that it also uniquely explains variance in word reading accuracy.

The results of this study suggest that highly developed phonological awareness and verbal short-term memory skills, together with adequate tactile spatial sensitivity determine the level of Braille reading skills.

Parallel versus sequential processing in print and Braille reading

In contrast to print reading, Braille reading is sequential rather than simultaneous (Braille cells are encountered one at a time), and exhaustive rather than selective (words are not skipped). This sequential nature implies that blind readers predominantly rely on the non-lexical grapho-phonological reading route, whereas sighted readers variably switch between a lexical and a grapho-phonological reading mode, depending on word characteristics.

In print reading, the use of an indirect grapho-phonological or a direct orthographic reading strategy depends on the frequency, irregularity and familiarity of the items. While words are typically recognised accurately

and fast (parallel processing), pseudo-words are decoded (i.e. sequential processing). The sequential nature of the Braille system, on the other hand, does impose a constant sequential decoding on Braille reading, as well as an effective use of phonological awareness skills.

Differences and similarities between reading with the fingers and the eyes

In the following, differences and similarities between reading print and Braille with respect to reading acquisition stages will be discussed, reading efficiency, and item length.

Reading acquisition stages*. A researcher* established an influential model of print reading acquisition in alphabetic writing systems. The model postulates that the child goes through three consecutive developmental stages. The first one is the *logographic* stage, in which the child treats words just like any other visual object or symbol. The recognition rate here is highly inaccurate. The second stage is called the *alphabetic* stage, which is reached by the association of phonemes with corresponding letters and graphemes. Repeated exposure to the same words results in the storage of whole-word grapheme sequences, constituting an orthographic lexicon. This *orthographic* stage is made possible by the direct connections from the orthographic and the semantic lexicon, without implying grapheme-phone correspondence rules. Whereas sighted children have the opportunity to experiment with incidental exposure to written language, blind children usually do not encounter written language until they are introduced to Braille words at home or at school. As a consequence, blind children directly start by the alphabetic stage, identifying Braille. They have to learn to discriminate the physical tactile patterns while associating them with the spoken equivalents in the language, and to remember the association. The tactile memory span comprises no more than two to three items, and as memory for tactile shapes is generally much poorer than memory for visually presented shapes. Phonological recoding is essential in Braille reading, particularly in the beginning of the reading development. Researchers are still debating if the orthographic stage exists in Braille reading. The effect of item length on reading speed has been considered to be one of the hallmarks of the grapho-phonological reading strategy. In contrast, others, however, showed that words are read faster than pseudo-words, which is in favour of the latest stage existence.

Reading efficiency. Braille reading is slower compared to print reading, 100 vs 250-300 words per minute, respectively. Braille reading also seems less accurate than print reading. This reduced accuracy is usually explained by the lower resolution of the tactile modality and the nature of Braille, where each character contains a maximal amount of information. The misplacement of one dot can result in an incorrect identification of the letter, whereas in print reading a large part of the display can be missing but leaving identification of letters fairly intact.

Item length. In young and adults print readers, the accuracy and speed of word reading are nearly constant, and are not influenced by item length. However, item length affects accuracy and speed for pseudo-word reading, and this is more the case for young compared to adult readers. These results are in line with those of earlier studies, showing that the number of syllables only impacts reading performance for low-frequency and non-words (which are presumably read by the grapho-phonological reading route), but not for high-frequency words (which ought to be read by the direct orthographic reading route). In Braille readers, the impact of item length on word and pseudo-word reading accuracy is identical for young and adults. Concerning reading speed, while pseudo-word reading speed is influenced by item length in a similar manner across both age groups, word reading speed on the other hand, is more determined by item length in young as compared to adult braille readers.

