DOCUMENT RESUME

ED 400 838 IR 056 153

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TITLE Some Issues Concerning Access to Information by Blind and Partially Sighted Pupils.

PUB DATE 96

NOTE 18p.; In: Sustaining the Vision. Selected Papers from the Annual Conference of the International Association of School Librarianship (24th, Worcester, England, July 17-21, 1995); see IR 056 149.

PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Access to Information; *Assistive Devices (for Disabled); Audiotape Recordings; Braille; Character Recognition; *Communication Aids (for Disabled); Computers; *Electronic Publishing; Electronic Text; Foreign Countries; Full Text Databases; *Information Technology; Optical Data Disks; Optical Scanners; Printed Materials; Secondary Education; Sensory Aids; Technological Advancement; *Visual Impairments

IDENTIFIERS Graphical User Interfaces

ABSTRACT

This paper examines problems faced by visually-impaired secondary pupils in gaining access to information in print. The ever-increasing volume of information available inundates the sighted and is largely inaccessible in print format to the visually impaired. Important issues of availability for the visually impaired include whether information is up-to-date, accurate, legible, and intelligible. The paper postulates the desirability of empowerment for personal autonomy through advocating a learner centered approach for coping with information. After considering some of the difficulties of presenting print to visually-impaired pupils, the paper examines some recent technological developments: the RNIB electronic newspaper, CD-ROM technology, and optical character recognition systems; notes some of the problems arising from graphical user interfaces; and makes some observations about study from tape. Braille has served the blind community well for over a century and a half, but its abiding utility for providing ephemeral information for visually-impaired people in the electronic information age is questionable. More effort should be put into promoting communication skills which involve keyboards and adaptations of existing communications devices rather than continuing to promote Braille as the only respectable means of information input and output for the visually impaired. (Contains 33 references.) (Author/SWC)

Some Issues Concerning Access to Information by Blind and Partially Sighted Pupils

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Abstract

This paper examines problems faced by visually-impaired secondary pupils in gaining access to information in print. It postulates the desirability of empowerment for personal autonomy.

After considering some of the difficulties of presenting print to visually-impaired pupils, it examines some recent technological developments: the RNIB Electronic Newspaper, CD and CD-ROM technology, and Optical Character Recognition systems, and notes some of the problems arising from Graphical User Interfaces.

The paper concludes with some observations about study from tape, and finally questions whether Braille can continue to be an automatic choice for providing ephemeral information for visually-impaired people.

The Problem

Information is the problem: there is just too much of it. It inundates the sighted; and it is largely inaccessible in print format to the visually impaired. Whether the information is ephemeral or more permanent, none of us can expect any longer to be able to absorb anything more than a tiny fragment of the information available.

The day of the polymath is over. The sheer volume of new information published in any given subject in any year is overwhelming; none of us can expect to keep completely up-to-date in developments in our own fields any longer. If you really want to be depressed, just wander along the shelves of journals in a university library, and imagine trying to garner anything like one per cent of the research material being published in the United Kingdom, let alone in English in foreign journals or in foreign languages.

Is it up-to-date?

Whether the information is up-to-date is an important issue. Even within the fairly stable environment of a boarding school, I find immense difficulty in controlling the accuracy of information. I publish a Staff Handbook each year. The number of errors which can arise in lists of names of pupils, of staff, of telephone numbers, and post codes, within such a tiny publication is unimaginable. We must insist, however, that information is only valuable insofar as it is accurate and up-to-date. There are few things less useful than last year's calendar! This insistence places the librarian in charge of a Braille stock with an intractable problem - whether or not to weed out old stock. The paucity of Braille provision has led to us hanging on to anything in Braille...even when it has ceased to have any real utility. But this attitude may change, as a result of electronic publishing, of which more later.

Is it legible?

The sighted world needs to recognize that there are problems with legibility of print, and that these are problems even for those with sight. Size of print, character of typeface, quality of paper, whether the text is printed on colored panels - all these are well-known issues for those involved with the education of the visually impaired. Awareness of the problems needs to be reinforced among the sighted world of information providers. Technology may be producing new solutions, but there will still be a lot of print around for a long time to come, and some of it is pretty awful in quality and legibility. The RNIB's "See it right" campaign needs greater support from all in the business of widening access to information.

Is it intelligible?

That's another issue altogether. But anyone providing information at whatever level can make some efforts to improve its intelligibility. This issue matters at the educational level in several ways" the in-house production of teaching materials, and the provision of information to parents and local authorities, for instance.

So there is a sizeable problem. The information you want is probably out there somewhere, but how do you find it, quickly, easily? That's a problem for all of us, whether we are looking for some obscure fact or something as mundane as a telephone number. Bad enough for the sighted in a sighted world; but how do our visually impaired pupils begin to cope?

Leaving aside for the moment any problems of access to information for school work, we ought to take stock of one salient fact. In secondary schools we have these pupils in our care for some seven or eight years, and we should provide them with strategies which will enable them to cope with the immediate post-school world (the world of further study perhaps, at university, HE or FE college), and the world of employment, but in addition, these strategies ought not to be fossilized methodologies, but must be flexible enough to enable our pupils to cope with a world in which change is pandemic. "Empowerment", a fashionable concept in some circles, is important in this context. What Aston says of rehabilitation might equally well define the aims of educationalists working with visually-impaired pupils: it should, he writes, enable them

> to cope with the demands imposed by their external environment;...to interact with, and preferably to have some influence on, their external environment;...(and) to be effectively functioning, fulfilled individuals, participating members of families and communities.[1]

I want to set out a picture of what I think we should be aiming at within our educational systems, to enable our pupils to gain information, to use it, and to be able to discover it for themselves. Anthony Kenny wrote about his own education, saying that

> During the years of Poetry and Rhetoric I read in Greek all of Homer, Herodotus, Thucidides, Aeschylus, Sophocles and Euripides, and in Latin all of Virgil, Horace, Tacitus and a fair amount of Cicero and Livy.[2]

Such a concept of education framed in terms of handing on the knowledge of the past to the next generation is seen to be an irrelevancy or an impossibility today, and must be relegated to a list of outmoded options, because it is an impoverished and impoverishing model, limited by the present knowledge of the teacher.

