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J M Gill, L L Clark & E Foulke

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Contents

Braille Learning: Further Experiments

Slater E Newman and Anthony D Hall
Department of Psychology, North Carolina State University
Raleigh, North Carolina 27695-7801, USA

We have recently completed three experiments in which the effects of discriminability among a set of braille symbols on learning their names has been studied. Although discriminability has been shown to be among the more powerful factors which affect learning when items are presented visually or auditorily (Kausler, 1974) no comparable finding exists for haptic presentation (Baddeley, 1976; Schiff, 1980). Perhaps most closely-related are the findings by Millar (1975a; 1975b) that short-term memory for haptically-examined braille symbols is a direct function of their discriminability.

In the first experiment the discriminability among the items in each of the two sets of braille symbols was determined. A 2x2 between-subjects design was used in which the variables were stimulus set (A-J or K-T) and item size (standard or large braille). Subjects (N=72) were given a discrimination task comprised of 60 pairs of symbols from one of the two sets. Each symbol was presented for haptic examination for 5 seconds and the subject reported whether the second symbol was the same as the first. Analysis of the data for number correct showed that the effect of stimulus set was significant ($p<.001$) but stimulus size and the interaction were not ($p>.05$). More correct responses occurred for the items in the A-J set.

In Experiment 2, subjects learned the names for the symbols A-J or K-T. The effects of a second variable, order of the items during study trials, was also studied. Again a 2x2 between-subjects design was used, the variables being stimulus set (A-J or K-T) and study order (alphabetical and constant, or nonalphabetical and varied). All test orders differed from all of the study orders. Subjects (N=64) were given five trials to learn the names for 10 braille symbols. On study trials each item was presented for 10 seconds for haptic examination along with auditory presentation of its name; on test trials the subject examined each item haptically for 10 seconds and responded aloud with its name. Analysis of number correct gave a significant effect for stimulus set ($p<.001$) but not for study order or the interaction ($p>.05$). Many more correct reponses occurred during learning the names for the A-J items than for the K-T items.

Experiment 3 was done to determine the extent to which item discriminability, response availability and associability between each item and its name contributed to the faster learning of the names for the A-J items. A 2x2x2 design (N=96) was used in which stimulus, response and associative factors were manipulated in the following way: For the stimulus factor, either the symbols for A-J or for K-T were used. For the response factor, the letter names for the A-J and K-T stimulus sets were either crossed or not crossed between stimulus sets. Finally, for the associative factor, the letter names either were or were not randomly associated with stimuli within each set. In all other respects the procedure was similar to that of Experiment 2 except that subjects were given 3 instead of 5 trials. Analysis of number correct during training gave a significant effect only for the stimulus factor ($p<.001$). As in Experiment 2 there were many more correct responses during learning the names for the braille symbols for A-J (no matter what they were called) than during the learning for the braille synbols for K-T.

Analyses of errors were done in all three experiments. In Experiment 1 (a) there was within each set a tendency for those items with fewer dots to be more discriminable and (b) errors were just as likely for pairs of items with a different number of dots as for pairs of items with the same number of dots. In Experiments 2 and 3 (c) item difficulty was directly related to the number of dots comprising the item (d) confusability among a pair of items during learning was directly related to the number of errors involving that pair during the discrimination task of Experiment 1 and (e) when errors were made during learning the A-J items, the subject was more likely to respond with the name of a symbol having the same number of dots as the stimulus than with the name for a symbol having either more dots or fewer dots; for the K-T items however there was little difference among these three kinds of errors.

The results of these experiments are similar to those obtained in studies in which items have been presented visually or auditorily, and demonstrate that discriminability among items plays an important role in learning their names. Discriminability was not, however, affected by item size, nor was rate of learning affected by the order of the items during study trials nor by what the items were called. The results for item difficultly (see c above) and for confusability during learning for the A-J set (see e above) were like those we have obtained before (Newman, Hall, Ramseur, Foster, Goldston, DeCamp, Granberry-Hager, Lockhart, Sawyer and White, 1982) in which only the set, A-J, was used. Neither the confusability results for A-J nor for K-T, however (see e above), are like those obtained by Nolan and Kederis (1969). As we have mentioned previously (Newman and Hall, 1981) it seems likely that these between-experiment differences in outcome are attributable to differences in procedure between their experiment and ours.

We are continuing our research on learning and memory for braille. We have completed experiments (a) on the effects of item size during study and test on learning, and (b) of immediate recall of braille symbols as a function of retrieval conditions. We hope that the results of these experiments will contribute to our understanding of the role of item discriminability in braille learning.

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Asymmetries in Spatial Resolution at the Fingertip

Eugene C Lechelt
Department of Psychology, University of Alberta
Edmonton, Alberta, Canada T6G 2E9

Introduction

Discrimination of spatial properties of a stimulus or stimuli are known to be influenced substantially by the inherent properties of the stimulus as well as by their spatial relatedness. One particularly well documented instance of this is known as spatial anisotropy which refers to increased perceptual sensitivity and preference for stimuli as a function of their orientation. Specifically, numerous studies have shown discrimination of stimuli in vertical and horizontal orientations to be more acute than discriminations in oblique or diagonal orientations. This occurence is known as the "oblique effect" and has been thoroughly reviewed by Appelle (1972) for the visual modality.

A study was conducted to investigate perceived stimulus spatial asymmetries, ie the "oblique effect", when employing passive tactile stimulation to the fingertip presented in a dynamic mode.