Braille reading and activation of the somatosensory system registration of (tactile and temperature information)

1. Tactile receptors activated by Braille reading

Braille reading starts with the activation of mechanoreceptors in the outer layer of the skin, more specifically the Meissner's corpuscles. This type of nerve ending is responsible for sensitivity to light touch. In particular, Meissner corpuscles have their highest sensitivity (lowest threshold) when sensing vibrations between 10 and 50 Hz. Meissner's corpuscles are primarily located in glabrous skin just beneath the epidermis; they are most densely concentrated in thick hairless skin, in areas that are highly sensitive to light touch, such as the fingers and lips. Tactile corpuscles respond optimally to shape and textural changes in exploratory and discriminatory touch. Their acute sensitivity provides the neural basis for reading Braille text. Any physical deformation in the corpuscle will cause an action potential in the nerve. Since Meissner’s

corpuscles are of the rapid adapting type, the action potentials that are generated quickly decrease and eventually cease. If the stimulus is removed, the corpuscle regains its shape and, while doing so, causes another neuronal discharge (or activation).

2. Nerve fibre types conveying tactile information to the brain

Following activation of the Meissner's corpuscles, the information is relayed via fast-conducting (30 – 70 metres pper second - large myelinated Abeta fibers (the thicker fibers with a myelin layer (consisting of insolating fatty substance) around them, also known as Abeta fiber)s to the central nervous system where they enter in the posterior part of the spinal cord, and travel ipsilateral via the posterior (lemniscal) column pathway to the lower brainstem, to make synapse with a second order neuron at the level of the dorsal column nuclei. Here, they cross the midline, and the tactile information is further projected to the ventro-posterolateral (VPL) nucleus of the thalamus, from where it will be sent further to the primary somatosensory cortex (SI), the brain cortical area that is specifically involved in the processing of somatosensory information.

3 The somatosensory cortex and Penfield's homunculus

Within *the somatosensory cortex (abbreviated as* SI), the body is represented in an orderly manner. Each part of SI represents a specific body area, be it the little finger, ring finger, the lips, the chest, etc. When electrically stimulating for instance the lip area of SI, this will evoke subjective (tactile, thermal) sensations in his body part. The organisation of the body in SI follows a few principles. First, some body areas take a relatively large cortical territory, which is directly related to their tactile sensitivity. For instance, the fingers, lips and tongue, i.e. body areas that are very sensitive to touch - but fairly small in size - , have an abnormally large cortical representation in SI. This leads to a "distorted" map of the body within SI, whereby size is not determined by the physical size of the body part but by its sensitivity. This is called the homunculus. (explanatory note: the body map within the primary somatosensory cortex is not determined by the physical size of the body parts (e.g. the leg is much larger than the fingers, but takes relatively little space in he primary somatosensory cortex) but by its tactile sensitivity. This is called the homunculus, which is the latin term for a very small human or humanoid creature. The homunculus looks like a strongly deformed

human being with hands and lips that are taller than chest, belly and legs combined.)

A next characteristic is that there is a large reproducibility of these maps across different individuals. These maps are plastic and hence subject to change/reshaping. For instance, people who had a limb amputated show a reorganization of their body map in SI, whereby the neighboring cortical area will invade the area that is normally occupied by the amputated body part.

Changes in tactile perception in Braille readers

It is commonly believed that congenitally blind individuals are better in tactile discrimination tasks, compared to their sighted counterparts. However, early behavioral studies provided contradictory results:

A study undertaken in 1988, conducted in a small group of blind individuals, showed improved tactile letter recognition performance at the fingertips in blind individuals. A subsequent study undertaken in 2000 compared tactile orientation discrimination related to space and direction in a group of 15 proficient early blind Braille readers and 15 matched control individuals without Braille reading experience. The blind participants had a lower tactile orientation spacial and directional threshold (called Grating orientation threshold (GOT), not only for the dominant Braille reading finger but also for the remaining fingers of the dominant hand. Using the same methodology, we compared GOT in congenitally blind, late blind and matched sighted controls. Blindness duration index (BDI) in the late blind group varied from 0.23 till 0.95. (The BDI is an index of the proportion of time, a person has been blind in his/her life, with “0” meaning never and “1” blind for the whole life / congenital).) Average Braille reading performance was significantly higher in the congenitally blind, compared to late blind participants, 111 and 69 words per minute, respectively. In the late blind group, we found a significant positive correlation between the BDI and reading performance. Congenitally blind individuals had a lower GOT compared to both late blind and sighted controls, indicating a finer tactile discrimination sensitivity.