Rather, we must be fitting our pupils with a range of skills which will enable them to cope with this explosion of information creatively, in terms of their own employment, housing, welfare, leisure, social and political needs. If, in addition to providing pupils with skills for discovery, we also fit them with skills for thinking through the implications of what they have discovered, we shall really be doing our job as educators. John Stuart Mill summed up this approach, when he said of education that it should be concerned to

> (make) people think for themselves, not to indulge them with bald summaries and crude slogans; fostering genius for future discovery (was) more important than in spreading what is (already) known.[3]

I have encapsulated this approach to education and the information revolution in a mnemonic: CALIFORNIA. Information is perhaps just as valuable as gold, so that isn't an inappropriate mnemonic to use. I suggest that our task is to create

> Competent Autonomous Learners, Information Finders, Organizers, Redeployers. Not Information Aliens.

This learner-centered viewpoint seeks to promote and enhance educational autonomy. Freeing us from the straightjacket of a classical approach to learning, the CALIFORNIA model fosters a philosophy which will enable the realization of independent learning. It espouses an

existential world view, providing a learning model for authentically free human beings who are enabled to use information constructively to realize their own personal vision, rather than being reduced to playing roles in someone else's script.

Application to the Education of the Visually Impaired

The central problem of applying such an educational philosophy to the education of the visually impaired lies in access to material. I have in mind here rather more the needs of those who use Braille, rather than those who can read print either with closed-circuit television, low-vision aid or through enlargement of print.

Our traditional cry has been, "Is it available in Braille?" For a Braille reader, if material isn't in Braille, then getting it put into Braille presents enormous problems of resources, not least cost, time and, ultimately, relevance. Is it going to take so long to get a Braille copy that the need has passed, or the information ceases to be useful?

The short-term solution to such a problem might be reading onto audio-tape, of course: but there are several problems of accessibility which make study from tape alone a daunting task. But study from tape can, however, be enhanced; the work of Aldrich and Parkin has shown this, and Hartley has suggested ways in which print conventions can be applied to tape production to facilitate use. This work is reviewed in the section captioned: "Improving Study from Tape."

Provision of Print Material for Pupils

When I first began to teach at RNIB New College (then called Worcester College for the Blind), there were relatively few print users in the school population, and the library resources reflected this: it was essentially a Braille collection of fiction for recreational reading, rather than a curriculum support resource. The needs of print users were being met in a variety of ways:

i. by individuals using appropriate low-vision aids, together with suitable lighting;
ii. by closed-circuit televisions;
iii. by enlarging text using the rough and ready enlargement of a photocopier.

These pupils coped in this situation remarkable well - probably recognizing that the alternatives were no help in reading print at all! But staff were not always very willing to recognize that simply enlarging poor-quality text (sometimes enlarging photocopies!) does not necessarily promote access to the text.

Nor was it always appreciated that enlargement of text was not inevitably a help: recognition of individual eye conditions is a precondition to determining the optimal presentation of printed material.

Staff at RNIB New College -- and I have little reason to expect that the position is any different in any other school for the visually impaired -- spend a lot of time producing materials in large print. Technological advances have made this a real option for us: computer-produced text and laser printers with scalable fonts have combined to make this a real possibility. Of course it helps enormously for many pupils -- that is why we do it -- but I sometimes wonder if we are tackling the problem the wrong way round.

We will bemoan the dearth of useful large print for our pupils in their libraries, but perhaps when we do this, we neglect to insist that pupils should be struggling -- yes, it will be a struggle for many of them -- to gain access to everyday printed materials by means of closed-circuit television or low-vision aid. The real world isn't always going to stop to provide access in suitable large print...and we may unwittingly be disadvantaging our pupils by giving them the best that technology can produce!

Nonetheless, during my twelve years of teaching at RNIB New College, technological solutions have come along which have significantly improved the provision of printed material for pupils. We now routinely use of computers for creating text, either through directly keyboarding in text, or by using text scanned in from print. The use of Optical Character Recognition systems, linked to a laser printer with scalable fonts, has revolutionized text production.

In the first instance, it has led to more text being available: perhaps better, but certainly more. More of us spend more of our time typing in or scanning in text that ever spent our days brailling texts for Braille users. It is important to note that linking such texts (however created)

with a Braille translation program such as Braillemaster, means that print users and Braille users can be working from an identical text. That is no mean achievement, and is an absolute godsend for the teacher in the classroom.

Why should a laser printer with scalable fonts be used to provide the best materials? There are two points to make here:

i. the density of the text (blackness) is very good when using a laser printer, and does not lose too much in quality when photocopied;

ii it enables us to cater easily for individual print needs, through the capability of producing the same material in varying sizes and in either bold or normal print style.

The effect of this is to make it possible for the teacher to produce, from one source, the computer keyboard, a satisfactory text in Braille and a range of large print sizes to meet the needs of all the pupils in a class. The benefits of this are immense. Anyone who has watched pupils attempting to cope with examination papers which have been enlarged to A3 size to produce a satisfactory font size, will recognize the gains here. That such pupils did cope pretty well under appalling circumstances is a tribute to their tenacity of purpose, rather than to our satisfying their needs realistically (one might even say reasonably).

Access to Information by Pupils

The provision of materials for class use by the teacher is only the beginning. It does not yet begin to address the problems indicated by our CALIFORNIA mnemonic, but fosters a dependency culture, and doesn't encourage the pupil to encounter a wider world of information.

Our goal is to promote autonomy of learning. Bearing this in mind will always create within us a "divine discontent" with simply providing pupils with ready-made materials, important though these may be as starting-point. Study from audio-tape has long been a valued methodology among schools for the visually impaired, and it has been shown to be capable of enhancement. Newer technological changes are widening opportunities for independent learning. I want to discuss briefly here the development of the RNIB Electronic Newspaper system, the application of CD-ROM to the education of the visually impaired, and some applications of Optical Character Recognition technology, and to comment on our experiences with them at RNIB New College. It should perhaps be noted here that RNIB has recently reconvened its committee dealing with the whole topic of electronic publishing, recognizing that this is the way things are developing in the world at large, and that this may present greater and hitherto unimagined opportunities for access by the visually impaired to the same information as the rest of the population.

