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FROM BRAILLE CODE TO SMART BOOK READERS: TECHNOLOGY AS A TOOL FOR READING EMANCIPATION OF THE VISUALLY IMPAIRED PERSONS

Abstract: This paper illustrates how, over the course of the last two centuries, the autonomous access of the visually impaired to reading material has expanded. The author coins the term "reading emancipation" to describe these processes. She illustrates it by referring to her own research involving in-depth interviews with the visually impaired readers regarding the use of various forms of books, such as books printed in Braille, talking books and e-books. The author also traces the historical background of the transformation of alternative book formats, from the development and spread of Braille code to digital books. The description of the evolution of book formats is set against the background of the transformations taking place in Europe with a strong emphasis on the impact of these transformations on Poland.

Keywords: books, Braille code, information and communication technologies, reading emancipation, visually impaired persons

Introduction

Until now, the visually impaired people as a category of readers using so-called special reading materials or alternative formats,[1] has been the subject of interest mainly

[1] These terms can be used interchangeably. Alternative reading materials or alternative formats refer to book formats that are considered to be different from the usual book formats, i.e. books published in black print and on other media than paper. They enable or facilitate access to the written word for people with various disabilities and build reading competences. M. Fedorowicz, *Specjalne materiały czytelnicze dla osób niepełnosprawnych. Zarys dziejów – formy – obieg społeczny*, Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 2002.

in the fields of library science and visual impairment pedagogy. The researchers from the aforementioned fields use the term "reading disability" to conceptualise groups of readers that, for example, cannot use standard print publications because of their disability. Reading disability is understood as "a permanent or temporary inability to use traditionally published black-print books due to a disability (e.g. brain damage, visual impairment, hearing loss) or a limitation of this ability due to social reasons (neglect, low level of education, addictions, poor language skills, etc.)."[2] This notion draws attention to the existence of groups with severely limited access to standard reading materials or completely excluded from it, including such important drivers of exclusion as social position or level of education and language skills. However, the idea of "reading disability" can be considered as stigmatising, because according to the above-mentioned definition, reading disability is characteristic of people with specific disabilities, and it is they who should improve their reading skills. Yet, visually impaired people (blind or low sighted) are fully able readers if the book is prepared in a format that is accessible to them.

The term "print disability" is now employed in the subject literature to describe the inability to read standard print due to, for example, learning difficulties, visual or motor impairments. It is considered less stigmatising because it does not place emphasis on being a disabled reader, but rather points to the inability to access conventionally printed publications.[3]

Notwithstanding, this perspective acknowledges the primacy of printed materials over alternative book forms, such as e-books and audiobooks, which began to gain enormous popularity among mainstream book readers at the turn of the 21st century.

In this paper I trace the transformation of book forms under the impact of technological developments and their role in expanding access to literature for the visually impaired and the gradual increase of reading autonomy, i.e. the increase of possibilities to use different book forms depending on individual preferences and needs. Moreover, this outline of a historical background, is illustrated by the opinions of visually impaired people on the use of different book forms collected in 2010 and 2018. I conceptualise this process of expanding reading autonomy as reading emancipation. I define it as independent, unrestricted access to literature of all kinds (fiction, scientific literature), both in the mother tongue and in foreign languages, available in an easy-to-use format. This means that using a book must be intuitive, simple and should not generate additional costs compared to the use of books by sighted readers.

[2] Ibidem, p. 10, transl. W.F.

[3] B. Woźniczka-Paruzel, *Bibliotekarz w sieci stereotypów i uprzedzeń – o postawach wobec osób z niepełnosprawnością czytelniczą*, "Toruńskie Studia Bibliologiczne" 2010, no. 1 (4), pp. 23–41.

Research methodology and sample

In 2010, I carried out a study whose aim was to explore how alternative book forms, including new ones such as audiobooks and e-books, are used by people with visual impairments. In my view, their development and uptake is closely linked to the development of information and communication technologies (ICTs). I was also interested in exploring how the growth in ICTs impacts the use of Braille code and its future. To this end, I reviewed the subject literature, with a special emphasis on the Polish context. Moreover, I present empirical material obtained through qualitative research among visually impaired people. I employed the technique of reflexive interview. This approach assumes flexibility on the part of the researcher to the interview, allowing for discussion that may resemble a natural conversation. When conducting the interview, I had a prepared list of issues I wanted to raise during the interview, but during its course the range of issues raised was modified, depending on the knowledge of the interviewee and the course of the interview itself.[4]