In a test performed 2003 somewhat different results were found in a large group of blind individuals (43 persons participated), consisting of both congenitally and late blind, and sighted control (47 individuals in this control group). Enhanced tactile sensitivity for grating orientations

was present in both groups of blind participants at the dominant (Braille reading) index finger. The average blind subject had a tactile sensitivity of an average sighted subject of the same gender but 23 years younger. More recently, in a research test performed in 2008 compared age-related changes in tactile sensitivity at the fingertips in a large group of blind Braille readers and matched sighted controls. The authors confirmed higher tactile sensitivity in the blind compared to the sighted control subjects. Whereas tactile sensitivity declined by nearly 1% per year in the sighted individuals, blind individuals did not show an age-related decline. Noteworthy, it seems to be established that tactile sensitivity neither correlated with Braille reading speed, nor with the amount of Braille reading, or the age at which Braille reading was learned. In contrast to the above results, other studies did not find systematic differences between blind and sighted individuals in thresholds for light touch, vibratory detection, length discrimination or two-point discrimination, or reported that the advantage of the blind disappeared after the sighted received additional training.

Improved tactile sensitivity in blind individuals can be explained either by the fact that they rely more strongly on tactile experience (*tactile experience hypothesis*), or by the fact that lack of vision by itself drives increased tactile sensitivity (*visual deprivation hypothesis*.) this question was addressed in an elegant study 2011 in a large group of blind individuals with varying degrees of Braille reading experience. The authors tested grating orientation on the index, middle and ring finger of both the dominant and non-dominant hand, and on the lips. The results showed that blind participants outperformed the sighted on the fingers, but not on the lips. Additionally, proficient blind Braille readers performed better with the preferred reading finger than with the other fingers, and their sensitivity scores on the preferred reading finger correlated with measures of the amount of Braille reading. These results are in line with the tactile experience hypothesis, and suggest that higher tactile spatial sensitivity in the blind is caused by a stronger reliance on the sense of touch.

Concrete Data on non-haptic tactile perception have to a large extent confirmed the findings: Blind individuals were trained to discriminate patterns of electro-tactile stimulation that were applied to the tongue by means of a tongue display unit (TDU. Data showed that at the group level, congenitally blind and matched sighted control individuals performed equally well in discriminating orientation, motion and shapes.

In a study in which “tactile-visual” sensitivity of the tongue was tested, a significant difference in the average performance of congenitally blind and sighted participants were likewise not found. Braille reading puts high demands on spatial processing in time (Braille reading puts high demands because it requires the simultaneous processing of spatial and temporal (time) information).

Braille characters consist of raised dots (±0.5 mm in height and 1 mm in diameter), spaced 2.4 mm apart, that are arranged within a three-row by two-column matrix, the so-called Braille cell. In order to identify a Braille character, the reader must detect which of the six positions contain embossed dots, while rapidly sweeping the finger over the Braille text. Proficient Braille readers encounter a cell approximately every 100 ms, and neighbouring dots within a cell every 50 ms. In sighted people, such short interstimulus intervals cause perceptual interference; participants may fail to perceive one of the stimuli, or merge two stimuli into a single percept. Therefore, researchers went to examine how proficient Braille readers avoid perceptual interference during Braille reading. For this purpose, they tested whether presenting another tactile stimulus in blind and sighted participants, using masked and unmasked vibrotactile detection and discrimination tasks, just before or after the mechanical tap, would interfere with task performance. The masking consisted of the presentation of a 100-ms lasting vibratory stimulus that was presented either 100 ms before (forward masking) or after (backward masking) the to be detected mechanical tap. Although blind and sighted participants performed equally well in the unmasked tasks, congenitally blind Braille readers, in particular the fastest among them, exhibited significantly less masking interference than the sighted. Braille reading speed correlated specifically with masking task performance. These data show that vibrotactile sensitivity *per se* is unchanged, but that perceptual processing is accelerated in congenitally blind Braille readers. The authors hypothesized that two plausible neural mechanisms might mediate this effect, on the one hand an enlarged somatosensory cortical representation of the Braille reading fingers, and cross-modal tactile responsiveness of the visual cortex, particularly in congenitally blind individuals, on the other hand The authors hypothesized that two plausible neural mechanisms might mediate this effect: 1) an enlarged somatosensory cortical representation of the Braille reading fingers, and 2) cross-modal tactile responsiveness of the occipital cortex, particularly in congenitally blind individuals (see below).