The RNIB Electronic Newspaper

Daily newspapers, a significant source of information for sighted people, are not usually available to blind persons except in tape-recorded versions; consequently, blind people's access to news is mainly dependent on radio, television and direct communication with other people.

Rubenstein developed a way of providing direct access to newspapers, using computers and telecommunications devices, and Linstrom reported this development to the IFLA Expert Meeting (Section of Libraries for the Blind) in 1987.[4]

By 1991 a team at the RNIB had developed a prototype of a Digital Daily Newspaper, which was designed to provide visually-impaired people with as full a text of a current daily newspaper as possible, in a form that they could access for themselves. Trial transmissions led to several changes being made. Now referred to as the RNIB Electronic Newspaper, the national launch took place on March 9th, 1993.

Digitalized newspapers have three elements: the process which formats and transmits the data, the hardware needed to receive it, and the software used to read the text. The British trials utilized spare capacity on Teletext transmissions, making national coverage possible. For the trial, the newspaper used was that of The Guardian. Its Managing Editor, Ian Wright, wrote that

> the Guardian was delighted to be invited to join the experiment. Between 1986 and 1990 (the Guardian) had itself undergone more technical change than had occurred in the previous hundred years. The whole process of the collection, selection and presentation of news, comment and analysis had become electronic.[5]

The Guardian's files consist of three elements: typesetting instructions, headlines, and the text of the stories. The full text of the newspaper, stripped of its typesetting instructions, is extracted from The Guardian's computer. This text is sorted into files: Home News, Foreign News, City, Sport, Features and Guardian 2 tabloid section. The digitized information is transmitted over the television network during the night, being received by a PC (modified by the installation of a decoder card) which is connected to the television aerial. To receive the text, it is necessary to install a PC with sufficient memory to store the program and allow for processing. RNIB New College agreed to take part in the trial transmissions, but had no suitable machine available. The generous gift of a Dell 316SX PC from Kays mail order company in Worcester, however, enabled the school to take part in the project.

The user is able to read the paper in a variety of ways, reading it in large print on screen, listening to the text, or reading a transcribed version (in either large print or Braille). Several days' papers can be stored on disc, and there is a facility to browse through back issues. Having chosen the issue required, and selected one of the file categories, the first headline is read by the speech synthesizer. If the user wishes to read that article, the down cursor is used to work through it at a self-determined rate. Options here are selected by choosing from a range of modes: article, paragraph, line, word and letter mode. We found that beginning with line mode gives the listener a reasonable idea of contents. Having listened to the information in line mode, repeating it in paragraph mode provides a more coherent picture of the whole article.

The most powerful feature of the system is its ability to perform searches, whether of the whole paper or one file. The user can search for a keyword in headlines only or in the whole text. The search facility allows searches to be made for up to ten keywords. Articles can be saved onto disc for reference or later use.

The trial transmissions tested various procedures. A number of refinements were made, although no radical changes were needed. The single most significant improvement was the addition of Teletext. Carmela Rosato and Cathy Rundle wrote their evaluation of the earliest trials in August 1990. They say that

> the system appears to have been very successful. The subjects have had very few problems in using it. All of them were able to use the system competently regardless of whether they had any previous keyboard or computer experience. Any problems which they experienced were relatively minor and easily solved. After six months, subjects are still very motivated and are willing to spend a considerable amount of their spare time using it. They are doing so on a very regular basis of between 1 and 2 hours. It is encouraging to see the very considerable amount of time they are spending on it at weekends (mostly around five hours) indicating that it is very much a part of their leisure activities. This is also very encouraging considering that the subjects all have full-time demanding jobs and have very limited spare time. Acceptability of the system thus appears to be very high.
>
> The results of the pilot trial so far are very encouraging, and seem to indicate that the service fulfills a previously unmet need. In the light of this evaluation, a full service would prove of considerable interest and use to many visually-impaired people and contribute a great deal towards improved access to information. [6]

Pupils at Worcester used the system mainly out of curiosity, and with no real desire to read The Guardian! They did not spend anything like the time indicated in the evaluation. Most pupils used it to read the sports pages. The Politics and Economics departments of the school found it useful: although the one day when the system failed totally was the day which carried the details of the Budget speech.

The biggest single criticism of the system by the pupils concerned the quality of the speech synthesis. Pupils used to hi-fi sound express intense dislike for the poor sound quality of the synthesizer. They are not alone in this. One adult user during the pilot transmissions reported that he

> (did) not use the system much because (he) hates the sound of the synthesizer and prefers reading Braille or listening to the radio. Does not tend to enjoy being read to anyway. [7]

The quality of speech synthesis with this PC was not significantly worse than that to which they were used in other situations in school, but it was of poor quality when compared with commercial sound sources, principally radio and television, audiotapes and music on CD. Quality of speech output needs to be improved if such a source of information is ever going to commend itself to those with high expectations of sound quality. This point is acknowledged by those involved in the project; Wright, for example, said that

> the present machines and the present software are both relatively primitive. The standard of speech reproduction must soon greatly improve.[8]

This is particularly important since, as Kelway says, "most visually-impaired people will use a voice synthesizer to output the text."[9]

One benefit of the system is its versatility. Having invested in the computer hardware and necessary software, the user is also able to use the PC for other purposes--word-processing and databases, for example. But other possibilities could be opened up:

> the decoder card which receives the newspaper data can also be configured to receive ordinary Teletext. Access could be provided to Teletext using a similar philosophy as the reading program to simplify learning and provide a comprehensive information system. Other newspapers could be included on the system to provide choice. Non time critical material such as monthly journals or specialist magazines could be sent out on disc and read using the same hard and software.[10]

Such access to teletext was incorporated in the revised system. It is important that visually-impaired people are introduced to new ways of gaining information, because information and communication will play an increasingly important role in our lives.

