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ABSTRACT

Proceedings of a 3-day working conference in Stockholm on educational research for the visually handicapped are presented, with five reports on research activities conducted by participating groups and five introductory papers. Research projects reviewed include information on research activities at the Research Centre for the Education of the Visually Handicapped at England's University of Birmingham, information on educational research on visual impairment in the German Democratic Republic, information on optimation by technical means of the conditions of learning for the blind and partially sighted in the German Federal Republic, information on the principal trends of scientific research in the field of investigation, information on teaching and education of visually handicapped children in the Soviet Union, and information on education research on learning problems for the visually handicapped in Sweden. Five introductory papers presented are titled conservation of substance in the blind and partially sighted, factors underlying the ability to learn braille in former readers of ink-print, methods for conveying graphical information to the visually handicapped, symbols for tactile maps, and methods of using talking books. (CB)

LÄRARHÖGSKOLAN I UPPSALA
Pedagogiska institutionen

REPORT NO 31 1972

Project: PUSS: VIII

EUROPEAN CONFERENCE ON EDUCATIONAL RESEARCH FOR THE VISUALLY HANDICAPPED

Edited by:

B. Lindqvist N. Trowald

ABSTRACT

Lindqvist, B. & Trowald, N. European Conference on Educational Research for the Visually Handicapped. Report No. 31, 1972. Department of Educational Research, School of Education, Uppsala.

This report is the result of an international conference on educational research for the visually handicapped held in Stockholm in October 1971. Eleven researchers from five european countries (Great Britian, German Democratic Republic, German Federal Republic, USSR and Sweden) participated. The conference was organized jointly by the Swedish Board of Education, the Swedish Association of the Blind, and the educational research group PUSS of the Uppsala School of Education.

The report contains a short presentation of the research activities conducted by the participating groups and five papers delivered as an introduction to the conference seminars. The topics of the papers are as follows:
Conservation of substance in the blind and partially sighted
Factors underlying the ability to learn braille in former readers of ink-print
Methods for conveying graphical information to the visually handicapped
Symbols for tactile maps
Methods of using the talking book

Finally there is a summary of the concluding discussion, the main result of which were as follows:

a) A working group was established to prepare a new conference
b) This working group will also study the possiblities of improving international documentation and exchange of information in the field
c) The Swedish PUSS group will prepare a report on the results of the conference which should be given widest possible circulation

EUROPEISK KONFERENS OM PEDAGOGISK FORSKNING FÖR SYNSKADADE

Lindqvist, B. & Trowald, N. Europeisk konferens om pedagogisk forskning för synskadade. Rapport Nr 31, 1972. Pedagogiska institutionen, Lärarhögskolan i Uppsala.

Denna rapport utgör resultatet av en europeisk konferens om pedagogisk forskning för synskadade, vilken hölls i Stockholm i oktober 1971. Elva forskare från fem länder (England, Väst- och Östtyskland, Sovjetunionen och Sverige) deltog. Konferensen organiserades av Skolöverstyrelsen, De Blindas Förening och projektet PUSS vid Lärarhögskolan i Uppsala.

Rapporten innehåller en kort presentation av de deltagande forskargruppernas arbete samt de fem föreläsningar, som inledde konferensens seminarier. Rubrikerna på de fem föreläsningarna är:

Mängdkonservering hos blinda och synsvaga barn
Bakgrundsfaktorer som påverkar inlärning av punktskrift hos f.d. svartskriftsläsare
Metoder för överföring av grafisk information till synskadade
Symboler för taktila kartor
Metoder för användning av talboken.

Avslutningsvis återges en sammanfattning av den avslutande diskussionen, som resulterade i följande tre rekommendationer:

a) En arbetsgrupp utsågs med uppgift att förbereda en ny konferens
b) Arbetsgruppen fick också i uppgift att undersöka förutsättningarna för bättre internationell dokumentation och informationsutbyte inom området
c) Deltagarna från PUSS-projektet åtog sig att sammanställa en rapport över konferensen vilken ska ges största möjliga spridning.

CONTENTS

PREFACE

This report is part of the research project PUSS, educational research project concerning the visually handicapped, which is conducted by the School of Education in Uppsala in cooperation with the Swedish Association of the Blind.

The aim of the project is to analyse and improve the learning situation of the visually handicapped student. Special attention is paid to learning problems in connection with special information media for the visually handicapped.

PUSS is working on a five year plan (1969-1974) and an annual grant covering the total post of the research by the Swedish Board of Education.

INTRODUCTION

Blindness and visual impairment cause many educational problems which are open to research. Throughout the years a substantial amount of investigations have been carried out in some countries. The bulk of this research has been dedicated to the learning and development of special skills like mobility, braille reading, listening, the use of tactual graphs, etc. But also for instance on cognitive and emotional development in blind children and social adjustment to different educational systems there have been some important research achievements. According to available documentation and information this research, however, often seems to have been rather sporadic and unsystematic, in many cases probably due to the limited economical resources.

The lack of coordination and systematic planning in educational research for the visually handicapped is a very serious problem. The population of blind and partially sighted students is a true minority group in our society and accordingly only limited resources can be made available to tackle the problems. On the other hand the problems in education caused by visual impairment are of many different kinds and a well differentiated research program is needed. In the future such programs may perhaps be created on a national basis in a few of the largest countries, but for smaller countries the only realistic possibility of achieving this is through close international cooperation.

To investigate the possibilities of cooperation in educational research for the visually handicapped an initiative was taken in 1970 jointly by the World Council for the Welfare of the Blind (WCWB) and the Swedish Association of the Blind for a European working conference. It was meant to deal with the present situation practically and concretely and the number of participants was therefore to be small. The group should mainly consist of educational researchers actively involved in research on blindness.