So far, the data all point in the direction of improved tactile discrimination performance in blind individuals. However, sometimes the plastic changes can also lead to increased error performance. For instance, in a piece of research performed in 1998, tactile detection thresholds and spatial localization of tactile stimuli at the fingertips in blind Braille readers in a combined behavioral and brain imaging study were measured. The behavioral results showed that blind Braille readers had a significantly lower tactile detection threshold compared to matched sighted controls. However, blind individuals more often than the sighted controls misperceived which finger was stimulated by the light touch stimuli. The brain imaging data revealed that the tactile misperception in the blind individuals was associated with changes in the central representation of the fingers in the primary somatosensory cortex.

Neuroplastic cortical changes in Braille readers

It is well known that extensive practice leads to neuroplastic changes in brain structure and function. For instance, professional musicians who have been playing a music instrument for many years show specific changes in white matter and grey matter. of brain areas and pathways involved in motor function and auditory processing, e.g. the *** corticospinal tract and the posterolateral aspect of Heschl's gyrus, respectively. (The brain consists of grey matter and white matter. The grey matter is the outer part of the brain and is a thin layer, 3 to 4 mm thick, packed with neurons. The white matter are fibers that connect the different parts of the cortex with each other, hence allowing information to be exchanged between different parts of the brain. The human brain has about 80 billion of neurons and 140.000 kilometre of white matter fibres.)

Since many blind individuals use Braille extensively, one might assume that this may cause changes in brain areas involved in Braille reading, such as the primary somatosensory cortex and the motor cortex. A first piece of evidence in this direction came from a study performed in 1993. These authors studied the organization of the primary somatosensory cortex in proficient Braille readers, using somatosensory evoked potentials (SEPs) elicited by a focal electrical stimulus to the tip of the index finger, and transcranial magnetic stimulation (TMS) that was delivered simultaneously with, and at different intervals after, the finger stimulus. The scalp areas, from which SEPs with amplitude of at least

70% of the maximal amplitude could be recorded, were larger when evoked from the reading fingers. Detection of the stimulus applied to the reading finger was blocked by TMS delivered over a larger contralateral scalp area, and during a longer time window after the stimulus. These results suggest that reading Braille is associated with expansion of the sensorimotor cortical representation of the reading finger.

In another test performed by a different group of scientists in 1998, it was tested whether fusion of cortical representations in SI in Braille readers is caused by increased simultaneous stimulation of the fingers during Braille reading. To this effect, they tested differences in the somatotopic representations of the fingers (systematically called digits) digits D1, D2 and D5 in blind Braille readers who used three fingers (digits 2–4) of both hands simultaneously for reading, Braille readers who employed only one finger for reading, and sighted non-Braille readers. Magnetic source imaging was used to determine the centre of cortical magnetic responsivity to light tactile stimulation of the finger tips and lower lip. The results showed a massive enlargement of the hand representation in the three-finger Braille readers compared with the one-finger readers and sighted controls. Three-finger readers also had a different arrangement of the finger representations along the postcentral gyrus in one or both hemispheres. Only one of the one-finger Braille readers' cortical topography of finger representations that was disordered. This "smearing" of the cortical representation could be adaptive for Braille readers who use three fingers in that it serves to fuse input transmitted over different fingers, so that the incoming information can be processed as a whole.

Under normal circumstances, stimulation of a particular cortical area produces a subjective sensation within the same domain. Thus, direct electrical stimulation of SI induces somatotopically organized tactile sensations referred to a particular body area (established way back in 1937 by Penfield and Boldrey). Transcranial magnetic stimulation (TMS) is a non-invasive technique that allows to stimulate the cortex underlying the TMS coil. The technique is used to temporarily block activity of a specific brain area, or to assess cortical excitability, i.e. the stimulus level needed to activate the cortex. (A highly excitable cortex is one that needs little energy to evoke a cortical response). This may be done by e.g. evoking a motor response (in case of TMS over the primary motor cortex) or a subjective sensation such as a phosphene (a sensation of a ring or spot of light) (in case of TMS over the primary visual cortex).