Electronic access to information is a concept that works, and may eventually become the norm in our society. What is new is that visually-impaired people will be able to access information in the same way as their sighted counterparts. This has been a long-term aim of many workers in the area. Wright touches on the gentle irony that the blind may be the first to benefit from the futurologists' dream of a day when

> very large amounts of information will be available...capable of being squirted down a high-speed line to a home computer (where the owner will) be able to select...what he or she wants to read, look at or even hear. ...This is the dream and it will happen well before the end of the century.[11]

If steps are not taken to ensure that the visually-impaired are encouraged to use new technology, then the implications for their full participation in society will be very serious. As new technology brings with it new forms of access to information, it is important that the visually-impaired should not be excluded. In 1984 Pumo warned that, "telecommunications, computerized production equipment and robotics pose serious threats as well as new possibilities to the employment prospects of the blind."[12]

This warning is repeated by Gerrey, Brabyn and Crandall, who observed that

> fax creates bit-for-bit facsimiles of documents that are being transmitted; no ASCII or text-based code is used in the communications. The modern trend of including fax as an uncoded form of electronic mail poses both a threat and an opportunity to visually-impaired persons' access to print.[13]

Graphical User Interfaces present similar problems, and it is good to note that work is already in progress to try to ensure that visually-impaired users can still gain access to material even when it is presented in a Windows-type environment.

CD and CD-ROM Technology

One of the most significant problems faced by blind pupils in gaining access to information is the physical bulk of Braille books. The Little Oxford Dictionary has sixteen volumes in Braille.

Where the sighted user learns to estimate whereabouts in the dictionary a word is likely to occur, and to open the pages accordingly, the Braille user must first discover which volume he wants, before beginning his word search. Worse is in store, however. The Little Oxford Dictionary presents words in their uncontracted Grade One form. A Braille dictionary ideally ought to serve as a guide to contracted forms.

A further disadvantage for users of Braille books (and of Braille reference works in particular) is that because they are expensive to produce, new editions are infrequent. The most recent Braille copy of the Guinness Book of Records in our library is 1975. A contemporary print copy is available: but this does not give the Braille user independent access to information. The National Library for the Blind has just published a Braille copy of the Oxford Children's Encyclopedia, in fifty-nine volumes. It is good to gain the benefits of independent access to current information in Braille: but the sheer size and cost is enormous.

"Talking Books" have long provided a source of access to print material for the blind. And students in higher and further education have been reasonably well served by, for example, the RNIB's Express Reading Service, which can produce work fairly quickly. There are limitations, of course, involving problems of graphs, diagrams, maps, charts, and photographs. The Cassette Library provides a range of serious texts for students and others.

But microtechnology is bringing about a variety of changes. From the point of view of producing written text, the blind pupil now has a range of options available to him, ranging from the simple conversion of his Brailled keystrokes into a printed hard copy, using the "Braille 'n' Print" machine, or a VersaBraille, which gives an ephemeral Braille display, but has the potential to produce a printout from an onboard printer, right through to a suitably modified IBM-PC. Most pupils at New College Worcester begin by using BBC computers, using Talking Wordwise software to enable them to listen to what they have written.

There have been a number of systems for computerized book production for several years. Allan Young (Head of Production at the National Library for the Blind) described the reasons for their move toward computerized book production methods. In the Library's Annual Report for 1981-82, we find the following paragraph which gives a fair indication of the then current situation:

> We feel that during the not too distant future, some at least of our own Braille production must be computerized. We wish to be certain, however, that the system adopted will be the best available for our needs and not only immediately but also longer term. Investigations are continuing.
> As a result of a survey and report by Dr. John Gill of the Research Unit for the Blind at Brunel University, London, in 1983, our present computer system came into operation in August 1984. [14]

Indeed, the principle governing the National Library for the Blind's approach to computerization was to ensure that once text was converted into machine-readable form (by one of several methods) the same document could be formatted by computer into Braille, large print or Moon type. That benefit (of producing identical text in multiple formats) has already been noticed above as a benefit of computer-generated text.

But technology does not stand still, and information is of course not confined to books alone. Gill had developed a system for producing an output of Prestel in Braille, providing blind people with access to information not previously available in a form they could read,[15] while Blenkhorn and Payne have described how Teletext has been made available to the visually-impaired.[16] Teletext is now also available through the RNIB Electronic Newspaper.

The only reference to newer forms of audio technology at the 1987 IFLA conference occurred in Leach's paper. He said that

> like other countries, Britain has tried to evaluate various media for the Talking Book. The current system has weaknesses...(and) it is only sensible to consider whether to change to the popular 15/16 i.p.s. system, or to standard cassettes, or to compact disc, or to some other system - or to persevere with the present one, doubtless improved.[17]

Here is an early indication that the increasingly popular Compact Disc (CD) might begin to impinge on the RNIB Talking Book Service. Friedlander has pointed out that

> domestic audio has seen the introduction of digital recordings in the form of compact disc (CD)...RNIB saw sufficient potential in the medium to investigate further. The conventional CD carries up to 75 minutes of stereo sound of hi-fi standard. This basic format was not appropriate for Talking Books because of the restricted playing time. After much technical discussion within RNIB and with those producing CD, a proposal was put forward which would enable a playing time of 12 hours to be achieved, albeit at a lower quality level. ...To extend the playing time, an efficient method of audio coding was developed...(which) led to a new form of compact disc, CDI (compact disc interactive). The resulting audio capacity would be ideal for a talking book. It is possible for a CDI disc to carry audio of several quality levels from full hi-fi downwards. Of particular interest is the level which would give a disc playing time of 19 hours.[18]

Even if we were only concerned with access to good text with good sound quality, it is interesting to note the recent start of a commercial series of "classics" of English literature on CD. At about three pounds per fortnightly issue, this sort of resource represents remarkable value. The capacity to store two CDs in a slimline case goes some way toward making access to a "library" of literature for the visually impaired a reasonable possibility. But it does raise in a particularly sharp form the question of who determines the access to material, since any selection implies a form of censorship.

Paul Thiele chaired a forum on "alternative information delivery systems" at the 1987 IFLA meeting. Papers were read about American radio channels for the blind, British radio programs for the blind, and Talking Newspapers, but of CD-ROM there was no mention. Yet it seems to some observers that the most developments in the education of the visually-impaired will come about through adaptation of CD-ROM technology.