Due to the selected research method, I limited my study to a small purposive group of visually impaired people who use alternative forms of books. In line with my research goals, I have interviewed people who do not use black-print writing on a daily basis and people who have lost their sight over the course of their life. I limited the age group to those aged 15 to 40 years. Overall, 38 interviewees took part in the research: 28 people were interviewed in 2010, and 10 in 2018. The sample contained 18 women and 20 men. 26 people who were blind from birth took part in the study. In contrast, 12 lost their sight over the course of their life. The interviewees included students and graduates of one of Poland's centres for the blind and low sighted, people studying in tertiary education institutions and/or working, e.g. as IT specialists specialising in assistive technologies and staff members of the library for the blind. In addition, I employed the snowball sampling method. It is particularly suitable in situations where it is difficult to reach members of a given population.[5] Thus, interviewees were invited to pass on information about the study to those who might be interested in participating.

Each quote in this paper is accompanied by a pseudonymised reference to a given respondent. The given number represents the sequence of carrying out the interviews. Thus, respondents referred to as B1–B28 were interviewed in 2010. Whereas those that are referred to as B29–B38 took part in the 2018 study.

I am well aware that the reported results are not generalizable and are thus not representative for the population of persons with visual impairments at large. However, my aim was primarily to gain an insight into an individual experience of book readers and their subjective experiences connected with different forms of books.

4 M. Hammersley, P. Atkinson, *Ethnography: Principles in Practice*, 4th ed., Routledge, Abingdon 2019.

5 E. Babbie, *The Practice of Social Research*, 12th ed., Wadsworth Publishing, Belmont 2010.

It is also important to stress that, as a visually impaired person myself, I am a user of alternative book forms and have experienced myself many of the transformations discussed in this paper. When studying in the mainstream secondary school, I was not able to access relevant textbooks published in Braille. At that time, I mainly leaned on my parents who would read aloud the textbooks for me or record their contents on audio cassettes, so that I could use them autonomously.

During my university education, both myself and my parents spent hours in the library searching for necessary books and other written materials, and then even more time scanning them. At present, the adaptation of books for students, Ph.D. candidates and staff members with visual impairments is being carried out by a special unit at my university. On the other hand, there is a rich collection of fiction books available in many formats, including audio, which can be stored on a portable device, such as smartphone or tablet.

All this has had an enormous impact on my autonomy and gives me more freedom to use the reading materials, and by doing so allows me to study and work. That is why in 2018 I decided to re-visit my research and update it with new interviews with persons participating in book discussion lists created and maintained by readers with visual impairments and thus re-consider this topic through the lens of a process which, in my view, is of an emancipatory nature in Polish conditions.

Reading by touching

Books have played an enormous role in the lives of the blind. This is because visual items, such as photos, films or paintings, are inaccessible or are only partially accessible for them. Until 19th century, even books were accessible mainly through public lecture for the blind.

The breakthrough came when the Enlightenment movement put forward the idea of creating an organised system of education for the blind. One of its advocates was the French philosopher Denis Diderot. In 1749, in his "Letter on the blind for the use of those who see," he drew attention to the role of sensory experience in human attainments, expressing his view that the ability to see is not crucial to the ability to understand and infer. He also suggested that the blind could read using the sense of touch.[6]

The idea of organised system of education for the blind was put into practice by Valentin Haüy (1745–1822), who in 1784 founded L'Institution Nationale des Jeunes Aveugles (National Institute for Youth) in Paris.[7] Haüy was a proponent of the idea of reading by touch. In 1786 the first book for the blind written in embossed italics was

[6] History of the Blind: https://www.britannica.com/topic/history-of-the-blind-1996241/The-blind-during-the-Enlightenment (accessed: 31.05.2022).

[7] B.H. Nordstrom, *The History of the Education of the Blind and Deaf*, United States Department of Education, 1986, https://eric.ed.gov/?id=ED309614 (accessed: 31.05.2022).

printed. The volume in question was Haüy's work entitled *Essay on the Education of Blind Children*. The height of the letters was up to 22 mm, which made the process of reading laborious, time-consuming and tiring. A blind person needed to move their finger along an embossed line reflecting the shape of the letter.[8]

Crucial to the tactile writing revolution was the move away from the supposed analogy between the sense of sight and touch. This was accomplished by Louis Braille.[9] He developed one of the most important reading systems for the blind still widely used today – the Braille code.