Since congenitally blind individuals do not have a visual repertoire, the question arises as to which type of subjective sensation will be induced when applying TMS over their visual cortex. In view of the high capacity of the visual cortex of congenitally blind individuals to show cross-modal responses, Ron Kupers and consortium hypothesised that the subjective character of the TMS-evoked sensations might be tactile. This was tested in 2008 in a direct manner by asking proficient blind Braille readers to report the subjective sensation following activation of the visual cortex by TMS. We found that TMS over the visual cortex induced distinct tactile sensations in the fingers in blind Braille readers; these varied in intensity, extent and topography depending on the stimulated visual area. There were important inter-individual differences with respect to the number of sites from which tactile sensations could be induced and in the topography of the referred sensations. The individual with the highest amount of finger paresthesiae (tingling sensations in the fingers) was the one with the best Braille reading performance. In contrast, blindfolded sighted control subjects exclusively reported visual phosphenes (point or circle of light) when we applied TMS over the visual cortex. These data indicate that due to *** cross-mal plastic changes, the subjective character of visual cortex activation in congenitally blind individuals may be tactile in nature.

Brain imaging studies of Braille reading

In 1996, a seminal paper was published in which the researchers, for the first time, measured brain responses while blind individuals were reading Braille. They included 8 individuals who had become blind early in life, learned Braille in early childhood and practiced Braille reading for at least one hour every day. The results of this study showed that Braille reading induced significant activations in various parts of the visual cortex in blind readers, including the primary visual cortex, and other parts of the visual cortex. Blindfolded sighted control subjects, performing a non-Braille tactile control task, deactivated their visual cortex. This study was important because it showed for the first time in humans that the visual cortex, deprived of its normal visual input, is *** recruited by non-visual, i.c. tactile, input. This phenomenon of activation of a sensory-deprived cortex by another sensory modality is referred to as *cross-modal plasticity*. The findings by the research team gave an explanation to an experimental observation, made ten years earlier by a Belgian team, showing that the visual cortex of the blind, at rest and during tactile and auditory stimulation, is *** metabolically more active

compared to that of matched sighted control subjects. The more recent research highlights the discovery that Braille reading activates the visual cortex in congenital blindness, was confirmed by a number of other investigators in the years following. Using a different control condition (auditory word processing) a subsequent study showed that congenitally blind individuals activate *** extrastriate visual cortex, but not primary visual cortex, whereas late blind individuals activated in addition their primary visual cortex. The authors explained this difference in primary visual cortex activation by the fact that Braille reading might trigger visual imagery in late blind individuals. As congenitally blind individuals had never had any visual experience, by definition, they cannot have any visual imagery.

The issue of differential activation in congenital and acquired blindness was also addressed in later neuroimaging studies. For instance, using a tactile discrimination task (instead of a Braille reading task), a research team reported that if blindness was acquired after the age of 16 years, the primary visual cortex becomes activated, whereas this is not the case for individuals born blind or who became blind before this critical age. The finding that 16 years is a critical age for activation of the primary visual cortex has not been confirmed by other authors.

In a study performed 2002, functional magnetic resonance imaging (fMRI) was used to compare brain activation patterns associated with Braille reading in a group of nine congenitally blind and 7 late blind individuals. Average onset of blindness in the late blind group was 13 years and average number of years of Braille reading was 30. The authors showed robust activation of large areas of the visual cortex in all blind participants. Congenitally blind individuals differed from late blind individuals by showing stronger activation in the visual -temporal cortex. The authors did not find evidence for modifications in language areas (e.g. Broca's area of the brain) or in somatosensory or primary motor cortex representing the Braille reading fingers. Therefore, the researchers concluded that the visual responses may represent language processing mechanisms that are normally present in the visual cortex (see below).