CD-ROM is a method of storing and gaining access to information. It is a specialized development of the compact audio disc, using an optical disc to store computer text, graphics, sound and data. The application of CD-ROM to text is fairly recent, and has been introduced into mainstream schools with government funding. But, as Daly wrote in his preface to Maureen Quigley's NCET booklet, *Searching effectively: NERIS on CD-ROM*, "it will take a couple of years of widespread use to develop an informed and critical perspective of CD-ROM as an educational resource."[19]

Friedlander had noted that in its read-only form, CD systems contain provision for precise indexing facilities.

> The playing surface of a disc can be divided into 100 tracks, each having 100 index points. The first track on each disc is used as a lead-in, and one index point on each track is used for pause encoding. This leaves 99 tracks with 99 addressable index points...The CD index would lend itself to the easy location of the start position of titles where several are recorded on one disc.[20]

This ability to precisely locate text is clearly going to be very significant for blind users of CD-ROM. Recent experience with the Concise Oxford Dictionary on CD-ROM shows how this will work to the advantage of the blind user. The letter of the alphabet is selected from a menu, and then various possibilities are prompted: Aa, Ab, Ac.... The appropriate area of the disc is located directly, providing savings in time for the blind user.

If precise indexing is one benefit to be gained through CD-ROM, then another is the sheer quantity of text which can be stored. Megarry demonstrated the real scope, when she wrote that two CD-ROMs could store "all the telephone books of Europe,"[21] while Moore says that the entire catalogue of the Library of Congress would fit on three disc.[22]

The introduction of CD-ROM at New College Worcester in September 1991 came about as a result of an invitation to take part in a joint Open University and RNIB research project, "CD-ROM technology for blind and partially sighted learners: accessing the curriculum", which began in January 1992. By September 1992, the project sites had been visited twice, hardware had been configured, and software installed and modified as necessary. In the autumn term a training day was provided at each site.

CD-ROM has introduced a new dimension of direct and personally-controlled access to

information for blind pupils. As Mary Taylor reports, "the CD-ROM system gives control back to the learner. It gives access to all the original resource. The learner can decide which disc to use and the search strategy to adopt."[23]

CD-ROM also goes much of the way to solving the problem of bulk of Braille--the number of volumes of reference works, for instance. The Hutchinson Paperback Encyclopedia has been installed as a CD-ROM on the library computer to provide a simple reference work for pupils. Other discs include the Guinness Disk of Records, and a CD-ROM containing a dictionary, thesaurus, dictionary of quotations and much besides. Each disc contains the equivalent of many Braille volumes, and is more up-to-date. The most recent addition has been the *Oxford English Reference Shelf*, containing the full text of seven Oxford reference books, together with Shakespeare, the *Revised English Bible*, and (curiously) *Alice's Adventures in Wonderland*!

Becker[24] is particularly impressed by the *World Book Information Finder*, which contains the text of the *World Book Encyclopedia*. The on-screen outline of the topics contained in a box at the head of the article in the print version is present on the left hand side of the screen, and as the user advances through the outline, so the main body of text scrolls, with the currently-highlighted section being present to the viewer. Use of Hypertext links and Windows structures enable the user to cross-reference to other material. In addition there is a useful dictionary accessible to the user.

Friedlander argues that while the indexing facility of CD-ROM and CDI would be of immense benefit to students, the small numbers of discs involved would make their production uneconomical. He says that "RNIB has never envisaged CDI as being practical in other than the recreational talking book service,"[25] although Moore suggests that "reference materials are an obvious choice for CD-ROM technology."[26] It is perhaps important to adventure further into the world of electronic publishing, rather than being frightened in advance of its costs. We should note the development of electronic publishing by the Open University, with course materials now available to disabled students on CD-ROM. And commercial companies exist to press discs of home-originated materials. Initial costs might be high, but there might be subsequent economies to be made (time, cost of Braille materials, binding, replacement).

These new opportunities bring with them difficulties for library management, the problem which Levine calls "the lack of a critical infrastructure" for CD-ROM.[27] How does the user of an on-line database or a CD-ROM publication establish the comprehensiveness or the currency of the material? Is it up to date? What principles of inclusion or exclusion have been used? Such a critical infrastructure for CD-ROM is not yet in place, but it is interesting to observe that the problem is being addressed by computer software producers. A CD-ROM distributed recently by a computer magazine gave access to 500 megabytes of software systems: trial versions to advertise the real thing, in addition to several free pieces of software and utilities. This trend will no doubt grow; we may expect publishers' catalogues to assume this format in the not-too-distant future together with extracts or samples from the text, no doubt.

There is the further exciting possibility of transferring school course materials onto CD-ROMs for pupils to use. No doubt a costly idea at present - but we can be reasonably certain that the downward price spiral evidenced in other computer areas will take place in this area of CD-ROM authoring also.

It is significant that schools for the visually-impaired are now using developments in CD-ROM technology as soon as their sighted counterparts. The speed of development in this area is worthy of comment. The sequence of events at New College demonstrates this clearly. The CD-ROM drive had been seen at an exhibition in London in April 1992; the first review was read in the press in June; by July a CD-ROM drive had been installed and software was being evaluated; it was introduced and demonstrated to staff in September, and available for pupils in October.

Problems with Graphical User Interfaces

Much CD-ROM software utilizes the Windows 3 Graphical User Interface. Systems which operate through Graphical User Interfaces (GUIs) have been described by Dixon and Mandelbaum as being retrograde steps, having the potential to decrease accessibility to information on the part of the blind. They note that

> the command-driven character-based interface of the 1980s personal computer is in danger of being replaced by GUIs, which, according to Bill Gates of Microsoft, is now the

mainstream of PC computing and will be the better interface for computer users in the 1990s.[28]

GUIs are symbolic interfaces intended to improve the speed of communication between people and computers. Words are removed from the process of communicating with the computer, such communication being made rather by means of symbols or icons. The Graphical User Interface "represents information as familiar objects or visual images that are close to everyday experiences directly pertinent to the tasks to be performed. The primary device is the visual metaphor," say Boyd, Boyd and Vanderheiden.[29] Townsend, outlining the advantages and disadvantages of GUIs, notes that "the GUI lacks support for the handicapped. If you can't work a mouse or have visual problems, the GUI is very difficult to use."[30]

The problems arise from the use of icons, graphical representations of concepts, designed to reduce the user's need to rely on memorizing a sequence of commands. Even partially sighted users may find difficulties with the "windows", particularly when they overlap. GUIs have been developed to assist the sighted user; they significantly complicate the screen review that is critical to blind persons.