A grant was given by the Swedish Ministry of Education and the conference was sponsored and organized jointly by the Swedish Board of Education, the Swedish Association of the Blind and the

educational research group (PUSS) on learning problems in connection with visual impairment at the School of Education in Uppsala.

Using WCWB contacts and available information on research in Europe it was decided that researchers from the following five countries should be invited:
German Democratic Republic, German Federal Republic, Great Britain, USSR and Sweden. It was also decided that the conference should contain two main sections:
I: Presentation of research by participating groups and
II: Seminars on some vital problems. The participants were asked in advance to suggest topics for the seminars. This report includes both the project presentations (section 1) and the introductory papers of the five seminars (section 2). Finally (section 3) a brief summary is given of the final discussion and recommendations made by the conference.

SECTION I

EDUCATIONAL RESEARCH ACTIVITIES IN FIVE EUROPEAN COUNTRIES ON PROBLEMS RELATING TO VISUAL IMPAIRMENT

RESEARCH ACTIVITIES AT THE RESEARCH CENTRE FOR THE EDUCATION OF THE VISUALLY HANDICAPPED

School of Education,
University of Birmingham,
England
By M.J. Tobin

This Centre was set up in the University of Birmingham's School of Education for an initial period of four years as from 1.1.70. Its financial support comes form Government sources and from the Royal National Institute for the Blind. In addition, other charitable institutions and grant-giving bodies provide finance to allow specific, short-term research projects to be undertaken, staff consists at present of a director, a senior research associate, two research associates, a research assistent, a technician, and secretaries. In the description which follows, an outline will be given of the work that is currently being undertaken. All the projects fall within the broad scope of the Centre's aims and terms of reference, but not all those aims are being pursued at this time. In general these aims and terms of reference are: - to carry out research into the educational and psychological needs of visually handicapped children and adults; to assist with the development of training courses; to develop and test teaching aids of all kinds; to give assistance of an academic, technical nature to teachers and others who may wish to carry out research within their own institutions and schools; to disseminate knowledge about research.

One project, which the director of the Centre was already working on when the Centre was opened, is concerned with (i) the construction of programmed learning materials to enable newly-blinded adults and children who were ink-print readers before the onset of blindness to teach themselves braille, and (ii) an examination of the teaching and organismic variables (such as tactual ability, age, short-term memory, intelligence, personality characteristics, sex and degree of residual vision) that are associated with success or failure in learning braille. The experimental phase of this project is now complete and a fuller account of the results will be communicated at the conference.

As a part of the Centre's practical assistance to teachers who are trying to develop new teaching approaches, the Centre has undertaken a survey of the spoken and written language of blind schoolchildren, aged 5-8 years, so that a group of teachers who are writing a new series of braille reading primers for young children may be able to base their work upon an objectively determined vocabulary. In this way, the cognitive load of the learners will not be unduly increased by having to try to read words that are not yet stable components in their vocabulary. The word-lists were compiled from written and oral sources. Teachers sent in examples of the written (braille) work of their pupils and the investigator (M.J. Tobin) also visited the schools and tape-recorded conversations with pairs of blind children. The written and oral materials were then analysed and word lists prepared. In compiling the lists, account was taken of the number of children using a word and also of the number of times the word was used. The formula employed to derive the rank order of the words was:

$$\text{Word Popularity Index} = \frac{100}{s} \times \frac{f}{s}$$

where n = number of children using the word,
s = number of children in the sample,
and f = number of times the word was used.

This work was essentially a 'practical' task since its object was to produce lists of words known to be used by blind children. However, the lists may be of interest outside the immediate purpose for which they were prepared since relatively little research has been done on the development and acquisition of the blind child's vocabulary. Copies of the monograph in which the lists appear will be brought to the conference for distribution to those colleagues who may be interested.

Mr. S.O. Myers, Senior Research Associate, is at present engaged on two projects. The first is an investigation into the living and working conditions of the ex-pupils of Condover Hall School. This school was founded in 1948 and takes in blind children who have additional handicaps. The aims are:

(i) to gain personal information on each expupil and attempt to evaluate suitability of present placement;

(ii) to feed back into the school information which may confirm continuation of present aspects of the education programme, or which may suggest modifications of that programme or indicate the need for new educational projects;

(iii) to examine the effectiveness of any aftercare service and supervision;

(iv) to assemble information concerning the actual facilities at present available for ex-pupils and, in particular, to examine the possibility of the absorption of these young men and women into the national provision for Physically Handicapped Adults and Mentally Handicapped Adults.

His second project is essentially a 'development of materials' scheme and its aim is to invent, adapt, and bring together techniques and materials for teaching some of the elementary principles of science to visually handicapped children. This piece of work was only begun this summer but already a group of teachers has been formed who are submitting ideas and teaching schemes that they have found useful and workable in their own schools. When an adequate collection of materials and schemes of work has been accumulated the Research Centre will help the schools to evaluate their usefulness. A subsidiary aim of the project is to make it possible for those teachers who may themselves not be scientists to use simple kits or 'instructional packages' in an imaginative and effective way.

Mrs. N. Norris, Research Associate, is conducting an investigation into the aims and methods of teaching English to the visually handicapped. The aims of this survey are to describe current philosophies and practice and to identify those aspects of the blind child's language development that are in need of further examination. The hope is that this survey will lead either to detailed, long-term research on the basics of the acquisition of vocabulary and syntactic competence and/or to the formulation of 'development' of projects designed to provide any necessary compensatory education that may be required by blind children.

Another area in which the Centre has research interests is the education of severely retarded and additionally handicapped blind children, for example the rubella deaf/blind. Miss R. Hill, a psychologist, is working with the director on an observational study of a group of these children who are either permanently hospitalized or who attend a hospital-based school on a daily or weekly basis. Among the studies currently undertaken are:

(i) observation of the 'play' behaviour of these children;

(ii) observation of the 'conflict' patterns within the play-room;

(iii) the observation of exploratory, vocal, and stereotyping behaviour under a variety of experimentally manipulated conditions;

(iv) an evaluation of some simple conditioning techniques in relation to the diminution of stereotyping (eye-poking, rocking, etc.) and to the development of longer spans of attention and independent behaviour.