The inspiration for dots system for the blind came from a dots cipher developed for military purposes by former artillery captain Charles Barbier de la Serre. He developed a cipher based on the combination of dots and dashes, which was supposed to make it possible to write and read reports and orders at night without the use of light.[10] It is worth noting that Barbier based his system on the number of dots, while Braille based his system on the position of the dots and the resulting shape of the sign. In addition, Braille reduced the number of dots from twelve to six (2 rows of 3 dots), allowing thus for 64 dots combinations, i.e. the signs of the system, including letters, punctuation, mathematical symbols, as well as musical notation. Not only the Latin alphabet, but also the Cyrillics and other alphabets can be represented in Braille code. It is also important to note that Braille renders the rules of orthography.[11]

However, Braille code raised some criticism. It was claimed, among other things, that it was illegible for sighted people and led to isolating blind people.[12]

The process of Braille dissemination took place at educational centres for the blind and at charitable and self-help associations, where the first Braille libraries were created.

In Poland, the official Braille code was approved in 1934 by the Minister of Religious Denominations and Public Enlightenment.[13] In 1952, the Central Library of the Polish Association of the Blind was founded. Its tasks included collecting, compiling, archiving and distributing literature among the visually impaired people. It also became a focal point for the integration of the community of blind and low sighted people.

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8 M. Czerwińska, *Książka niewidomego* [in:] T. Pilch (ed.), *Encyklopedia pedagogiczna XXI wieku*, Żak, Warszawa 2003, pp. 849–858.

9 Louis Braille (1809–1852) born in the town of Coupvray, 40 km from Paris. He was the youngest of four children of Simon-René Braille and Monique (née Baron). His father owned a saddlery workshop, and it was there in 1812 that 4-year-old Louis, while trying to help his father with his work, injured his eye with a leatherworking tool, as a result of which he lost his sight at the age of 5. C.M. Mellor, *Louis Braille: A Touch of Genius*, National Braille Press, Boston 2006.

10 Z. Krzemkowska, *Ludwik Braille i jego dzieło*, referat wygłoszony na inauguracji Międzynarodowego Roku Braille'a w Polsce, 3.12.2008, http://www.brajl.pzn.org.pl/ (accessed: 31.05.2022).

11 M. Czerwińska, *Pismo i książka w systemie L. Braille'a w Polsce. Historia i funkcje rewalidacyjne*, Stowarzyszenie Bibliotekarzy Polskich, Warszawa 1999.

12 M. Fedorowicz, op. cit.

13 M. Czerwińska, *Książka niewidomego…*, op. cit.

Importantly, in 1957 a decision was made to employ blind librarians. This meant the development of adapted library practices and keeping all documentation in Braille.[14] A momentous event both for its job-creating potential, as well as for its emancipatory consequences.

To conclude this brief overview, it should be noted that proficiency in Braille requires training, which is why, according to some researchers, "it is mainly used by people who are blind from birth or become blind at an early age. The main reason for the difficulties of many older people to learn Braille is that their tactual acuity is not as good as that of a young person."[15] For such people, as well as for blind and those who acquired visual impairment at a later stages of their lives and thus do not use Braille code, the so-called talking book proved to be a breakthrough in access to literature.

Reading by hearing: A brief history of talking books

Before proceeding, a note on terminology has to be made. The term talking book was used by government agencies and charities to refer to books recorded for the use of blind people on shellac and vinylite records. In contrast, the term audiobook was not widely used until the early 1990s. In 1994, the Audio Publishers Association recognised "audiobook" as an industry standard.[16]

The origins of the modern talking book can be traced back to the 19th century. In 1877, Thomas Edison invented the phonograph, one of the first devices to enable the reproduction of the human voice and thus make reading aloud independent of the physical presence of the reader. As Edison pointed out, one of the original uses of the phonograph was to record phonograph books for the blind.[17]

A breakthrough in the recording and distribution of talking books came in the 1930s with the slow-speed, close-groove record. It then became possible to record longer pieces of about 20 minutes each. At this time, the first unabridged novels began to be recorded in the USA and UK, in response to the needs of WWII veterans who had lost their sight as a result of the war effort.[18]

The history of talking books in Poland goes back to 1962, when a professional recording studio was opened at the premisses of the Central Library of the Polish Association of the Blind. Initially, the readers were amateurs, e.g. students. Then,

[14] T. Dederko et al., *Biblioteka Centralna Polskiego Związku Niewidomych. Przeszłość, teraźniejszość, przyszłość* [in:] M. Czerwińska, T. Dederko (eds.), *Niewidomi w świecie książek i bibliotek. Wybrane zagadnienia*, Oficyna Wydawnicza STON 2, Kielce 2008, pp. 127–134.