Method

Seven sighted subjects, and one congenitally blind and two partially blind were tested. An Optacon was used to present the stimulus material to each subject. Stimulus line orientations were professionally prepared and fitted in the apparatus so that when the camera was positioned and focused appropriately they were uniformly presented to the central portion of the tactile array. Four stimulus orientations were used as standards: vertical, horizontal, right diagonal, left diagonal. Only one standard orientation was tested during an experimental session. A trial consisted of two sets of two lines. For all conditions, three of the lines were of a standard stimulus orientation and the other was at one of several comparison stimulus orientations. Each line activated the tactile array for approximately one second with a one-half second intrapair interval and a one and one-half second interpair interval. This mode of stimulus presentation is typically referred to as the "Times Square" mode in that the stimulus "sweeps" across the tactile array.

A two-alternative forced-choice paradigm was used in that subjects were asked to report which set of lines (1st or 2nd) had a stimulus orientation which was not at the standard orientation for that condition. For the vertical and horizontal standards, eight comparison orientations were used: 2.5°, 5°, 7.5° and 10° in either direction of the true horizontal and vertical. Similarly, for the standard diagonal orientations, 5°, 10°, 15°, and 20° deviations in either direction were used. Hence eight deviation (comparison) orientations were tested against each of the four standard orientations. In an experimental session, each of the deviation or comparison orientations were presented once at each of the four possible stimulus line "locations". Subjects served in each of the four standard orientation conditions ten times according to a randomized schedule.

Results

A substantial but equivalent oblique effect was found for both sighted and visually impaired observers, ie orientation deviations from vertical and horizontal orientations were substantially more accurately discriminated than deviations in orientation from right and left diagonals. Although perhaps surprising to find this effect on such a restricted sensory surface, it is of theoretical interest in that it is consistent with visual and haptic data (Lechelt and Verenka, 1980). At an applied level, these results have implications for the training of users of the Optacon as a reading aid of "visual" printed material in that a major factor in letter recognition errors might well reflect differential tactile resolution of a stimulation configuration as a function of its inherent orientation components.

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Braille Services of the South African Blind Workers Organisation

E J J Kruger
Braille Services, 102 8th Avenue, Mayfair 2092
PO Box 45129, Mayfair 2108, South Africa

The S.A. Blind Workers Organisation is a selfhelp movement of blind people operating on a national basis in South Africa. One of its main activities is the printing of braille by a special department called Braille Services. As this country is multilingual, eight different braille codes are at present being used. Braille is also produced in uncontracted braille for some languages. Braille Services is the only braille printing press to cope with this gigantic task to provide blind braille readers with braille in their own vernacular.

Ever since the Conference on Computerised Braille Production held in London in 1978, Braille Services worked on a project to convert its manual production to that of using computers. It was not only a matter of acquiring the hardware but the most difficult part was to create software for seven indigenous languages - English presented no problem as software was already available for British standard braille. With the aid of a South African University and a student in computer science, this problem could be solved after an extensive training tour to the USA, England, Germany and other countries on the continent of Europe. Braille Services eventually settled for the hardware provided by Triformation Systems of Stuart, Florida, USA and the software provided by Joe Sullivan of Duxbury Systems. The first hardware to arrive during 1981 was the LED 120 together with supporting North Star computers and inkprinters. The PED 30 arrived during March 1983. With this new equipment and technology Braille Services became the first braille printing press in South Africa to convert its braille production from manual to computer.

Research and development fortunately did not stop at this point in time. It was only the beginning to many new horizons. Existing hardware and software had to be updated to keep abreast with developments in computer technology. The next stop was to find or design equipment or interfaces to enable Braille Services to make use of computer data already kept in store by publishers. With the aid of engineers from the General Post Office Telecommunication and Electronic Institute this problem was solved. With the aid of the Corona computer and its multimate package software, data stored by other computers and word processors could be transferred with very little additional editing. This "Crosstalk" facility opened a new world to our blind people by gaining fast access to newly published material.

With the aid of a "connect up" tape machine, computer data stored on disks can now be transferred to magnetic tape and then to our computer installation for virtually immediate translation into braille.

Special software had to be created to delete unnecessary computer entries not applicable to braille production. A close liaison is thus now being established between Braille Services and publishing houses to draw on their computer data store.

Another major breakthrough we recently achieved was to build a special interface to convert a Deutsche Blindenstudienanstalt manual stereotyper to computer drive. With this advent Braille Services virtually doubled its capacity for braille plate embossing. We also make use of the Perkins manual machine for transcription and duplication on Brailon on the Thermoform Machine. For diagrams and graphics we use the Minolta three dimensional duplicator operating on capsule paper.

As South Africa is a developing country and a multilingual society the braille reading blind community is comparatively small. We have some eleven schools for the blind and partially sighted children and Braille Services is responsible for providing eight of these with their braille needs. We serve, amongst others, English, Afrikaans, Zulu, Xhosa, North Sotho, South Sotho and Tswana. Venda has only just received its own braille code and will require braille literature in the near future. We also print uncontracted braille in thr Kwanyama language spoken in Namibia. The demand for braille, especially for educational purposes, is increasing so rapidly that Braille Services has no other choice but to employ the most up-to-date computer technology in an effort to keep abreast with the demand

HX-20 with Braille Devices

D Weygand
Fondation pour la Readaptation des Deficients Visuels
3 rue Lyautey, 75003 Paris, France

We have chosen the HX-20 microcomputer because of its numerous qualities combined with a small volume. The programs we did were done in order to allow blind persons to program, and to do various performances, either with the VersaBraille or independently.

The operation by blind persons of the HX-20 alone is rather limited (taking down of notes in large quantities, for instance); but for sighted transcribers, it may be used for transcription in Grade I or Grade II braille and for text input. Our software enables text processing and storage on cassettes, editing as well as connecting HX-20 to VersaBraille or to a printer. Connected with the VersaBraille, the HX-20 reveals to be a very efficient instrument.

The HX-20, when connected to the VersaBraille, creates an interdependence for these machines. This permits blind people to program in Basic or machine language as efficiently as sighted people. Besides, with the programs, you are provided with functions allowing you to re-organise chapters already written in the VersaBraille; such as blocks transfer or blocks introduction, change in a chapter organization, etc. Lastly, the HX-20 is supplied with a Braille keyboard which may take the place of the standard keyboard with a simple change of mode, this either for programming or for management.