The Centre has also been examining the possibility of increasing the visual efficiency of those blind children who have some usable, residual vision. Using the materials developed in the United States by Dr. Berraga, a small-scale, pilot study was carried out this summer with five children in one of our schools for the blind. The improvement after training was of a satisfactory order, and further work is being planned to see whether a scheme of lessons can be devised so that all blind children with some residual vision might be given the help and training they need to make them more effective users of their residual sight.

The final project which we are working on is envisaged as a long-term investigation into the cognitive growth of the visually handicapped child. Further details of the beginnings of this service of investigations will be given in the paper on cognitive growth which is to be given by M.J. Tobin at the conference.

In addition to these larger projects, the Centre gives assistance of various kinds of teachers of the blind. One area in which it is beginning to make a contribution is in the design of teaching aids - drawing-boards, adaptions of psychological tests (form-boards, peg-boards, etc.), and pieces of apparatus for use in training the multiply-handicapped blind.

INFORMATION ON EDUCATIONAL RESEARCH ON VISUAL IMPAIRMENT IN THE GERMAN DEMOCRATIC REPUBLIC

K.P. Becker
(Edited and translated by B. Lindqvist)

I. General background

In the German Democratic Republic (GDR) the schools for the blind and the partially sighted from an integrated part of the socialistic educational system. Blindness and partial sight are historical categories, which relate in a dialectic way to the conditions of society. There is no purely biological or mechanical definition which forms a generally valid borderline between blindness and partial sigth. At present the following definitions are valid in our country:
a) In schools for the partially sighted pupils are taught, whos visual impairments prevent their optimal education in normal schools.
b) In schools for the blind we teach children who, because severe visual impairment, can't read or write normal print (even with special aids) and whos education can not be satisfactorily given elsewhere.

This applies for children, who have at the most a visual acuity of 1/3. On the basis of medical and psychological investigations, which consider the whole personality and the effect of visual impairment in the individual case it will be decided, if the child is to be educated in a normal school, a school for the partially sighted or a school for the blind. As a role all children with a visual acuity of 1/7-1/25 go to a school for the partially sighted.

II. State and development of educational research

2.1. Formation of theory

Within the basic research on theories on special education and rehabilitation there are reciprocal relations between general research on rehabilitation and special investigations on visual impairments. On one hand knowledge from the field or rehabilitations is deductively transferred to the education of the blind and partially sighted and on the other hand

the special characteristics of the personal development of visually impaired individuals contribute in an inductive way to theoretical conceptualication in the general field. In this way general characteristics in connection with handicaps - disturbance of mobility, language, sensory and cognitive development and social behaviour - are studied as to their presence and effect in visually impaired individuals. Special methods for training, compensating and activating the visually handicapped are investigated as to the possibilities of their application in the general field of rehabilitation.

2.2.Infant training and care

As we know that the first years of life are of great importance for the development of personality, we pay special attention to problems relating to infant training and care. Effects of blindness and partial sight on the development on the elementary obilities and skills are investigated (diagnosis), possibilities of compensating the defect are tested (methodology) and conclusions for the early education of preschool children are formulated (parents counselling)

2.3. Preschool education

Kindergartens form an important part of the socialistic educational system. They offer an optimal physical and mental development of the child and prepare the child for school.

In the field of preschool research on visual impairment the aims of the general preschool education are specified for the education of blind and partially sighted children and special educational methods are tested. Special attention is paid to the development of technical aids, didactic games, embossed picture-books and special aids for sensory training. Objectives, contents and methods for the school preparation of preschool children (in the form of day visits to schools for the blind and partially sighted) are studied.

2.4. Education and habilitation of blind and partially sighted children

Investigations of the tactual perception among the blind and on training methods in connection with tactual perception form the basis for research on further utilization of embossing techniques and for the development of typhlographics. This

research in based on theories of learning and perception. Special aids are developed by means of vacuum forming technique and educational and noneducational methods for the use of these aids are studied.

The present definition of blindness means that a large proportion of blind children have some useful residual vision, which in terms of visual acuity means from 1/25 - 1/200. Hypothesising that this residual vision can be utilized for the acuisition of knowledge, we investigate the possibilities of utilizing visual information in low vision children. The influence on visual perception by illumination and colour intensity in the environment is the basis for the formation of training methods and development of teaching and learning aids. The objective is to create a tactile-optical or an optical-tactile preception to improve visual behaviour supported by tactual information.

The visual perception of the partially sighted is disturbed in various ways all according to cause, degree and effect of visual impairment. This provokes the question, to what extant a disturbed sensory organ can reproduce adequately the objective reality. This question is of great importance to develop educational processes for the partially sighted. The answer to this question will make it possible to draw conclusions in order to create an optimal development for partially sighted children. The deficiencies and disturbances of the sensory organ are investigated as a basis for rehabilitative training.

2.5. Didactics and methodology in the education of the blind and partially sighted

The aim of the education of the visual impairment corresponds to that of the general education of system. The same syllabus as in a normal school is applied. The didactive and methodological investigations aim at utilizing the research findings in the field of education and habilitation of the visually handicapped for the development of special education and methods and aids in the teaching of the blind and partially sighted.

Special attention is paid to the natural sciences, engineering and sports. The editing and preparation of books for the blind and partially sighted is investigated in the didactive-methodological research. The basis for this is our knowledge of the reading ability, the sensory activities and the tactile and optical achievements of the visually handicapped.