[15] M. Hersh, M. Johnson (eds.), *Technology for Visually Impaired and Blind People*, Springer, London 2008, p. 143.

[16] M. Rubery, *The Untold Story of the Talking Book*, Harvard University Press, Cambridge 2016.

[17] M. Rubery (eds.), *Audiobooks, Literature, and Sound Studies*, Routledge, New York–London 2011, pp. 3–4.

[18] Ibidem, pp. 5–6.

professionals (actors and radio announcers) became involved. At that time, books did not yet reach a wider audience due to the lack of regulations governing the lending of reel-to-reel tapes.[19]

In the first few years of the existence of the recording studio, fiction and established works of classical and contemporary literature which were not published in Braille were recorded. Books for children and young people were intentionally not recorded, in order not to draw them away from Braille. With time, the catalogue was enriched with popular science books, non-fiction, poetic works and some academic textbooks.[20]

In order to make books accessible to blind people who did not have reel-to-reel tape recorders, which were expensive at that time, reading clubs were organised at the local branches of the Polish Association of the Blind and cooperatives of the blind. In the peak period of its development, this form of collective book listening benefitted almost two thousand people.[21]

Gradually, talking books began to reach public and hospital libraries. In 1972, cassette tapes were introduced, replacing the reel-to-reel tapes used until then for recording talking books.[22]

There were two prevailing tendencies in talking books publishing. The first was to meet the demands of the community, and the second was to shape reading tastes and culture by supplying books of high artistic value.

During Martial Law in Poland (1981–1983), artists organised a boycott of radio and television. Thanks to this, almost all the great among the actors living in Warsaw passed through the Department of Recording and Publishing at the Central Library.[23] The talking book is a huge step in the reading emancipation, since the process of publishing talking books is much shorter than the publishing process of books in Braille. This enables the quick publication of books that reflect important literary and social events.[24]

At the dawn of the 21st century, it became possible to download talking books stored in digital audio formats (MP3, WAV) and listen to them on portable digital players. This has greatly increased the convenience of the book. This can be illustrated by the following example. Whereas James Clavell's novel *Shogun* consists of 16 volumes in Braille, it is recorded on 59 cassettes and occupies 521.84 MB in its digital version.

Talking books are now used not only by visually impaired people, but also by dyslexics, people who are temporarily or permanently unable to hold a traditional book or those who, as a result of other health problems, are unable to read printed books.

[19] D. Tomerska, *Ludzie studia nagrań*, cz. 1, "Pochodnia" 1998, no. 1.
[20] D. Tomerska, *Ludzie studia nagrań*, cz. 2, "Pochodnia" 1998, no. 3.
[21] D. Spychalski, *Niewidomi i książki w 40-leciu*, "Bibliotekarz" 1984, no. 9/10, pp. 240–247.
[22] M. Fedorowicz, op. cit.
[23] D. Tomerska, *Ludzie studia nagrań…*, cz. 2, op. cit.
[24] D. Spychalski, op. cit.

Talking books have become an integral part of the mainstream publishing market. They are listened to by people on long car journeys, or while doing monotonous mechanical work that requires the use of their hands.

Talking book is constantly evolving. As Matthew Rubery notes, human voice is being replaced by synthetic voice which, in turn, is present on an ever growing number of electronic reading devices.[25] I will return to this issue below.

My own research shows that those who use talking books read by a human voice have stressed their aesthetic value, and contrast deriving pleasure from listening to the natural human voice with the monotony of synthetic speech, which causes fatigue after prolonged listening.

> The synthesiser can't convey emotion, it intones badly, sometimes it intones too much. I prefer to listen to a natural human voice, the voice conveys the content of the book, the emotion. The audiobook gives me a break from the sound of the synthesiser. If I work on a computer with a synthesiser for several hours a day, I get tired of this synthetic sound after a while (B23).

However, a talking book imposes a certain pace of reading, it does not promote stopping the reading process for reflection and repeating more difficult passages or passages containing particularly interesting thoughts.

In addition, audio recordings do not offer the possibility of working with the text, i.e. making comments and writing notes in the margins, inserting bookmarks in the text, marking specific passages to return to them, referring to the specific page number, browsing, navigating through specific pages, chapters, etc.

The era of the computer and the digital book

Another breakthrough in the history of book forms was the advent of the e-book and Optical Character Recognition (OCR). These inventions again revolutionised the way books are read. Undoubtedly, they have also increased access to books for people with visual impairments.