When the available terminal cannot be a VersaBraille, the commands destined for the VersaBraille may be cancelled.

HX-20 Specification

The main features of the HX-20 portable microcomputer are:

- 2 processor sets, master-slave kind,
- memory size: 16 Kbytes, extendable to 32,
- 8 Kbytes ROM or EPROM introduction possible in an internal socket. 2 ROMS or EPROMS may be introduced into the memory expansion,
- built in microcassette and microprinter,
- 4 lines of 20 characters LCD screen,
- to the AZERTY or QWERTY keyboard are added programmable function keys,
- RS-232 I/O for external screen and diskette driver,
- junction plugs for bar code reader,
- a battery supply enables an autonomy of 50 hours maximum,
- programming in Basic language (Microsoft) and in machine language (microprocessor 6301).

Software developed for a blind user

1. Double keyboard: With a simple flip of a switch, one may pass from AZERTY or QWERTY standard keyboard to the braille one, which uses but 7 keys of the original keyboard. Also included are complementary keys which such as "carriage return", "control", "shift", "graphic". All Epson keys are non-functional at this time. In this mode, when the keys are released the character is stored in the memory, allowing a security of stoke. The displayed

characters are standard ones, but the Braille characters displayed by dots appearing on the screen is done for sighted transcribers who can read the Grade II braille.

2. Communications with a braille display terminal such as a VersaBraille, or with any braille terminal, or with any standard or braille printer using RS-232 interface. Programs in Basic or machine language can be transferred from the terminal to the HX-20 or from the HX-20 to the terminal. This increases editing capacities by permitting writing in "local" (eg 1 page of 900 characters in the VersaBraille), then transferring it into the HX-20 memory. Inversely, you may store software from the memory onto a cassette or onto any other support.

You may have an image of physical screen (LCD) or of the whole virtual screen at any moment. This image, which is the exact copy of VersaBraille, enables you to read the virtual screen contents quickly and eliminate the consecutive blanks, but you may require several VersaBraille pages. The physical screen copy is carried out in two ways: In monitor mode (in which the HX-20 uses the LCD screen only without cursor care), the screen is then copied without the needless blanks; in basic mode or generally when virtual screen is used; in this mode, the LCD screen is copied in full, and when the used terminal is a VersaBraille, its cursor depends on the LCD screen cursor. When you have set the HX-20's line length of virtual screen to 20 characters, the cursor will, after the copy, come back to the HX-20's cursor position and will follow the horizontal and vertical movements manually ordered. When the HX-20 is in insertion mode, the insertion code is received by the VersaBraille, as well as when the deletion is effected, it takes place at the same time on the LCD screen as in the VersaBraille. To avoid any search, VersaBraille receives two preliminary commands with any request for a screen copy: "top of page" and "page deletion", but you may cancel these commands if you wish to keep the succeeding pages.

Thanks to this interdependance, a blind programmer may fully use the HX-20's editing capablities; moreover, he may use indifferently and without commutation, the VersaBraille or HX-20 keyboard with, on the HX-20, the advantages of automatic repetition of screen and cursor keys. All these commands may be sent from the VersaBraille without automatic repetition, and with a double stroke for control characters.

3. Application software concerns text processing and text editing onto a printer or a VersaBraille. They allow to re-set pages or chapters in the VersaBraille. In the writing mode, the text is set in the HX-20's virtual screen, the dimensions of which are presently 153 lines of 20 characters each or approximately 3060 characters. The number of lines will be increased in the future, because of loading into the EPROM of all programs written into the assembler. The processing possibilities are these of the HX-20's editor including insertion, deletion, and tabulation.

When you reach the last 50 characters, you will hear a sounding signal with each stoke which is issued in order to signal that you are at the end of a page. If you have already reached the end of your page, the text will be automatically copied in the text buffer and the number of characters will be displayed. The page created in this way may be either saved onto the microcassette, printed, or transmitted to the VersaBraille.

The protection on cassettes is carried out by blocks of one page each and of varying length. Thus in order to save the tape, each page must be entitled and all titles gathered in an index which will be registered in the tape page No 0. In addition to each page title, you will find in the index the references nescessary to re-read the tape. The present maximum number of pages is 13 but will be increased in the future. A microcassette's maximum capacity is 50,000 characters per track. When a page has been created or re-recorded on the tape, the index is automatically brought up-to-date before any change of software.

The last text remains in memory up to the moment that deletion is commanded. The re-reading of a page recorded on the tape may be done in writing the page title which, after "carriage return", is displayed with its counter reference; one "Control C" starts the search and loads the page into the buffer. With a simple touch and if necessary, the buffer will be copied onto the virtual screen and the text may be read again or corrected.

The configuration control editing program enables to fix the text printing parameters including number of lines, number of columns, end of line characters (CR or CRLF), and transmission parameters. When the same printer is often used, its parameters may be memorized and printing may be started by pressing one of the function keys.

The configuration control editing program also comprises options destined for the VersaBraille. For this one, the number of lines and columns is fixed to 0 and both the number of characters per page (from 1 to 900, 850 by default) and the number of pages (from 1 to 200) are considered. This last parameter is useful when you wish to transfer a text into a chapter which was already created in the VersaBraille. This enables one to avoid overstepping and thus to lock transmission. In this particular case it will, every time that the VersaBraille changes a page, activate the cursor of the VersaBraille on the following page. If the transfer is being done on a new chapter, this parameter is no longer in use, as the VersaBraille's cursor is automatically re-set at the time of the passage to the following page.