It is important that the problems of restriction of access through developments like GUIs should be acknowledged and faced. Neilsen, Pickering and Vella are clear what may be the cost:

> for many disabled people, computers offer the potential to increase independence and quality of life, and to reduce the degree of handicap caused by the disability. However, unless the disabled person has an effective means of controlling the computer, this potential will remain untapped and, in an increasingly computerized society, the result may be a relatively greater degree of handicap.[31]

Helen Petrie recently reviewed Burger and Sperandio's recent volume, *Non-visual human-computer interactions: prospects for the visually handicapped*, in the British Journal of Visual Impairment 11 (July 1993). Burger and Sperandio present a collection of papers from a meeting in Paris in March 1993. Petrie says that the topic of human and computer interaction was particularly timely, "because of the problems posed for blind computer users by the increasing use of graphics-based computing environments in place of text-based environments."[32]

Sperandio's own paper discusses developments in GUIs. Jane Berliss's chapter is entitled "*Software solutions to the problem of GUI inaccessibility to blind persons*" (pages 131-143). Petrie and Gill's recent paper, "*Current research on access to graphical user interfaces for visually disabled computer users*" in European Journal of Special Needs Education 8, 153-157) should also be consulted.

When CD-ROM discs were brought into use at New College, the system was run using Microsoft Windows 3, in order to operate the Hutchinson's Electronic Encyclopedia. But though the Microsoft Windows 3 environment, with its menu of icons, presents few problems to the sighted or partially-sighted user, the blind user is perhaps better served by a keyboard approach. One day, however, the totally blind user may be able to utilize the icons directly, using what Boyd, Boyd and Vanderheiden call "interception-based access software."[33]

CD-ROM has solved one practical problem, indicative of the way in which things will develop. In July 1991, the RNIB indicated that Braille copies of Shakespeare's *Measure For Measure* were unavailable, and unlikely to be reprinted in the near future. It was decided to use this as a test of the usefulness of CD-ROM in text production terms. The CD-ROM disc of Shakespeare's Works was purchased and installed. The text of the play is conveniently presented in files each containing one act. The text was copied to floppy disc and translated into Braille using Braillemaster software. The resulting transcription proved perfectly satisfactory. The advent of CD-ROM technology for the English department has meant a liberation from slow, uncertain and expensive Braille production, resulting in in-house customized copies, as and when required. Since storage of Braille volumes has always been a headache, there is some relief available in this area too. Simpler and cheaper electronic publishing of texts on computer discs are also making a similar contribution to the library stock and to the English department.

Methods of access adopted for users will vary depending on their residual vision. If they are able to make use of the VDU screen, then that is available to them. It is expected, however, that most pupils will use CD-ROM through speech synthesis. The same problems of quality of speech

synthesis exist here as they do with the Electronic Newspaper, but it is hoped that the user will find that the quality and range of information available will outweigh the present disadvantages of the speech synthesis.

The NERIS database on CD-ROM has also been installed on the library PC. The school had been a subscriber to NERIS, but it was very little used. The instant availability of the data on CD-ROM has proved to be very useful. Shirley Matthews noted that the NERIS database

> was designed primarily as an information service for teachers, advisers, librarians and educational support services in general. However, in schools, the database has also proved to be a valuable source of information for pupils and provided useful information for geography, environmental and scientific topics[34]

The NERIS material was demonstrated to various teachers, by choosing a topic and exploring the database to find suitable work sheets or a piece of usable material. Material suitable for GCSE and Advanced level studies was particularly focused upon. This was printed, and its usefulness discussed with the teacher. In several instances, it was also discussed with pupils. It was stressed that, while NERIS is primarily intended for teachers, pupils would be welcome to explore its resources for themselves. In some cases, pupils worked co-operatively: one with some sight operating the mouse and searching using the VDU, discussing possibilities and materials discovered with others. Suitable material was then transferred to floppy disc. The purpose of transferring to disc from NERIS is to permit editing of the text. Editing permits the removal of redundancies, and any necessary re-formatting can be done at this stage.

One feature which I have found useful when preparing text for Braille users is the numbering of paragraphs, which can be added at this editing stage. Acknowledgements of source, author and publisher are added at the end of the article, before being translated into Braille and produced for pupils' use.

It is one of the educational tragedies of the 1990s that, just when NERIS was proving to be really useful because of its availability on CD-ROM, the government removed the funding that made the service possible.

Optical Character Recognition Systems

In 1912 Fournier d'Albe recognized the potential use of a phenomenon exhibited by Selenium, its variable conductivity in relation to different amounts of light. By 1914 a device called the Optophone had been produced. Light was reflected off print on to a selenium bridge. This in turn produced a series of five musical notes. By learning the chords, scales and discords the blind user was able to "read" the print. The literature abounds in references to other early attempts to develop machines that would read print, especially from the 1960s and 1970s, with devices like the Battelle aural reading device and Topaz's "photo stylus", the Stereotoner and the Visitoner. (30) The most significant work done during the seventies, however, was that done by Raymond Kurzweil, whose research work on algorithms to recognize patterns or type letters led him to develop the Kurzweil Reading Machine, demonstrated publicly for the first time on January 13, 1976. Evaluations of the machine in Britain were undertaken by the RNIB and St. Dunstan's. Such Optical Character Recognition systems are now an immensely important factor in access to information for the visually-impaired.

Optical Character Recognition systems were lucidly described by Converso and Hocek as being systems which "translate printed material into an electronic format that can then be stored and processed via a computer monitor, a printer, or an adaptive device like a speech synthesizer or Braille display."[35]

The components of a complete Optical Character Recognition system are a scanner, an OCR card, additional disk-based Optical Character Recognition software, software to manipulate the recognized text, output devices, and a PC.[36]

Cost would inhibit most individuals from purchasing such optical character recognition systems without help, but several machines have been installed in public libraries. The cost of the new generation of machines is decreasing somewhat, bringing such machines within the realms of contemplation. Such a device offers an effective route for generation of Braille and large-print text, and the use of an optical character recognition system to scan text for computer translation and

production may become the optimal route for text production. The National Library for the Blind is now using scanning for producing many of their books. Although such a machine would no doubt generate its own work, it might be feasible to operate a service regionally, perhaps augmenting the Braille service operated by several of HM Prisons. Such a method might facilitate better support of visually-impaired pupils in integrated settings, where the mainstream school cannot afford a scanner for one or two pupils alone.