The idea of electronic book was articulated in the essay entitled *As We May Think* (1945) by Vannevar Bush. In it, he drew attention to the difficulty of processing the multitude of information available. Today we call this problem "information overload." Bush believed that information left trails and that one document would lead to information in another. Therefore, the solution could be a personal device to store information and allow easy and quick access to it. This idea laid the foundation for later work on the personal computer, and information trails, nowadays known as hypertext.[26]

[25] M. Rubery (ed.), *Audiobooks…*, op. cit.

[26] L. Manley, R.P. Holley, *History of the Ebook: The Changing Face of Books*, "Technical Services Quarterly" 2012, vol. 29 (4), pp. 292–311.

The researchers stress the difference between an electronic book and e-texts, which is written in hyper-text markup language and viewable on a computer. In contrast, the main characteristic of an electronic book is that it must be read on an e-book reader or with special software. Broadly, it can be defined as a content of any book made available in electronic form through four different methods: a downloadable, dedicated ebook; a dedicated ebook reader; a web accessible ebook; or a print-on-demand book.[27]

The dynamic development of electronic books was made possible by the invention of Optical Character Recognition (OCR), which "may be defined as the process of converting images of machine printed or handwritten numerals, letters, and symbols into a computer-processable format."[28] The key element in the process of making the printed word available in electronic form is an optical scanner, which converts a traditional (analogue) image into its digital form. The OCR system then recognises characters and words. Importantly, OCR systems also use the lexicon and apply spell checking techniques. Then, the text can be read by synthetic speech.[29] Finally, OCR'ed book or newspaper converted to a digital format can be stored on an electronic device.

In the case of the visually impaired, however, access to e-books would not be possible without the use of assistive technologies for using computer without sight. There are several ways for non-visual access to computers. First, there are Braille devices. These include Braille displays – output devices that convert text and graphic information appearing on a computer screen into Braille code.[30]

In addition, a Braille display features navigation and routing keys for navigating through the text, which allows very accurate text editing as it provides a better orientation than when using synthetic speech. With the Braille display it is also possible to read musical notes, mathematical formulas and learn foreign languages.[31]

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27 S.K. Sawyer, *Electronic Books: Their Definition, Usage and Role in Libraries*, "LIBRES: Library and Information Science Research, Electronic Journal" 2002, vol. 12 (2), pp. 1–28.

28 S.N. Srihari, A. Shekhawat, S.W. Lam, *Optical Character Recognition (OCR)*, Encyclopedia of Computer Science, January 2003, pp. 1326–1333, https://dl.acm.org/doi/10.5555/1074100.1074664 (accessed: 31.05.2022).

29 It is worth mentioning here the Kurzweil Reading Machine which was invented in the 1970s by American engineer and entrepreneur Ray Kurzweil. It was designed as a reading prosthetic aid for the blind. The device used OCR to process printed material: books, letters, in most common font styles and sizes. Once processed, it converted the text into synthesised speech in English. The user operates the machine by placing a sheet of paper printed side down on the glass surface of the scanner and pressing the "Page" button on the control panel, and listens to the synthetic speech produced as an electronic camera scans the page and transmits its image to a minicomputer housed within the device, A. Kleiner, *A Description of The Kurzweil Reading Machine and a Status Report on its Testing and Dissemination*, https://www.rehab.research.va.gov/jour/77/14/1/kleiner.pdf (accessed: 31.05.2022).

30 M. Hersh, M. Johnson (eds.), *Technology for Visually…*, op. cit.

31 *What Is Refreshable Braille Anyway?*, 22.02.2018, https://wcblind.org/2018/02/what-is-refreshable-braille-anyway/ (accessed: 31.05.2022).

Thus, when working with a computer, the Braille code becomes a provisional representation of the characters displayed on the screen. In this way, the limitations of the Braille code that for years had been a subject of criticism are overcome: the hermetic nature of the code, the inability to correct written characters, the large size of Braille books.[32] Electronic Braille devices make it possible to read almost any digital text, so those who prefer to read in Braille can now use not only printed books, but also e-books on a Braille display. It is no exaggeration to say that, thanks to technological progress, Braille has become more accessible than ever before. As shown by my own research Braille users point out that they concentrate more when reading by touch, and can therefore remember things better and absorb knowledge more easily than when listening to an audiobook.

> When I have a book that I need to show that I know it, I prefer to read in Braille. I have a tactile memory, I absorb knowledge more easily by reading (B7).