2.6. Vocational rehabilitation

Results of the scientific and technical revolution and the development in the field of higher education have lead to new forms of occupations among the youth in general. This has also had an effect on the vocational training of the visually handicapped and there has been a great increase in the number of visually handicapped students in recent years. The research on vocational training is partly orientated towards finding new occopations and partly towards the problem of retaining a job. From the experiences of occupations like typing, physiotherapy, computer programming, industrial occupations and academical professions conclusions are drawn for vocational preparation, guidance and training.

III. Organization of research

The educational research on visual impairment is integrated in the general research on rehabilitation and thereby forms a part of the general educational research, which is lead by the academy of pedagogical sciences. The research activities are conducted by researchers of the Section for rehabilitative Research and Sciences of Communication of the Humboldt University of Berlin.

In the result of the third socialistic reform of higher education the principle of coordinating teaching and research is formulated. Several tasks are solved in cooperation between researchers and students. A very important contribution is also given by the German Association of the Blind and Partially Sighted. The central board of this organization has formed special committees on education, technical aids and vocational training which play an important part in the research activities. The Association of the Blind and Partially Sighted is the head of institutions like the Central Library for the Blind and the Workshop for Embossed Material and Teaching Aids which both contribute essentially to the achievements in the field of educational research.

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(Edited and translated by B. Lindqvist)

OPTIMATION BY TECHNICAL MEANS OF THE CONDITIONS OF LEARNING FOR THE BLIND AND PARTIALLY SIGHTED

Report on the state of research

At present a research project is being carried out in order to improve the learning situation of the blind and partially sighted by creating new learning media. An optimation of learning conditions can be achieved, if the visually handicapped students at their disposal have learning devices, learning programmes and technical information media, by means of which auto-instruction and individualised education is possible. In the following we will confine ourselves to report on the present state of research on the utalisation of technical aids.

1. Background

It is our opinion that the advantages of programmed learning could be of special value in the education and rehabilitation of the blind. To utilize the methods of programmed learning for the blind a learning device had to be developed, which could store learning programmes and present them in suitable modes to the blind. The technical development of such a device for the blind - Braillphon 1 and 2 - will be described in the following.

2. Technical description

An apparatus storing learning programmes for the blind must work audio-tactually. Recorded speech and braille must be used. Accordingly the learning device, which we have given the name of Braillophon 1, has been conceived in the following way:

Development phase 1 - Braille magnetic tape store
A learning device for the blind of this kind must absolutely contain a store of braille signs in a suitable information carrier.

After some experimenting we have managed to store braille signs on magnetic tape. The store can be used in connection with the learning device to produce braille texts but apart from that it can be used separately as a reading device.

Development phase 2 - Braillophon 1

The Braillophon 1 information carrier is an electronic control magnetic tape device. The tape will be programmed through impuls coding according to the structure of the programme. All branches and every single frame will be planned with regard to the total programme. An electronic control unit provides the correct run of the programme. Th pupil only has to press the so called "proceed"-key, by which he releases a frame. Speech, scenes, music etc. can be conveyed to him auditively through earphones. Written information and tasks will be produced on an electronic braille-writer. In addition to this other information like graphs, maps, books etc. may be offered according to the programme plan. After having worked through a frame many pupil reactions are possible. The pupil will either press the "proceed"-key or one of the four alternative keys. He thereby gives the impuls for the next step of the programme.

Braillophon 1 has, as pointed out above, two outputs - an auditive and a tactile one - but only one input possibility. Through the development of Braillophon 2 the input possibilities have been extended.

Development phase 3 - Braillophon 2

In the Braillophon 2 we have included an electronic comparing device for braille. It makes a direct electronic comparison with braille script possible. All correct solutions have been registered in advance in the programme. When the pupil gives a correct answer on a braille keyboard connected to the Braillophon 2 the correctness is confirmed by the electronic comparing device. Over the electronic control unit the continuation of the programme follows. When the given answer is wrong the error is registred electronicly and the point of the programme will be found which has been foreseen when this kind of error is made. The pupil is then confronted with a frame of an additional programme. He receives additional information and sometimes also additional tasks, until he finally will be directed back to the main programme.

Technically seen it is possible to make direct comparison of the braille script either letter by letter or word by word. What is preferable from an educational point of view will be demonstrated in the evaluation of the prototypes which will start in the middle of 1971.

Development phase 4 - Braillex

The fourth development phase has the purpose of constructing an information storing device for the blind called the Braillex. It works along the same principles as the comparing device of the Braillophon 2. The output follows auditively or tactually, when a word has been given over a braille key-board. As information carrier a magnetic tape is used. The Braillex works as an electronic dictionary. The contents of an encyclopedia, a dictionary or a telephone directory can be electronicly stored. If the student wants to "look up" a specific word he writes it down on the braille key-board and after a relatively short time he receives the desired information auditively and/or tactually. The Braillex will doubtlessly save much time for the blind student when he wants certain information.

3. Educational problems

Finally we want to comment on the educational problems that will turn up in connection with the introduction of the Braillophon 2 in the schools for the blind. In our department in Dortmund model programmes are developed at present, which can be stored in the Braillophon 2. Existing book programmes are tested to find out if they can be adapted to the Braillophon 2 and completely new programmes are developed. We are at present working on a short programme which is an introduction to programmed learning for teachers. This programme, which I have developed myself will be introduced as our first test programme in the middle of 1971. We have also finished a programme to be used in the teaching of English, the aim of which is to test and practise certain parts of the course. We are also working on a programme to be used in music. The model programmes will be made in a liniar form within our pilot studies. The testing of these programmes will of course suggest certain changes. We will retest and revice the programmes and then finish them and transfer them to a programme library which we have plans to create. Such a library will improve our possibilities to give individual teaching to pupils with learning problems. By creating

the Braillophon, the Braillex and a programme and information library we hope to facilitate the access to knowledge for the blind and thereby to improve the possibilities of integrating the blind in our modern society.