RNIB New College acquired an Optical Character Recognition system in 1993: the Arkenstone Open Book system. It is clear that in subjects which use text predominantly, the Optical Character Recognition is becoming an invaluable tool. Typically, the text is photocopied (often enlarged to 115%) before scanning. Text to be scanned is placed on the scanner patten, and the SCAN option selected. When text input is completed, choices are made from a menu. After conversion to ASCII code, the text is saved onto the hard drive, and can then be exported to a floppy disc, for review and editing in a word-processor.

The raw scanned text often needs considerable attention. The results of optical scanning depend largely on the quality of input text. Battered typefaces or display fonts present problems, as does layout in some instances: banner headlines over double or triple-columns, for instance, or text which incorporates boxes of additional information--often white text on pastel colored panels. Spell-checking does help, but it alone cannot solve all the misreadings.

While checking scanned text for errors, the option also exists to modify the text: revising American spellings, deleting superfluous material, adding explanatory notes, or incorporating up-to-date information or figures. The final text can then be processed in a variety of ways. Large print can be generated by using scalable fonts on a laser printer, while Braille is generated through translation (using such software as the Braillemaster program) and a Braille embosser. Although at RNIB New College the Technical Resources Assistant prepares a certain amount of material using the scanner, a number of teachers have quickly learned to become proficient in order to produce their own materials. Thought the process can be time-consuming, particularly if the original material is poor in clarity. It is still seen to be a practical way of producing a wider range of Braille and large print materials than could have been contemplated using direct hard-copy brailling or existing transcription services.

This extension of the range of Braille material available seems to be the greatest benefit of scanner technology. Visually-impaired pupils do not live in isolation, even in residential school settings. They have families and friends, and want to read the same sort of things as their sighted companions. Scanning must be the first choice for straightforward literary text, even if scientific and mathematical material is still a bit beyond its capabilities. The Optical Character Recognition system at New College has coped impartially with Latin poetry, Chaucerian English, sociology and economics textbooks and University prospectuses.

The problems of Braille hard text production are readily solved in a residential school for the visually impaired, but may be much more difficult in the wider world. I return again to the concept of a regional or sub-regional facility which would be able to prepare Braille text from a customer's own disc: perhaps local Associations for the blind, or schools for the visually impaired, or the Prison Braille Units.

Since Optical Character Recognition systems are designed to function as personal reader, with speech synthesis available, they can be used to provide direct (independent) access to printed matter. It is a matter of great joy that a number of such machines are now available through the Public Library Service up and down the country. Optical Character Recognition systems are thus seen to be a tool which will restore to the visually-impaired their independent control over personal affairs: a tool which will enable them to realize their own personal vision, to become capable autonomous learners, information finders, organizers, redeployers, not information aliens in an information-overloaded world.

Improving Study from Tape

Because of the cumbersome and expensive nature of material in Braille, there has been a long tradition of providing recorded materials for the blind. The American National Library for the Blind began providing recorded material in 1931, while in Britain the Nuffield Talking Book Library began operations in 1935, for example.

Talking Books are not the only system providing recorded material for the print-handicapped. While the RNIB's TBS provides mostly fiction and popular works, its Cassette Library is the main provider of academic, professional and non-fiction works, with some twelve thousand titles available, increasing by some twelve to fifteen hundred titles annually. These tapes use the standard compact cassette form, in either two or four-track format for new material, and two-track for older tapes. Other sources of recorded material include voluntary and statutory bodies, in addition to commercially-produced materials for both leisure and academic purposes.

The audio departments of local libraries now provide access to records, audiotapes, CDs and videotapes. Many libraries also support local Talking Newspapers, aimed principally at the print-handicapped but also at other physically handicapped users. From their beginnings in Aberystwyth in 1969, there are 500 such Talking Newspapers in Britain in 1993. Local Talking Newspapers contain local information, but have two drawbacks: the time taken in recording and distribution; and the problem of unwitting censorship of material. Nonetheless, it is evident that the service is meeting a need.

In addition to information on Talking Newspapers, many commercial, local government and national concerns are making consumer information available on tape. Tobin and Hill's 1984 survey of the needs of the blind in Birmingham found that "considerable interest was expressed in having information available on cassettes."[37] Braille literacy among the elderly blind is not high; if information is to reach them, it must be available in an accessible form.

The user of recorded material would appear to be relatively well provided for. But is this wealth of material used? The evidence of borrowing from collections is that the service is in demand; both from the RNIB's Cassette Library using ordinary cassettes and from the TBS which uses a special format for its tapes. There are 70,000 members of the TBS. RNIB has recently identified the specific needs of the Asian visually-impaired population in this respect: launching a Talking Book Service in Hindi in April 1992.

Parkin and Aldrich have published a number of papers dealing with various aspects of studying from tape, beginning with their survey of visually-impaired students using the RNIB Cassette Library. Their most striking finding was how unprepared for aural study the students in the survey had been.

> Although 57% had received special education, it is notable that very few had studied from tape prior to beginning their tertiary studies. Moreover, only 2 members of the sample had used an American Printing House (tape recorder with pitch-correction facility) at school, although this is the most popular tape machine among visually handicapped students in tertiary education.[38]

The research showed that, though regarded as blind (with 73% Braille literacy), 50% of them were able to read large print. The practical consequence of this is that there would appear to be some merit in providing the tape sets with large-print contents leaflets, since one practical problem in using taped materials for study is finding particular sections on the tape: a problem considerably exacerbated by multi-tape sets. This is reinforced when we note that 36% of the sample use print as their commonest source of information, while 25% listed the Cassette Library as their most frequent source of material, and only 10% said that Braille was their main source of material. The comparatively infrequent use of Braille, despite the high incidence of Braille literacy in the sample, reflects the fact that Brailled material is often not available or at least not available quickly enough to be useful.