Some interviewees also claim that reading Braille activates the attention more strongly, which makes the reading more valuable.[33] This is illustrated by the following passage:

> In my opinion Braille will always have, and should always have, its devotees. Braille is slower to read, but because of that you read more attentively. The difference is really noticeable, I know from experience. A synthesiser or a voice artist always interprets the text in some way. Even monotonous reading without intonation is an interpretation of some kind. Reading in Braille leaves space for your own interpretation. And above all, it gives freedom from the constant chatter of the synthesizer, which can be very tiring (B35).

One interviewee (a person who acquired blindness) points to the analogies between tactile and visual reading:

> I always considered myself visual learner, written text was easier to remember. It is always more difficult to remember the text you listen to. I don't know Braille. I think knowing it would help me to read books. Putting your hand on the letters is like putting your eyes on a written text, I think it makes it easier to read. Less information escapes you. When reading by ear, all it takes is a moment's inattention to overlook information. It's hard to go back later because you have to move the file or the tape. With Braille it is the same as with the eye; it is easier to move the hand over the text than to find a given passage of text in a sound file (B1).

Almost all interviewees emphasised the value of Braille e.g. for language learning.

This is confirmed by a qualitative study of blind translators and interpreters in Poland, in which the interviewees identified the ability to read and write Braille as

[32] M. Czerwińska, *Książka niewidomego…*, op. cit.

[33] M. Paplińska, *Niewidomy czytelnik – cyfrowy tubylec czy brajlowski analfabeta? O kryzysie umiejętności czytania dotykowego* [in:] K. Czerwińska, M. Paplińska, M. Walkiewicz-Krutak (eds.), *Tyflopedagogika wobec współczesnej przestrzeni edukacyjno-rehabilitacyjnej*, APS, Warszawa 2015, pp. 179–195.

one of the key competences for a blind person wishing to pursue the profession of translator.[34]

Braille definitely makes it easier to learn the rules of punctuation and spelling, it enables blind people to use various kinds of drawings, diagrams, maps; in everyday life blind people use it to make notes, to tag various objects, e.g. CDs, medicines, household appliances etc.

A person who is not able to read and write in any kind of print is considered illiterate. Thus, acquiring information only through the auditory channel may contribute to secondary illiteracy among people with visual impairments. This does not apply to people who became blind but had used black print before losing their sight.[35]

Apart from their unquestionable ability to broaden the opportunities for working with texts and increase access to books that have not been (and will probably never be) recorded in audio format (such as scientific books), attention must also be drawn to the high cost of electronic Braille devices. Consequently, a blind person is often unable to bear this expense. In order to purchase these specialised devices, they must resort to subsidies from the state or from charitable organisations.

Speech synthesis, in turn, has been a key factor in the increase of accessibility of ICTs for persons with visual impairments. Synthetic speech has revolutionised the way visually impaired people get information. It makes it possible to operate a variety of tools: word processors, spreadsheets, e-mail applications, Internet browsers, electronic banking, databases. Speech synthesisers are very popular among visually impaired users, mainly because of the speed of transmission of information, which is equal to the speed of speech (the user can adapt the pitch, tone and speaking rate of the synthesiser to their individual preferences). Moreover, speech synthesis is accessible to all visually impaired people (except people with severe hearing loss), regardless of factors such as their visual abilities, age, Braille fluency.[36]

Another major advantage of technologies based on information retrieval through auditory channel is their significantly lower cost compared to Braille electronic devices. Thanks to the technologies described above, blind people can access books in electronic formats, such as TXT, HTML, PDF and DOC.

In 1988, an attempt was made in Sweden to integrate the talking book with the electronic book. To this end, the international system for recording digital talking books, DAISY (Digital Accessible Information System), was developed. This format was intended to replace cassettes and revolutionise the use of talking books by introducing a document structure that would provide readers with easy navigation through

[34] W. Figiel, *Levelling the Playing Field with (In)accessible Technologies? How Technological Revolution Has Changed the Working Conditions of Blind Translators*, "Między Oryginałem a Przekładem" 2018, vol. 24, no. 3 (41), pp. 75–88, https://journals.akademicka.pl/moap/article/view/224 (accessed: 31.05.2022).

[35] M. Paplińska, op. cit.

[36] N. Walter, *Nowe media dla niewidomych i słabowidzących*, Wydawnictwo Naukowe UAM, Poznań 2006.

books, similar to that of a printed book, but with the added features of navigation of audio content. DAISY is a multimedia standard in which text and sound are synchronised. The text layer retains the original structure of the book: the division into sentences, paragraphs, chapters, thus enabling the user to navigate within the book: jumping by phrases, searching and jumping to any part of the book based on its table of contents, jumping to a specific page, the ability to insert and search for bookmarks, highlight a fragment of a digital talking book and take notes.