The activation of the visual cortex by Braille reading in blind individuals can be explained in two different manners. A first possible interpretation is that blind Braille readers use their visual cortex in a completely novel manner. An alternative interpretation is that the visual cortex is

necessary for encoding orthography, either presented visually or tactile, into information that can be used by language areas in *** frontal and temporo-parietal brain areas. In the latter scenario, visual cortex activation by Braille readers would not represent a *** de novo adaptation, but rather a normal function present in normal sighted individuals but that becomes triggered in a cross-modal manner. This hypothesis was tested in a series of ensuing studies from the same group. In one of these studies, the investigators measured brain responses to phonological and semantic tasks, presented auditorily. In the phonological task, participants heard words and they were asked to covertly find another word that rhymed with the cue-word (e.g. *bake – rake*), whereas in the semantic task they were asked a word that was semantically associated with the cue-word (e.g. *bed – sleep*). The fMRI results revealed that only blind individuals showed increased activity in various subparts of the visual cortex. The spatial extent of visual cortex activity was larger in congenitally compared to late blind participants. The congenitally blind activated the visual cortex in both lexical tasks, but more strongly in the semantic task. Late blind individuals exhibited visual brain responses only for the semantic task. *** These findings hence support the claim that the visual cortex activity in blind people engaged in language processing may be related to semantic processing.

The question that remains to be answered is whether the activation of the visual cortex during Braille reading is also functionally relevant. Formulated differently, is the visual activation observed during Braille reading just an *** epiphenomenon, of f.i. mental imagery or attention, or is it really involved in Braille reading? Indeed, the fact that a brain area shows increased activity during a task does not necessarily imply that it also actively contributes to task performance. Two studies have addressed this question using TMS: In In the first study, undertaken in (1997, Braille performance was measured in participants receiving TMS stimulation over the visual cortex or another control site not involved in Braille reading. Results showed that when TMS was applied over the visual cortex, congenitally blind individuals made significantly more mistakes, and they reported distortions in tactile perception.

In the second study, undertaken in 2006, the effect of repetitive TMS (rTMS) was tested on Braille reading performance. A difference from the first study mentioned above, is that in this study, the effect on Braille reading was measured *after* and not during the TMS application. In brief, a group of congenitally blind participants were asked to read as quickly

as possible, a list of Braille words that were written in an unfamiliar (Finnish) language. Both reaction times and number of errors were measured. The same list was repeated three times in a row, a procedure which induces repetition priming, meaning that time needed for reading the word list will be shorter with each successive repetition. Next, rTMS was applied for 15 minutes over the visual cortex or SI (control). Immediately thereafter, participants received a new word list which they had to read again three times. Results showed that following rTMS over visual cortex, compared to SI, blind participants made significantly more errors and were significantly slower. In addition, the repetition priming effect was significantly smaller following rTMS over the visual cortex.

Together, the results of both studies show that the visual cortex is indeed functionally involved in Braille reading in congenital blindness.

It is worth mentioning a unique case report of a congenitally blind proficient Braille reader, who after bilateral damage to the visual cortex following a stroke was no longer able to read Braille, despite the fact that tactile perception remained unchanged. Indeed, the patient did not notice any impairment in touch discrimination when trying to identify the roughness of a surface or locate items on a board.

A question that may emerge is whether similar functional reorganization can also happen in individuals with normal vision who have learned to read Braille. This was examined in a quite recent study in 2016, where healthy sighted people were trained to read Braille. The authors monitored changes in brain activity that occurred following 9 months of daily training with Braille reading. Subjects showed enhanced activity for tactile reading in the visual cortex, including the visual word form area (VWFA) that was modulated by their Braille reading speed and strengthened resting-state connectivity between visual and somatosensory cortices. Moreover, TMS disruption of VWFA activity decreased their tactile reading accuracy. No changes in brain activation were measured in SI.

Conclusion

In this paper, the effect of Braille reading on tactile discrimination has been reviewed and brain responses in blind individuals. The available data suggest that congenitally blind Braille readers have superior tactile discriminatory performance compared to normal sighted subjects. This improved tactile performance is limited to the Braille reading hand and

does not generalize to the rest of the body, suggesting that it is training-induced. Brain imaging studies revealed that long-term Braille reading induces structural and functional changes in both the somatosensory and visual cortex. Braille reading consistently activates the visual cortex in congenitally blind individuals. Finally, visual cortex activity in blind people engaged in language processing may be related to semantic processing.

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