RESEARCH INSTITUTE OF DEFECTOLOGY
ACADEMY OF PEDAGOGICAL SCIENCES OF THE USSR
By M.I. Zemtsova

THE PRINCIPAL TRENDS OF SCIENTIFIC RESEARCH IN THE FIELD OF INVESTIGATION, TEACHING AND EDUCATION OF VISUALLY HANDICAPPED CHILDREN

As visually handicapped children we would regard:

a) Totally blind children as well as those who preserve light-perception using the tactile-hearing means of perception of educational material;

b) Partially sighted children with the residual vision up to 0,04 on the best eye with the correction by means of glasses using the tactile-hearing and visual means of perception;

c) 'Low-vision' children with visual acuity within the limits of 0,2-0,3-0,4 with the correction by means of glasses on the best eye using the visual and hearing means of perception of educational material.

In the USSR special schools for visually handicapped children constitute a part of the system of public education and the care of them is taken by the State. In these schools tuition and boarding is free of charge. Teaching and education of visually handicapped children is based upon the general principles of public education development in the country put forward by V.I. Lenin.

During the years of the Soviet power in the USSR there was formed a genuine democratic system of education providing all visually handicapped children irrespective of their social position, nationality, race or religion, with the possibility of acquiring secondary or higher education, of mastering this or that speciality, and after accomplishing their education of getting a job which will siut their interests and skills.

Teaching and education of visually handicapped children is founded on a scientific basis. Variability of scientific research carried on at scientific institutions and teacher training

institutes of our country, allows to solve in a complex way the problems connected with teaching, education, restoration of functions, medical and socially-industrial rehabilitation of visually handicapped people. This is done with the use of recent scientific achievements in the field of medicine, pathophysiology, technology, etc.

In our report we shall dwell on the research which is carried on in the Institute of Defectology of the Academy of Pedagogical sciences of the USSR.

Various departments and laboratories of the Institute of Defectology and scientific institutions and teacher training institutes cooperating with it are carrying on inverstigation of problems dealing with children's blindness and weak eyesight. According to the demands of life the following principal trends of their activities could be distinguished:

a) Working out of genuine scientific fundamentals of development, teaching and education of visually handicapped children including studying of clinical forms, etiology of visual defects, physiological mechanisms, structure of primary and secondary disturbed functions, of ways and means of compensation and correction of disturbed and underdeveloped functions of children with visual insufficiency. Study of blind and partially sighted children with the diseases of the central nervous system accompanying blindness and weak eyesight.

b) Study of peculiarities of cognitive activity and phychic development of visually handicapped children, of the character of secondary deviations of psychic development, of ways and means of preventing various forms of abnormal development when there exist visual and sensor defects. Development and usage of residual vision in the process of teaching of partially sighted children.

c) Peculiarity of physical development of visually handicapped children at different age levels. Formation of kinaesthetic functions, of ways and means of preventing and overcoming insufficiency in physical development and formation of kinaesthetic sphere. The role of therapeutic and prohylactic physical training, rhytmics, gymnastics and special lessons

on special orientation undertaken for correction of the defects of physical development. Indications and contra-indications as regards physical exercises for children with various clinical forms of visual defects. Ways and means of improvement of the blind with the help of sports.

d) Pedagogical research on improvement of the contents, methods and organization of education at special schools for the blind and partially sighted. Working out of ways of further development of educational system, of the structure and types of special schools in view of planning of this system and further differentiation of teaching pupils. Ways and means of increasing the level of education in connection with the growing amount of information in conditions of technical and cultural progress. Education and the all-round development of pupils. Problems of poly-technical, industrial and vocational training of pupils at schools for the blind and partially sighted.

e) Technical devices of teaching, educating, compensation and correction of the disturbed and underdeveloped functions of vision.

f) Hygienic basis of teaching visually handicapped children. Working out of pedagogical and hygienic requirements to designing of school buildings for teaching the blind and partially sighted as well as to constructing of special equipment for partially sighted children (desks, tables, chairs); hygienic substantiation for general and individual norms of artificial lighting. Requirements to graphic design of textbooks, didactic material, note-books, etc. Study of fatiguability and working abilities of visually handicapped children of school age, determination of school assignment norms and those of regime of educational activities at special schools. Recreation, protection and development of defective vision in the process of teaching.

Let us dwell on several scientific problems which form a part of the above-mentioned trends of research.

1. Mechanisms, ways and conditions of compensation of disturbed functions in case of blindness and low-vision. On the basis of a long-term pathophysiological research of clinical forms, etiology, pathogenesis of visual disturbances there was discovered the structure of visual defect, shown the typology of abnormal development of blind and partially sighted children and made clear certain genetic factors which cause the emergence of individual forms of visual pathology. (Research undertaken by Kaplan. A.I., Pevzner M.S. and Eidinova M.B.).

   Study of the brain electrical activity on a large number of blind and partially sighted school pupils gave a possibility of reveal the peculiarities of neuro-dynamic processes in case of the total blindness and different degrees of visual defects. There was shown a direct dependence between the degree of alpha-rythme expressiveness and preservation of the central vision acuity and discovered the physiological mechanisms of compensating reorganisation of nervous processes when the vision is lost. It was discovered that when a person is blind the focus of the brain electrical activity is transferred from the cervical sphere to the central cortix zone.

   The experiments carried out on animals showed the change in correlation of cortex and sub-cortex functional activity in case of the loss of eyesight. The obtained data on investigation of the brain electrical activity would allow to substantiate the principal trends of the active interference into the process of compensating development when dealing with blindness and deep visual disturbances (Inverstigations undertaken by L.A. Novkova and N.N. Zislina).