A book in the DAISY standard consists of the following elements: audio files with recorded voice of the speaker, digital text of the book, the so-called synchronisation file, which directly links all tags in the text layer with corresponding time codes in the audio narration (it aligns specific text files with corresponding audio files), navigation control file, which allows the reader to move freely and smoothly through the structure of the book, while maintaining full synchronisation of the text and audio layers.[37]

Turning back to the results of my own research, when it comes to books in DAISY, the interviewees reported that they knew how to navigate through the book structure and work with texts offered by this format. However, most of them only used its audio contents. Some interviewees argued that DAISY would be suitable for textbooks, e.g. for language learning, dictionaries and encyclopaedias, i.e. for those materials that require navigating through chapters, pages and paragraphs:

> I do not use DAISY, but this is because of my carelessness, since that form makes it really easy to navigate through page numbers, paragraphs, chapters. This format would be very helpful with textbooks used for university courses, where you need to make bookmarks, select pages, search specific phrases, use footnotes, appendices (B4).

Blind interviewees argued that the choice of a particular book format depends on the purpose of a book in question and the purpose of reading (science book, fiction, reading to acquire knowledge, reading for pleasure).

> When it comes to books for university courses or school readings, I would like to have these in DAISY format. However, when it comes to books that are read for pleasure, I don't know if DAISY has any use here. Such books are read from cover to cover (B25).

What, then, were the transformations in the use of alternative book forms? First of all, the once popular cassettes have been replaced by books recorded in digital audio formats. There has been a significant increase in the number of books available in the online resources of the library for the blind, now part of the Labour and Social Security Library – Department of Collections for the Blind.[38] They can be listened to both

[37] G. Kerscher, V. Luceno, L. Leith, *Accessible DAISY Multimedia: Making Reading Easier for All* [in:] R. Manduchi, S. Kurniawan (eds.), *Assistive Technology for Blindness and Low Vision*, CRC Press–Taylor & Francis Group, New York 2012, pp. 293–314.

[38] In 2007, the Library launched an online digital library (accessible for registered library users), which provides access to digital collections, including books in DAISY format (over 13,000 titles), digital text (2082), synthetic MP3s (2079), https://wypozycz.dzdn.pl/wol/ (accessed: 31.05.2022).

using the online player and offline, on the user's preferred digital player. It is worth noting that access to the library's book collections is free of charge.

Thanks to digitisation (the falling prices of Internet connection and thus the growth in streaming services) and the growth in mobile technologies, the last decade has seen a significant increase in the availability of talking books on the open publishing market. A breakthrough in this respect was the emergence of smartphones and mobile apps, as well as the huge popularity of subscription services offered by platforms such as Netflix, HBO, Spotify, which offer films or music. Currently, companies publishing and distributing audiobooks and e-books, such as Audioteka, Storytel, Empik, also enable access to their collections through a subscription.[39]

Access to digital books, both those published commercially and book collections prepared specifically for the visually impaired (available free of charge) is possible through an application installed on a smartphone or tablet without the need for using desktop web browser. An example of such app is Voice Dream Reader. It allows the user to read e-books and audiobooks on their smartphone. The app can connect to cloud services, such as Dropbox or Google Drive, thus making the book download process independent of the use of a desktop computer. Another app, EasyReader, directly connects to the digital resources of libraries for the blind from many parts of the world, including the Polish library. Thus, the collections can be used without tedious downloading and transferring of audiobooks to a smartphone.[40]

The development of ICTs plays a crucial role in gaining autonomy in the use of reading materials. However, many of the above-described solutions, Braille displays or players for DAISY books, are expensive and force the user to acquire additional skills in order to effectively use such devices, such as memorising of keyboard shortcuts or key combinations or, when it comes to smartphones or tablets, gestures.

That is why each of the above-described book forms can potentially include one group of users and at the same time exclude another group, for instance, people who are gradually losing their sight and have not been previously exposed to ICTs. This is particularly relevant for the elderly who by losing their sight are deprived of access to information, including books. Learning ICTs may be both difficult and stressful for them. By the same token, talking books may be challenging for deafblind users.

An interesting, and, importantly, low-cost alternative to a PC or mobile devices with touch screens is the use of voice assistants, such as Amazon Alexa or Google Assistant. The user "talks" to them and is, in a way, interacting with them as if it was a living human being. Such devices may offer a quick and simple access to digital libraries of audiobooks and books recorded with speech synthesizer.[41]

[39] *Rynek audiobooków w Polsce*, 9.12.2020, https://rynek-ksiazki.pl/aktualnosci/rynek-audiobookow-w-polsce/ (accessed: 31.05.2022).