In addition to the number of characters programming per page, if the text transmitted to the VersaBraille comprises "graphZ" characters, these are converted into a "Page advance" command for the VersaBraille. Thus, when using the HX-20 one may include, if one wishes to take down notes, commands destined for the VersaBraille while the copy is being made eg changes of pages, paragraph symbols, new chapters and so on. Therefore, the "braille keyboard" mode permits the HX-20 to send these codes in using the "control" key in the lower case mode. The ordinary control characters may be sent by means of the "control" key, but in the upper case mode.

The "number of pages" parameter of the text editor is also used to get the VersaBraille cassette ready in automatically reserving by chapters, all containing the same number of pages; cassette preparation may thus be automatically effected.

The RS-232 interface of the HX-20 is very easily programmable in pressing the appropriate function key and in introducing the five necessary values with the keyboard: speed (110 to 4800 Bauds), data length (7 or 8), parity, stop bits (1 or 2), and transmission protocol (symbol under which 16 different values may be used according to the protocol actually used). The HX-20 is set up by default to 4800, 8, N, 2, dtr/dsr. When you put in the command "V" with the keyboard (in the main menu), the HX-20 is automatically set on the same parameters as the VersaBraille [4800, 7,E, 1, C (C = dts/cts)] which represents a transmission without any character loss. When you send a command to the VersaBraille in this mode, the acknowledgment character (AK) is awited before ant other work is started.

The HX-20 can produce audible signals with a range of 3 octaves. In the above described programs, these signals are mostly used in order to create signature-tune marks. Thus, when the HX-20 is used in this mode and alone, these reference marks are of use to who do not benefit from the LCD screen; in particular, an audible signal enables one to know in which mode (upper or lower case) you are working. The cassette and character counters may be read by the process which consists of attributing a musical note to each digit from 0 to 9. Finally, we have developed an audible alarm program with the Epson's program, to avoid any unpleasant surprises. When the battery is discharged, the text that is being written is saved.

All these programs are subject to improvemnt, ie they will be completed thanks to experienced users, including programs to do scientific calculations, braille characters displayed on the LCD screen

Document Reading over the Telecommunications Network

Rebecca Stenius and Jan-Ingvar Lindstrom
Swedish Federation of the Visually Handicapped
S-122 88 Enskede, Sweden

Introduction

Only a small part of all printed, written or graphic information is available to the visually impaired. It is available only if adapted to a medium open to the visually impaired, eg if recorded on cassettes.

Most of the information is, however, never adapted in the way described above. The visually impaired person is reduced to obtaining information he needs in other ways, eg with the help of relatives. This is often difficult, sometimes even impossible.

This situation implies:

- That the visually impaired person does not get a general view of supply of information and therefore cannot select the part of it he is interested in.

- That his personal integrity is reduced, eg in the case of private letters etc.

- That the information reaches him late, if at all. This implies a limitation of natural communication sources.

The Swedish Federation of the Visually Handicapped took the initiative in launching the "Home Telefax Project" - an effort to find methods of improving the supply of information for the visually impaired by means of document reading over the telecommunications network. Telefacsimile equipments of three different types were placed in the homes of seven visually impaired subjects. Using these equipments, the subjects had, during five months, the possibility to transmit documents to the reading service centre, also provided with a telefax set. Once transmitted, the documents were described to the subjects orally over the phone.

The aim of this evaluation is to describe an experiment with document reading over the telecommunications network, but also to gain experience and evaluate that experience systematically, thus creating a basis for decisions on a continuation of the experiment and a permanent application of it.

A number of questions will then be requiring an answer: What did the supply of information for the subjects look like? Did it improve during the experiment? How did the experiment work? How did the technology work? How could a permanent reading service system be organized? What technology could be recommended?

Method

The evaluation is based on the case studies of the subjects, who were observed during the five months of the experiment and three additional months. The collection of data took place during structural interviews with each one of the subjects, as well as through inquiries and records kept of the experiment. Five relatives and three subjects who had cut short their participation were also interviewed.

Activities evaluated

The subjects were selected at the suggestions of the regional federation of the visually impaired in Stockholm. They were to represent different catergories of the visually impaired. This means that the group was a very heterogeneous one. It consisted of two women and five men of 13 - 67 years. All of them were visually impaired, some of them from birth, others since more recently. One subject had additional handicaps. Conditions varied as to homes, families and occupations. The majority did, however, have jobs.

The only immediately available document-transmitting systems were telefacsimile equipments. According to international standards, these are divided into groups from 1 to 4, group 4 standing for the most sophisticated equipments with a quicker transmission of a higher quality. After due consideration of accessability to the visually imapired person, price etc, three equipments were chosen: the Nefax 3500, supplied by the National Swedish Telecommunications Administration, the HF 2050 supplied by Siemans and the 3M 2346. In the course of the experiment, the equipments were shifted from one subject to another in order to enable a comparision of the different marks to take place.

A reading service centre, open on workdays from 8 am to 10 pm, was set up in the premises of the Swedish Federation of the Visually Handicapped. The staff were available to read the documents transmitted, record short messages on cassettes etc.

The transmissions was effectuated once the subject had loaded his telefax set with the document and called the reading service centre, whereby a copy of the document was transmitted to the receiving telefax set of the centre. As soon as it had been transmitted, the document was described to the subject over the phone.

Results

Although all of the subjects normally have somebody to read to them, there may be long intervals in between. The visually impaired person has to wait until the sighted person has time to help him, and does not get the assistance when he himself wants or needs to have a document read. He cannot, either, have as much material read as he would have wished, nor as throughly as he would have liked it, but must be satisfied with what the sighted person is able to read. Most of the subjects receive a great deal of their mail in ordinary printing.

Sighted relatives who read to the subjects often experience the situation as being trying, time-consuming and producing a sense of guilt. They would rather use the time consumed on social intercourse with the visually impaired person.