   The psychological and pedagogical investigation of ways and conditions of the compensation of disturbed vision in the process of teaching was carried out for many years. This allowed to reveal large potential possibilities of psychic and physical development of blind and partially sighted children, to show the natural correlation of teaching processes and compensating developments on different age levels at various degrees and clinical forms of visual disorders. The obtained data on psychological and pedagogical

investigation of children and of compensating conditions in case of a different structure of the defect allowed to give grounds for ways and forms of differenciated teaching of visually handicapped children and of correcting work to prevent secondary deviations in the development (Investigations of M.I. Zemtsova, Yu.A. Kulagin, L.F. Kassatkin, N.S. Kostuchek, N.B. Lurje, I.S. Morgoulis, N.G. Morozova, B.A. Sermeev, L.I. Solntseva etc.)

2. Study of peculiarities of the cognitive activity of visually handicapped children.

Peculiarity of the processes of perception in case of blindness and deeply disturbed vision (slowliness and many-staged forming of images in fragments) was revealed by means of comparable and experimental psychological investigation of psychic processes of blind, partially and normally sighted children. Such psychic phenomena as observation, memory images, figurative thinking arbitrary attention, logical memory special orientation are disturbed if a child is blind or partially sighted. Certain disproportions in the development of the verbal-logical systems of communications on the one hand, and visually - sensory elements - on the other, are observed when the vision is lost or deeply disturbed. It is noticed that impoverishment of sensor experience causes certain changes in a concrete word meaning in pupils' speech and sometimes it results in a formal acquisition of knowledge.

Abnormalities in the development of higher psychic functions of primary school children are of secondary and temporary character. Evident deviations in psychic development of the children could be overcome under conditions of special education. A great number of psychological and pedagogical investigations have shown that disturbances of visual functions do not hinder the development of comprehensive thinking and the logical aspect of the speech of blind, partially sighted and "low-vision" children. This is true if visual disorders are not accompanied by attending diseases of the central nervous system, (Research carried out by M.I. Zemtsova, N.S. Kostuchok, V.A. Lonina, Z.P. Mikhailukova, I.S. Morgulis, L.I. Solntseva, N.S. Tsaric, etc.)

Studying of cognitive activity peculiarities made it possible to work out on a scientific basis a system of visual aids, special devices, to improve methods of teaching and recommend forms of differentiated teaching of visually handicapped children. Numerous problems connected with cognitive activity of visually handicapped children are being worked out in a differentiated aspect under the guidance of A.I. Zotov, the Head of Typhlo-Pedagogical Department of the Leningrad Teacher-training Institute after Hertsen (Research by A.G Litvak, V.A. Feoktistova etc.).

3. Dynamic and clinico-pedagogical study of the contingent of pupils at the schools for the blind and partially sighted.

In conditions of the present development of the society the contingent of pupils changes year after year under the influence of social, economic, demographic factors. It is also influenced by the achievements of medicine. This could be proved by the study of dynamics of pupils contingent at school for visually handicapped children carried out every other 5 years (1958, 1963, 1968) by the Institute of Defectology. The child blindness was found to be reducing year after year. For instance, in the Russian Soviet Federative Socialist Republic in 1958 25 % of all pupils studying at special schools were absolutely blind, in 1963 they made only 12 % and in 1968 - 8 % [x]. There is also observed a noticeable decrease of the number of the blind children with residual vision. Clinical forms and etiology of visual disturbances undergo changing as well.

At schools for the blind, the principal clinical forms will be cataract, atrophy of the visual nerve, microphtalm. As against the gradual decrease of the acquired forms of blindness and weak eyesight there is observed a relative increase of inborn forms. There is a slight increase in the number of blind and partially sighted children with attending disturbances of the central nervous system.

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x) The similar data of the decrease of the children's blindness were obtained in all other Republics of the Soviet Union.

The obtained data allows to give reasons for the development of the differentiated network of schools, to work out measures on treatment, prophylactics and rehabilitation as well as to make projects of the further development of the educational system, of the types and structure of schools.

4. The Development of the System of Education and Improvement of the contents of education.

In connection with the development of science, culture and technology, and the improvement of the system of public education as a whole at the present time in our country on the basis of scientific research the contents of education at schools for the visually handicapped was greatly improved. And at those schools the polytechnical and vocational training were radically reconstructed. This result in introduction of teaching such subjects as electrotechnics, elements of machinery, fundamentals of production, special graphics. Newly-introduced industrial types of labour lessons changed primitive types of aprenticeship. To give pupils the amount of conscious and deep knowledge in compliance with the curriculum for regular schools and for them to cover the material by the due tempo, an extra year was added to the term of studying at special schools for blind and partially sighted children. This was done at the expense of organizing preparatory classes. The number of laboratory lessons and other types of independent practical work was also increased. In view of health protection of the children the amount of school assignment was reduced, the regime of studies was changed and the teaching hour at the preparatory classes was cut down. To promote the individual teaching assistance to children, the number of pupils in a class was made not more than ten, and in case of children whose visual defects are accompanied by mental and speech disturbances, this number becomes 5-7 pupils in a class. Fulfilling the task of the Ministry of Education of the USSR the Institute of Defectology assisted by the teachers of basic schools has worked out a new structure of special schools, new teaching plans and curricula; new text-books are now under preparation. All this is done in accordance with demands to public education. A new enrolment instruction for special schools

for visually handicapped was drafted. New teaching aids on industrial and vocational training, on teaching fine arts and other subjects to the blind were developed for special schools.

5. Technical aids for teaching visually handicapped children.

The improvement of the educational level of blind and partially blind children, quick tempo of covering the learning material put forward the problem of developing technical devices for acquiring and digestion of information in an economical way. Technical aids are used with due regards for the peculiarities of cognitive activity and processes of compensation of the disturbed functions. Special electronic recording devices, hearing and vibrational, are being created. This is the basic principle for the construction of various aids of indirect signalization for laboratory and practical work on physics, chemistry, geography, biology and other subjects. This enables the blind to acquire knowledge and skills in accordance with the full regular school curriculum and to obtain higher education on various specialitites. Models of reading apparatus with polyphonic and tactil signalization were constructed. Audio-visual aids are widely used in school for partially sighted children. In teaching deaf-and-dumb children an important role is given to technical aids for receiving information. This gave to some of the children an opportunity to gain secondary education and to enter higher educational establishments.