[40] J. Zadrożny, *Czytanie książek na iPhone*, http://www.trakt.org.pl/czytanie-ksiazek-na-iphone-jacek-zadrozny/ (accessed: 31.05.2022).

[41] J. Beksa et al., *Usability Study of Blind Foundation's Alexa Library Skill*, "Journal on Technology and Persons with Disabilities" 2020, vol. 15, pp. 104–118.

Conclusions: Has reading emancipation been completed?

In this article I have traced how forms of books have changed under the impact of technological transformations, and how these transformations affect the accessibility of books for the visually impaired, thus increasing their opportunities for inclusion in various spheres of life, such as education, employment and culture.

The interviewees who took part in my study stressed that they felt they had quicker and easier access to fiction books. In contrast, those enrolled in higher education programmes pointed out that access to specialised academic literature was still limited and difficult, e.g. in fields such as psychology, economics, finance, management, science, computer programming, textbooks for learning foreign languages. All these usually contain visual material: charts, diagrams, extensive tables, photographs, graphic diagrams. In order to make them accessible for people with visual impairments they need additional, often time-consuming and tedious adaptation. This involves converting inaccessible formats into text, including all elements of the text structure.

At the next stage the text is proofread, the content structure is provided and alternative text description for graphical information (i.e. a concise but comprehensive description of the visual content) is added.[42] Adaptation of academic textbooks usually takes place at universities and is often one of the tasks of university disability support offices.[43]

There is no doubt that advances in modern technologies have significantly increased the autonomy of visually impaired people, including by reducing hurdles to accessing books, especially thanks to the spread of texts in digital formats. And thanks to the many available technological solutions, both those based on the sense of hearing and those that rely on the sense of touch, it is possible to read a book on a computer, a mobile device, using a speech synthesiser or a Braille device, depending on the needs. This is a milestone on the road to reading emancipation for people with visual impairments. However, there is still a significant barrier when accessing specialised literature and textbooks at different levels of education. There is still not enough digital adaptations and textbooks adapted and printed in Braille. Moreover, the visually impaired have to incur large additional costs in order to acquire Braille devices or DAISY book players.

[42] Biuro ds. Osób z Niepełnosprawnościami Uniwersytetu Warszawskiego, *Adaptacja materiałów dydaktycznych*, https://bon.uw.edu.pl/uslugi/adaptacja-materialow-dydaktycznych/ (accessed: 31.05.2022).

[43] Akademicka Biblioteka Cyfrowa (The Academic Digital Library) at the University of Warsaw has a rich collection of scientific publications. The Library prepares and makes available publications in audio and text formats. The Library's collections can be used by persons with a disability certificate, S. Piekarski, *Wszystko o Akademickiej Bibliotece Cyfrowej*, 1.06.2017, https://bon.uw.edu.pl/wszystko-o-akademickiej-bibliotece-cyfrowej/ (accessed: 31.05.2022).

It should also be kept in mind that the enormous increase in the importance of modern technologies in general, and the increase in the importance of assistive technologies in particular, in the life of persons with visual impairment, is connected with the need for constant acquisition of competences and skills necessary for their effective use. The lack of access to modern technologies or insufficient skills in using them, in turn, may generate new forms of inequalities and social exclusion, e.g. in the sphere of education or in labour market.[44] This is particularly relevant in the case of the elderly who are losing their sight.

Therefore, the pursuit of reading emancipation, in the broadest sense of this term, should take place in several equally important areas. One of them is developing skills for efficient use of ICTs, both those that are considered mainstream and those that are regarded as assistive technologies. Another area that cannot be ignored is the ability to read and write in Braille, including the ability to read embossed drawings, diagrams, plans and maps by touch. As suggested by my own research, many blind Braille users believe that the benefits resulting from the knowledge of the Braille code significantly exceed purely utilitarian applications, e.g. for reading Braille floor markings in a lift. Despite the unquestionable dominance of modern technology, for some blind people Braille code is still an indispensable tool for learning, working and communicating. Last, but certainly not least, there is an urgent necessity to cater to the needs of the elderly people who are losing their sight. As our societies age, all these areas are likely to remain relevant in the foreseeable future.

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[44] K. Dobransky, K.E. Hargittaib, *Unrealized Potential: Exploring the Digital Disability Divide*, "Poetics" 2016, vol. 58, pp. 18–28.

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