During the experiment, the reading service system was, primarily, used to examine the mail and have its contents described. The individual differences in how the system was made use of were, however, considerable. One person transmitted all types of information that could, technically, be transmitted. Others only transmitted information she could not normally have read to her. Some subjects used the reading service system every day, others more sporadically. 72% of the documents were transmitted between 10 am and 9 pm.

In spite of these individual differences in how the the system was made use of, the evaluation showed that most of the subjects, ie five out of seven, considered their supply of information to have improved during the experiment. Those who did not experience any improvement were both young persons living in sighted families. They also received the smallest amount of mail.

The improvements primarily had to do with a reduced dependence on relatives and a faster retrieval of information. The subjects were also able to read the information more throughly and to read the material that would normally not have been read at all, eg advertisements.

Relatives also considered their situation to have improved during the experiment. There were less material to read and what was left was not considered to be very trying.

According to an inquiry made, five out of seven subjects want the reading service system to become permanent. One subject wants the experiment to be extended in order to ensure a permanent reading service system to be established later. One wants the experiment to be laid down with the motivation that it is too expensive compared to its limited field of application. This person did not experience any improvement during the experiment.

With the exception of the 3M 2346, the telefax sets were considered to serve their purpose. All of the subjects rapidly learnt how they worked. The transmissions were, however, considered to take too long (three minutes), and the telefax sets were considered to have too small a capacity for documents of more than 10 sheets.

The use of the telefax sets were also limited by the poor quality of the transmission of small print and of gray-scaled documents. Soft and thin documents easily got creased in the telefax sets. Most of these problems disappear if more sophisticated telefax sets, eg those belonging to groups 2,3 or 3, are used.

According to an expert at the Terminal Approval Services of the National Swedish Telecommunications Administration, the type of telefax sets used here (group 1,2) will disappear from the market within the next few years for the benefit of the sets in group 3. Leasing and selling prices are also expected to go down.

Conclusions

The subjects consider their supply of information to be very unsatisfactory and their relatives responsibility for the reading service to be burdening. A permanent reading service system with telefax sets would improve the supply of information for the subjects considerably. Such a system could be organized as above within the frames of other service activities for the visually impaired, eg the reading service system of libraries or some other societal service. For this, telefax sets of at least group 2,3 must be used. This recommendation may, however, soon be outdated.

Learning and Immediate Memory for Braille Symbols - Implications for Training

Slater E Newman
Department of Psychology, North Carolina State University
Raleigh, North Carolina 27695-7801, USA

Anthony D Hall
IBM Corporation

Although the braille system has been in existence for more than 150 years, recent reviews of the literature (see, for example, Foulke, 1982; Lorimer, 1982) indicate that there is little information about how braille is learned. This is especially the case if one is interested in the learning of braille by those exposed to it for the first time.

During the past five years we have carried out a number of experiments on the learning of braille as well as on the discrimination between, recognition of, and immediate memory for braille symbols (Newman, Hall, Foster & Gupta, in press; Newman, Hall & Gupta, 1983; Newman, Hall, Ramseur, Foster, Goldston, DeCamp, Granberry-Hager, Lockhart, Sawyer & White, 1982). Currently we are attempting to identify factors which affect the haptic perception of braille symbols.

Among our findings are that:

1. Presenting braille symbols for visual- (as compared with haptic-) examination during study trials facilitates their learning, even if the subjects are tested haptically. Visual presentation during the study trials is also more facilitative than if both modalities are available (either simultaneously or successively) during study trials.

2. The use of large braille symbols (for which the size of the braille cell is 6 x 9 mm) during study trials facilitates their learning when haptically- (though not visually-) presented even if the test items are in standard braille (for which the size of the braille cell is 4 x 6 mm).

3. Learning the names for braille symbols is affected by the discriminability of the symbols from one another but not by what they are called.

4. Some subjects characteristically underestimate and others characteristically overestimate the number of dots comprising braille symbols.

5. The order of difficulty of braille items is very stable over a wide range of experimental conditions and tasks.

We will discuss the implications of these and of other research findings for the design of the programs and materials for the teaching of braille.

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Haptic Pictures: How Blind People Judge their Effectiveness and Sophistication

John M Kennedy
Department of Psychology, University of Toronto, Scarborough
Ontario, Canada M1A 1A4

Paul Gabias
Department of Psychology, New York University, USA

Blind adults unfamiliar with raised-line pictures were asked to sort several such pictures. In one task, 6 assorted pictures were given and the subjects ranked the pictures from "drawn by the youngest person" to "drawn by the oldest person". In the second task, subjects were given five different pictures of the same object (a spinning wheel) and the instructions were to rank the pictures according to how well they fitted the referent. In the third task, one drawing (of a table) was given and subjects were told the same drawing had been produced by two different people, each person giving a distinct account of how the drawing related to its referent. The instructions to the blind subjects were to judge which description had been given by the older person. The drawings used on all three tasks were based on drawings actually made by blind subjects of various ages (children and adults) in recent studies in Toronto, Arizona and Haiti.

Substantial agreement was found between the blind subjects, indicating that (1) haptic pictures convey information well between subjects, (2) subjects appreciate which drawing systems and devices are more appropriate, and (3) subjects concur on the "stages" in the development of the ability to draw. These results, in conjunction with those from our previous research suggest that pictorial materials may be extremely useful to the blind in texts, educational settings and in general reading. Some developmental aspects of these applications will also be considered.

Editor's note: This is the abstract of a paper presented to American Psychological Association Symposium, Toronto, August 1984.