One of the questions debated among producers and users of taped materials concerns the acceptability of recording parts of books. Traditionally, the policy has been to record complete works only. But where texts are being used for study and reference, we might question this policy.

Many sighted students will read only relevant sections: and we should expect that blind users of tapes would probably want to do the same. The survey showed that 30% needed to read less than a half a book. Parkin and Aldrich make the point that

> as publishers adopt more modern technology the speed at which books appear will increase, and existing texts would become redundant faster. The recording of whole books would seem to be increasingly counterproductive.[39]

They also explored two other topics: the benefits of accelerated speech and of active listening strategies. Their work indicates that improvement in listening and learning skills is possible. They summarize the problems of studying from tape this:

> listening to a tape recorded text places far greater demands on memory and attention capacity. While listening to a tape the listener is essentially passive and for this reason their mind may wander and miss an important point.[40]

They point out that researchers have become increasingly interested in "active listening" techniques, which aim to engage the listener more and, in so doing, improve their retention of information.

Hartley has done some very interesting work on effective tape production.[41] Observing that we know surprisingly little about how to produce effective audiotapes, he took the considerable literature on print text design as the basis for an investigation into whether text-design principles could be transferred to audiotape production. He notes that text layout uses a range of devices: summaries (overviews, interim reviews), headings (primary, secondary and tertiary), and sequencing (logical, hierarchical and numerical, both simple and complex) to aid the reader. Emphasis is achieved by a variety of strategies: bold typeface, italics, underlining, color and boxes. Readability is an important factor with short sentences, active voice and simple vocabulary promoting comprehension.

Hartley suggests that taped material for study should

i. employ different voices for summaries;
ii. employ change of pace or tone for headings;
iii. use a different reader for questions; and
iv. use 2 or 4 track machines, enabling pupils to record answers on one track and compare them with model answers on the other track.

These insights are related closely to programmed learning techniques. He also suggests that research should be undertaken into indices of listenability.

The Future of Braille?

What I have been saying about the immense and ever-increasing amount of information, much of which will now be accessible to the visually impaired through electronic publishing media, begins to raise some questions about the continuing utility of Braille.

I have come to believe that, in terms of information (particularly ephemeral material), Braille production has probably ceased to be the best means of communication for the visually impaired. Monthly magazines are an interesting example. RNIB has been thinking for a long time about producing a magazine for computer users. One concern about magazine production, inevitably, is the Braille production capacity which it takes up. But here, we might think, is an obvious candidate for abandoning the very thought of production in Braille at all. A magazine for computer buffs - surely here is a golden opportunity to experiment with its production on disc. Targeted at people with an interest in and almost certainly access to computers, for whom RAM, ROM and FLOPPY hold no terrors, such a magazine could surely be issued on electronic format, which could then be accessed by speech, by large print on-screen, by printing in large print, or even dumped to Braille locally through organizations with Braille embossers--the local library service, or school for the visually handicapped, perhaps, serving a wider constituency. Don't get worried about whether such a magazine should be on three and a half or five and a quarter inch discs--these are just technical red herrings which paralyze our ability to move on into the electronic future, but they are not insoluble problems.

If we consider the economics of Braille production of magazines, it seems clear that supplying me with several copies of magazines (*Fizz, Weekender, Radio Times*, for instance) through the post may no longer be the best way of producing and distributing the material. One floppy disc would permit me to generate as many copies as I need, at point of distribution: and also to archive the material satisfactorily, if that was what I wanted to do with it. As it is, I rather suspect that

the Braille copies which come into school are read once or twice, and then feed the local recycled paper bank. I wouldn't mind betting that the local post office would be delighted at handling less Braille in bulk; and we could be demonstrating a wider ecological responsibility by reducing Braille magazine production...well, it's a thought!

This only makes much sense, of course, when applied to material produced in Braille by RNIB. But what about the thousands of bits of paper that will never begin to be Brailled for the visually impaired user? We need to recognize the impossibility of the task. Some organizations may make strides in this direction--banks with Braille statements, the National Trust with Braille guidebooks for some properties, and so on.

But perhaps the most signal disadvantage of Braille as a communicative medium is its inherently unidirectional character. Perhaps a story shows this most clearly. When I came to teach at Worcester, I fully expected that Braille would be an important medium in the pupils' lives. I had to learn the code, master the quirks of the Perkins, thermoform material, read and write in Braille for all sorts of purposes. The pupils did their best to read the stuff I wrote for them. But as a housemaster I was struck by the lack of incoming Braille for my pupils. Nobody wrote to them in Braille except RNIB! *Their own parents did not write to them in Braille, and certainly not their friends.* They all spent much of their lives on the telephone. That was the answer. Parents had not learned to use the Braille code to write to their children, not simply because they didn't have a Perkins, but because there was no real point. Anything they wanted to say could be said more easily, more directly, quicker by telephone. Braille, it seemed to me, was almost entirely equated by these pupils with learning in school, not with living independent lives.

Indeed, they were doing what many of the rest of us do--phoning for taxis, dialing for their pizzas, listening to telephone information lines, ringing the station for information about times of trains, using Directory Enquiries...not bemoaning that the timetable wasn't available in Braille! They were using everyday technology to meet everyday needs. Indeed, if we were to award a prize to the piece of equipment which has done most to promote autonomy for the visually impaired, it would have to be awarded to the telephone, with perhaps the cassette tape recorder a very close second. The evidence available to me suggests, however, that they are not making very much use of such systems as Teletext, perhaps because we are not encouraging them to gain independent access through speech output.

Braille has served the blind community well for over a century and a half: but we have to ask serious questions about its abiding utility in the electronic information age. We must continue to promote Braille literacy - don't for one moment imagine that I disparage its usefulness in some circumstances, but we should put considerably more effort into promoting communication skills which involve keyboards and adaptations of existing communications devices rather than continuing to promote Braille as the only respectable means of information input and output for the visually impaired. We may concur with Carbonneau, who observed that

> just as Louis Braille gave a sightless people a new dimension in life - a wealth of knowledge once limited to people who could see - the Information Age as seen through the computer will bring a new dimension in helping the blind individual realize his fullest potential.[42]

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