The problems of programmed teaching are being successfully settled in order to raise the effectiveness of education. Such optical aids of vision correction as different types of table and put-on magnifying glasses help to partially sighted children to increase in 1.5 - 2 times the speed of process of reading texts in ordinary manuals. The use of such sets contributes to the promotion of the effectiveness of teaching and acquiring valuable visual information.

6. Protection and hygiene of under-developed vision with the pupils of special schools.

6. Complex clinical, physiological and hygienic study of the influence of different levels of lighting on changing of partially sighted children visual functions served as a basis for working out new norms of artificial lighting in school buildings. These norms found their way to all schools for visually handicapped children. Special furniture, in particular school desks, was designed to further the increase of working ability and decrease of fatiguability of pupils. To be ready to take up a new teaching plan and curricula much work has been done in studying the eff ciency of partially sighted children in primary schools and recommendations on regulations of learning material and improvement of pupils´ school regime were given. Optimum size of print for text-books to be used in schools for "low vision" children were designed. To teach visual reading to partially sighted children search investigations on constructing flat type were carried out.

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2. "Partially Sighted Children". Articles. Edited by Kulagin, Yu.A., Morozova, N.G., Aidinova, M.B., Moscow, "Prosveshchenie", 1967.
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8. Lurje, N. B. "Peculiarities of Teaching Partially Sighted School Children". Metodical Letter. Moscow, "Prosveshchenie", 1968

9. "Peculiarities of Perception of the Blind and Compensation of the Lost Vision by Means of Typhlo-Technics. Works of the Research Institute of Defectology". Chief Editors Zemtosova, M.I., Sokolanskij, I.A. , Moscow, "Izvestia" of the Academy of Pedagogical Sciences of the USSR., Issue 90, 1957
10. Ermacov, V.P. "Vocational Training at Schools for the Blind". Moscow, "Pedagogica", 1970
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EDUCATIONAL RESEARCH ON LEARNING PROBLEMS FOR THE VISUALLY HANDICAPPED

The educational system for the visually handicapped in Sweden consists of a special school for the primary education of the congenitally blind and a system of individual integration of all students at higher levels. A total number of about 500 pupils and students are at present served within this system.

One of the specific traits in the learning situation of the visually handicapped is the use of special information media as a substitute for inkprint material. An effective use of these media is a necessary but not sufficient condition for success in the education of the visually handicapped and is of special importance for the individually integrated student.

In order to analyse the learning situation of the visually handicapped, with special emphasis on problems in connection with special media, the Department of Educational Research at the School of Education in Uppsala in 1969 started a research which runs on a 5 year schedule and is sponsored by The National Board of Education.

Aim of project

The aim of the project is to record the difficulties experienced by persons with visual impairment with regard to studying, and to attempt to improve methods of acquiring knowledge.

Structure of the investigation

The work of the project can be divided into three main spheres:

1. Study of the problems, a more detailed recording of the connection between study problems and background variables, as well as a presentation of relevant issues for detailed analysis.

2. Execution of a series of subordinate investigations in connection with item[1)] above, as well as a small number of major and more detailed investigations.
3. Implementations of the results.

Methods

The work is mainly arranged in accordance with three principles:

1. With the aid of bibliographical compilations and analyses of previous research in this field, both in Sweden and abroad, to place the problems in a broader context and thereby arrive at the most relevant formulation of the issues.
2. With the aid of comprehensive questionnaires and interviewing procedures, to obtain a clearer picture of the study problems of persons with visual impairment.
3. With the aid of various experimental techniques, to work out as efficient study methods as possible for every category in connection with the special media. Braille and talking books have been subjected to a more detailed study from the point of view of the psychology of learning.

Field of work

Three major investigations are planned to take place within the framework of the project:

1. Study of braille as a medium for learning.
   This will include plans to develop a new method for analysing the reading process in connection with braille and to study how sensitivity of the fingers, training effects, etc., affect the rate of reading. It is intended that the relations between rate of reading, comprehension, capacity and retention on the one hand, and on the other hand uncontracted braille and braille abbreviated in various ways, will be studied. There are also intentions to develop new materials to be used in the teaching of braille among school-beginners.
2. Auditive recorded information will be analysed from the point of view of retention and compared to visual reading. Various forms of pre-additing of material and of note-taking techniques will be tested and evaluated. The importance of certain background variables will also be analysed. At the October conference a paper will be given on the present state of these investigations.

3. Means of conveying graphical information.
   There are two main ways of communicating non-visual graphical information:
   a) Verbal discriptions of diagrams and graphs are given in talking books
   b) Tactile graphical material are produced within braille books and as a additional material to both braille and talking books.

   The possibilities and limitations of these methods are being analysed within the project. A paper will be given at the October conference on the present state of these investigations.
4. Mental adjustment.
   As it is a known fact that the students' mental state affects study efficiency, the intention is to determine, with the aid of certain background variables, how various categories of persons with defective vision function mentally in study situations and how they succeeded in adjustment to their handicap.

Some investigations - finished and in progress

1. Bibliographical collection.
   On behalf of the project a part-time librarian has been employed, whose work consisted of compiling a bibliography of relevant literature, mainly based on the following four sources:
   a) AFB research index
   b) Review of educational research
   c) Psychological abstracts
   d) Listening bibliography

   The report which has now been issued is arranged in three main sections: one dealing with auditive information, one dealing with tactile, and a third with general problems. The bibliography includes about 400 items.
2. Questionnaire to teachers concerning individually integrated pupils.
   Questionnaires adressed to teachers to record how the integration of pupils with severe defects of vision is proceeding in the comprehensive school. All teachers in grades 8 and 9 of the subjects English, Chemistry and Social science in

Sweden, who have a pupil with visual impairment in their classes have been sent a questionnaire mainly concerned with the following aspects:

a) Information for the teacher of the pupil with visual impairment.
b) Visit/s by the itinerant teacher.
c) Availability of teaching material.
d) Existing braille and talking book literature.
e) The so-called "Test Paper Service" of the Aids Centre.
f) The organisation of lessons.
g) The adjustment of the pupil.
h) Daily routine with a pupil suffering from visual impairment.