Coding Preferences by Young Braille Readers

Susanna Millar
Department of Experimental Psychology, University of Oxford, England

The studies that are discussed were prompted by the case of a blind child who could not read Braille althouh she could spell and write stories in Braille by means of a Perkins Brailler (Millar, 1983). The reason for this startling discrepancy between reading and writing was that "Helen" depended on phonological strategies and neglected shape coding. One question is whether coding by sound and neglect of shape is associated with the early stages of braille. Thus braille letters are difficult to code as shapes while physical features such as dot numerosity provide easy discrimination cues (Millar, 1977, 1978). The resulting slow letter recognition explains the letter by letter sequential reading that is common in braille (Foulke, 1982; Nolan & Kederis, 1969). Phonological strategies would help at this stage to remember individual letters.

For faster readers evidence was presented which shows that they process familiar short words faster than single letters. It thus seemed possible that there is a change in stategy with reading proficiency so that faster braille readers rely on global word shapes for the meaning of words. Alternatively, differences in strategies may not be associated with reading level as such, but could characterise Retarded readers.

Two experiments were reported which test children's coding strategies in relation to reading proficiency levels and to retardation. The task was to choose the odd one of three words on the basis of semantic category, similarity in sound, similarity in shape and similarity in dot numerosity. Coding preferences were tested by providing two alternative bases for any choice. The results showed that, when given a choice, the basis of coding differed with reading level only in association with Mental Age. But when Retarded and Normal Readers were compared, Retarded readers showed a differential preference for phonological strategies and neglect of shape in contrast to Normal readers.

A further study tested the ability to use a given strategy by providing only one basis for choice and instructing subjects to use it. It was found that word shape was significantly less accurate, and no faster than the other bases for coding by all subjects, inculding the faster readers. Moreover, Retarded Readers were able to use all forms of coding, and did not differ from Normal Readers when instructed to use a strategy. The difference was in their coding preference when left to their own choice.

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Haptic Perception/Identification of 2- and 3-Dimensional Patterns Research and Application

Susan J Lederman
Department of Psychology, Queen's University, Kingston, Ontario, Canada K7L 3N6

Roberta L Klatzky
Department of Psychology, University of California, Santa Barbara 93610, USA

Bobbie Klatzky and I have been collaborating for several years on research concerning the haptic preception and identification of 2- and 3-dimensional patterns. I will summarise the results of three sets of experiments. The first two sets (Lederman, Klatzky and Barber, in press) consider how observers (sighted, blindfolded, and blind) determine certain configural properties of raised line patterns, typical of the tangible graphics displays used to present spatial information to the blind. The observers were asked to report distance information (euclidian and/or 'functional', ie the distance actually traversed by the hand during exploration) in the first set, and corresponding direction information in the second set. Our principal interest was in the euclidian (ie straight-line) estimates. The experiments were designed to test the hypothesis that observers would take into account the actual exploratory movements along the raised pathways. The results indicated that subjects used movement-based strategies when evaluating distance, but when assessing directional information, they chose different heuristics based on static spatial referents. The two sets of results not only point out that a variety of heuristics might be used in perceiving a pattern haptically; they also have implications for the design and exploration of tangible graphics displays.

The third study focused on haptic identification of common 3-dimensional objects. Unlike the results of the previous haptic research with arbitory configurations or 2-dimensional simulations, we (Klatzky, Lederman, and Metzger, in preparation) have found remarkably 'expert' performance, ie about 96% accuracy (or only 82 errors in 2000 responses). We argue that such a task is more 'suitable' to the capabilities of the haptic system. In short, it is hardly surprising that measures of identification using simulated objects and graphics displays - as they are currently designed - underestimate the capabilities of the haptic system. These stimuli appear to deprive that system of its most effective cues.

In summary, the results of our research on haptic evaluation of two- and three-dimensional stimulus configurations may be valuable in the design of future graphics displays, highlighting the capabilities and limitations of the haptic user system.

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Materials for Mentally Retarded Blind Children

Lilli Nielsen
Refsnaesskolen, 4400 Kalundborg, Denmark

In 1981 the Department for Technical Development in Stockholm offered 285,600 Swedish Crowns for the development of prototypes of new materials described by the author, who is a consultant for blind mentally retarded children in Denmark. Alf Lindbergh, leader of the project and Ingvar Lindstrom, designer of the prototypes, are both working in the department of education in Kopparbergs lans landsting, Hedemora, Sweden. The author has functioned as consultant for the project. In 1983 the materials had been through several trials in connection with 40 blind mentally retarded children. The materials are now being produced in a sheltered workshop for mentally retarded adults and can be ordered from Dagcenter Korpen, Box 77, 77600 Hedmora, Sweden.

Brief Description of the Materials

The Support Bench: For children, 4 years or even 17 years old, but not yet able to sit without support. Placed in prone position upon the Support Bench the child can move his arms and legs and by this develop the curves of the spine which are necessary for sitting ability.

The Sound Box: To give a child with very little ability to move the possibility to switch on and off the record-player inside the box and thereby be the one to decide if the record should play or not. This can be done by the head, shoulder, hands, feet or whatever part of the body the child is able to move.

The Blower: To motivate the child who in prone position cannot raise his head to do so and to motivate any child to strengthen his muscles, hands as well as feet.

The Tapping Frame: To give the handicapped child who cannot move from place to place the possibility and the permission to play banging games. The hypothesis is that banging games are closely connected with speech development, why it is important that children without speech get the possibility to play banging games.

The Little Room: To give blind children possibility to develop the very first understanding about space.

New Braille Devices

This section includes devices announced since the last issue of Braille Research Newsletter, as well as devices which have become available in this period. It is becoming increasingly common for devices to be announced up to a year before production models are available. The information in this section is taken from the International Survey of Aids for the Visually Disabled (October 1984 edition).

BRAILLO.NORWAY AS
Ringshaugvn. 118, PO Box 647, N-3101 Tonsberg, Norway. Tel: 033-30977.
Model: Braillo 20
Description: Embosses a maximum of 42 braille cells on fan-fold paper of maximum width 310 mm, at up to 20 cells per second. RS232 interface 110-9600 baud; internal 16 Kbytes of which 9 Kbytes used for programs. Braille 13-key keyboard on flexible lead. Dimensions 50 x 29 x 16 cm for printer; 25 x 12 x 3 cm for keyboard; weight 7 Kg.
Price: 37,900 Norwegian Krone

BRAIL-TECH INC
48 Brady Street, Hull, Quebec J8Y 5L4, Canada. Tel: 819-770 2825.
Model: Grapho-Braille Terminal
Description: 20 to 30 cell per second braille embosser using fan-fold paper without sprocket holes. Maximum paper size 27.9 x 27.9 cm (11 x 11 inches); this is not a standard paper size. Maximum of 40 cells per line and 30 lines per page. RS232 interface. Operates from 115 volts, 60 Hz, 300 watts. Dimensions 47 x 37 x 15 cm; weight 14 kg.

N V ELBICON
Industriezone nieuwland, B-3220 Aarschot, Belgium. Tel: 016-560611.
Model: Elekul
Description: Single-sided embosser operates at up to 400 cells per second. Uses continuous paper without pin-feed and cuts it into sheets after embossing. RS232 interface at 4800 baud only. Maximum line length of 40 cells. Dimensions 100 x 65 x 125 cm; weight 120 Kg.
Price: 700,000 Belgium Francs

ELECTRONICS AND AIDS LTD
Brunnenstrasse 10, 7240 Horb/Neckar, German Federal Republic. Tel: 07451-7051.
Model: BT 40
Description: Paperless braille system with 40 cell single line 8-dot braille display, 8-key keyboard, two floppy disc drives (165 Kbytes) and 64Kbyte CP/M processor. Average index searching time of 4 seconds. Options include ASCII keyboard, 11 Mbyte hard disk, printer/screen terminal, 1.2 Mbyte floppy disks, 16 bit processor/memory up to 800 Kbytes. Dimensions 36 x 24 x 7 cm; weight 3.5 kg.
Price: 17,200 Deutschemarks

Model: MBT 80
Description: Paperless braille system with 80 cell 8-dot braille display, floppy disc (165 Kbytes), and 64 Kbyte CP/M processor. Same options as for BT 40. Dimensions 28 x 26.5 x 20 cm; weight 6.6 kg.

Price: 26,830 Deutschemarks

Model: MBS 80
Description: Incorporates 80 cell 8-dot braille display, braille keyboard and Olympia printer. The braille keyboard dimensions are 21.5 x 15.5 x 6 cm; weight 0.7 kg. The braille display consists of 2 lines with 40 cells and 2 status cells each; dimensions 50 x 10 x 8 cm; weight 2.85 kg. The processor has a storage capacity of 7920 characters and two RS232 serial interfaces; dimensions 28 x 26.5 x 20 cm; weight 6.6 kg.
Price: 25,620 Deutschemarks

Model: BD 80T
Description: Paperless braille display with 80 cell 8-dot braille display to be used as a terminal to mainframe computers, and connected through an interface to the video RAM of the screen terminal.
Price: BD 80T 18,940 Deutschemarks; interface 4,840 Deutschemarks

ELINFA
56 bis, Rue du Louvre, 75002 Paris, France. Tel: 296 41 12.
Model: Micro Ordinateur Braille
Description: Cassette-based paperless braille device with 8 braille keys and 4 command and cursor keys. Braille display of 24 cells expandable to 40 cells. Two RS232 interfaces programmable up to 9600 baud. Cassette holds 400,000 characters with a maximum transfer rate of 150 characters per second. Operates from mains supply, or from two AA size batteries which will last about 10 hours. Dimensions 25 x 13 x 2.5 cm; weight 1 kg.
Price: 42,000 Francs with 24 cell display

FUTURE COMPUTER PRODUCTS INC
3028 Aquadale Lane, Cincinnati, Ohio 45211, USA. Tel: 513-661 2266.
Model: Braille microcomputer system
Description: Combines a 64 Kbyte CP/M microcomputer and a 40 cell 8-dot braille display. Choice of 5 inch or 8 inch floppy disc drives.
Price: $8000 with 5 inch disc; $8500 with 8 inch disc

MATSUSHITA RESEARCH INSTITUTE TOKYO INC
4896 Ikura, Tama, Kawasaki, Kanagawa, 214 Japan.
Model: Duplication system
Description: An optical reader detects the embossed patterns on the braille original and converts them to electronic signals. The braille can be proofread and edited on the screen of a microcomputer. The output is to a mechanical punch which makes a negative braille printing plate.

F H PAPENMEIER GMBH & CO KG
Talweg 2, Postfach 1620, D-5840 Schwerte, Federal Republic of Germany. Tel: 02304-16005.
Model: Braillex T
Description: Portable braille terminal housed in a briefcase. Incorporates multifunction keyboard, optional braille keyboard and single line braille display (choice of 20, 40 or 80 cells). Built in 3.5 inch disk drive and floppy disk controller for additional 5.25 inch or 8 inch disk drives. Two RS232 interfaces, Centronics interface, interface for cassette recorder, video output. Baud rates from 110 to 9600.

Price: $4200 to $8300

Model: Braillex PC
Description: Similar to Braillex T but includes software OS9 level 1 as standard.
Price: $4200 to $8300

PATHWAY COMMUNICATIONS LTD
8A St Martin's Street, Hereford HR2 7RE, England. Tel: 0432-53434.
Model: Braillewriter
Description: Device with braille keyboard and Votrax speech synthesizer. Capacity 10,000 braille characters. Incorporates simple editing facilities. Operates from rechargeable batteries. RS232 interface for output to a printer, embosser or a computer. Dimensions 62 x 180 x 375 mm; weight 1 kg. Optional mini-printer and cassette.
Price: £995; £1175 with printer; £1375 with cassette

RESUS INTERNATIONAL
Wijnhaven 102B, 3011 WV Rotterdam, The Netherlands. Tel: 010-11 02 07.
Model: RS-212
Description: 15 cell per second braille embossser with a maximum of 40 cells per line. Uses sprocket-fed fan-fold paper from 200 to 360 mm wide and 75 to 430 mm long.. Can produce either 6 or 8 dot braille. RS232 interface from 110 to 9600 baud with choice of protocols, or 8 bit parallel interface. Uses MIT braille ASCII code. QWERTY or braille keyboard can be plugged into parallel port. Dimensions 420 x 140 x 280 mm; weight 9.7 kg.
Price: 14,775 Dutch Florins

TRASK DATASYSTEM AB
Stockholmsvagen 34, S-182 74 Stocksund, Sweden. Tel: 08-85 90 30.
Model: Trask P40
Description: Table-top braille embosser with two printing modes - continuous embossing in both directions of the printing head at 20 cells per second, and left to right printing at about 10 cells per second. Paper widths (forms, rolls or fan-fold) 310 and 210 mm, with maximum of 42 cells per line. RS232 interface with a maximum transfer rate of 9600 baud. Choice of braille keyboard and/or QWERTY keyboard. Braille cell size is Marburg Mittel. Dimensions printer 43 x 23 x 16 cm, keyboard 38 x 18 x 6 cm; weight 9 kg.
Price: 25,000 Swedish Krona with braille keyboard

TRIFORMATION SYSTEMS INC
3132 S.E. Jay Street, Stuart, Florida 33497, USA. Tel: 305-283 4817.
Model: TED-600
Description: 600 line per minute (c 400 cells per second) double-sided braille embosser. Maximum of 40 cells per line and 25 lines per page. Paper width 26.7 to 34 cm, paper length 27.94 cm (11 inches). RS232 interface from 75 to 19,200 baud. Operates from 105-127 volts, 50 to 60 Hz, 1250 watts. Dimensions 61 x 66 x 103 cm; weight 114 kg.
Price: $41,250 (dom. $37,500)

Model: Personal Brailler
Description: 10 cell per second braille embosser with a maximum of 40 characters per line and 25 or 27 lines per page. Can emboss 120 dots across

the paper using a vertical matrix of four dots maximum. In this graphics mode it can be used for embossed graphics. Paper width 26.7 to 34 cm, paper length 27.94 cm (11 inches). RS232 interface from 75 to 19,200 baud. Operates from 105-127 volts, 50 to 60 Hz, 250 watts. Dimensions 42.5 x 60.3 x 23.5 cm; weight 15.9 kg.
Price: $3245 (dom. $2950)

VACUUM FORMING COMPANY
3/21 Prabhadevi Industrial Estate, 402 S V Savarkar Marg, Bombay 400 025, India. Tel: 422 4430.
Model: Vacuum forming machine
Description: For duplicating braille on thermoplastic sheets. Supplied with a standard frame of 300 x 400 mm and a 2 minute adjustable heater timer. Extra clamping frames can be supplied in other sizes.
Price: 13,500 Rupees

Recent Publications

Braille Music - An International Survey by John Henry. Published by National Library for the Blind, Cromwell Road, Bredbury, Stockport SK6 2SG, England. Print edition £6.95; braille and audio 2-track compact cassette editions in preparation.

This book aims to establish which institutions throughout the world hold material likely to be of greatest use, to establish which of these is willing to make its material available overseas, and to give guidelines as to the best means of approaching these institutions.

The first section comprehensively surveys the availability of braille music in 29 countries. The second section analyses the availability by musical instrument.

This book is an essential source of information for anybody seriously interested in braille music.

Information & Disability - State of the Art & Trends in Sweden & other Nordic Countries by J I Lindstrom, Swedish Federation of the Visually Handicapped, S-122 88 Enskede, Sweden.

A study was initiated by the National Swedish Board for Technical Development to highlight the general aspects of information technology (IT) and disability in Sweden and other Nordic countries. Information technology is conceptually divided into the terms "Computerization" and "Telematics". The study mainly concerns the handling of digital information.

The state of the art and trends in Nordic countries is reviewed. It is stated that personal and home computers have a significant market with an increase of 200% annually, whereas large computers show a very slow increase. Trends for the future are: an extended use of home computers for various purposes, an increased memory capacity and lower prices, a world market dominance for IBM, AT&T (and Apple?) and increased compatibility.

Telematics is divided into one-way and two-way communication. Existing and foreseeable techniques for the information transfer is reviewed. Conditions for the promotion of R&D in the IT field is discussed, especially as far as governmental resources and efforts in the Nordic countries are concerned. Certain Nordic authorities involved in the planning, supervision and follow-up of IT activities are introduced.

An important condition for any activity is knowledge about the number and composition of the consumer groups. Basic facts about these groups are reviewed. Also, the development and provision of aids in Sweden is described.

IT and disability is discussed by stating that IT could highly facilitate the lives of disabled people - but that it could also be very aggravating. The actual and possible use of computers as well as of telematics with regard to disability is reveiwed.

In the following chapter, current activities according to the type of disability are introduced - the whole survey being based upon a project list; the disabilities concerned are visual impairment, deaf-blindness, hearing impairment, deafness, speech and mobility impairments.

Two projects, run in Sweden are described, vis. the Talbas project and the Speech, Sound and Hearing project (the TLH project). The Talbus project was a Nordic project, the aim of which was to support and facilitate R&D concerning speech-based aids for disabled people. The TLH project is a Swedish project started in 1980 for the promotion of R&D in the field and for the facilitation of interdisciplinary exchange of information and collaboration.

The study ends with conclusions and remarks, including some suggestions of possible international co-operation. Finally, there is a list of literature. A project list and a list of manufacturers in the field of IT and disability in Sweden are added to the study as appendices.