To sum up, it may be said that first-hand information has come to the knowledge of the teachers to a very varied extent. Visits by itinerats teachers have generally been appreciated but have come too late. Similarly instructional materials of various kinds have arrived too late during the term, sometimes not until 6 weeks after the start of the term. The "Test Paper Service" has been utilized to a relatively small extent but appreciated in those cases when teachers have used it. The teachers consider that the extra work involved on behalf of a pupil with visual impairment has been less than was originally expected, and that while the pupils have adjusted well to the school situation they tend to be too passive during lessons, and most of them do not trouble to take any kind of notes.

The questionnaire was distributed to 57 teachers, 51 of whom responded.

3. Study of the relationship between auditive and visual information.

This report, which is connected with our analysis of the talking book as a medium of instructions, is a comparison of information presented auditively and visually and of retention shown by subjects with normal sight and blind subjects. In a first investigation we have compared blind pupils and pupils with normal sight (90 pupils from grades 5-9). We have tested their immediate retention of auditive information. The results show no difference between pupils with normal sight and blind pupils in grade 5 (about 11 years of age), but the blind pupils achieve better results in the higher grades.

In a second investigation we have tried to find out whether there is any differences in the retention shown by pupils with normal sight when a material is presented auditively and when it is presented visually. We have further attempted to find out if there is any difference between pupils with normal sight and blind pupils when a material is presented auditively. The material used in this second investigation was of a different type.

When the retention of pupils with normal sight was tested, we found differences between auditive and visual presentation, in the favour of visual presentation. This difference disappeared after a week. No significant difference was found in the retention of material presented auditively to pupils with normal sight and blind pupils. We noted that tiredness affected the results of subjects with normal sight on the first occasion that retention was tested. This exhaustion effect disappeard after a week. No such effect was noted for the blind.

School marks were used as a background variable. There was positive correlation between marks and results in the test for both pupils with normal sight and blind pupils.

4. Speed of talking books and comprehension capacity.
   This investigation was intended to determine whether an increase in the speed of talking books reduces comprehension capacity and retention. Various experimental groups listened to a talking book with various rates of reading. The texts were also of two types, one being literary and the other factual in character. The investigation revealed that no deterioration could be observed up to an acceleration of 20 % over the normal speed.
5. Mental adjustment of persons with defective vision at adjustment courses.
   The investigation was intended to study the effects of the adjustment courses on the mental state of persons with defective vision. All pupils admitted to the adjustment courses in Sweden were tested by means of Adjustment Test CMPS, and the intention is to carry out a follow-up study after 6 months in order to determine the effects of the courses. The test will be supplemented by personal interviews

and the results related to education, duration and degree of defective vision as well as certain other background factors.

6. Graphic information conveyed by verbal description.
The possibilities of being able to transfer information about graphs by the use of verbal description were investigated as part of an analysis of the talking book. The problem was seen against an information theoretical background. By considering man as a channel for information processing with a limited capacity for receiving and processing information, the independent and dependent variables could be operationalised within the same conceptual system. The experiment was based on the hypotheses that detailed verbal descriptions (of high complexity) would lead to less understanding than less-detailed verbal descriptions (of low complexity), that understanding of the description of the graph would be less the more complex the graph described, and that this effect would be stronger for a detailed than for a less-detailed verbal description of a graph.

To measure the dependent variable "understanding the description of a graph", a logarithmic measure (amount of information in bits) was used, which measures the distribution of the responses over the five alternative responses, given for each description. The alternative responses consisted of a correct reproduction fo the figure that was described and four distractors. The result of the experiment was that rough verbal descriptions gave significantly better understanding than detailed descriptions. More complex graphs showed a weak but not significant tendency to be less understood.

Contrary to expectations, this relation was not affected by the amount of detail in the verbal description. The theoretical consequences of this result are discussed, as are other problems met with in the design of the talking book within the conceptual framework of the information theory.

7. Questionnaire to individuelly integrated students.
An investigation conducted by questionnaire concerning the subjective conception of those with visual impairment with regard to difficulties in studying and the pupils' degree of activity in adult education for persons suffering from visual

impairment has been carried out. A report has not yet been issued.

8. The effect of tactile surface structures.
   In collaboration with the Department of Psychology, two investigations have been carried out to study various surface structures used in embossed mapp production. Final reports have not yet been issued.

SECTION II

FIVE INTRODUCTORY PAPERS ON VITAL EDUCATIONAL PROBLEMS FOR THE VISUALLY HANDICAPPED

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CONSERVATION OF SUBSTANCE IN THE BLIND AND PARTIALLY SIGHTED

Summary

The effect of visual impairment is discussed in terms of previous investigations examining a variety of perceptual and cognitive skills. One of the reasons for the British practice of providing segregated facilities for the blind and partially sighted rests upon the belief that compensatory education is necessary and, furthermore, can only be effected within a 'specialist' system. Much of the evidence adduced to justify the current practice is based upon the performance of visually handicapped children on conventional tests of intelligence and achievement and on a variety of auditory and tactual tasks. It is suggested that Piagetian-type problems may be of direct practical use to teachers of the visually handicapped in terms of both diagnosis and teaching. From a replication of a conservation of substance experiment with a group of 189 blind and partially sighted children, it is inferred that, while the best of them perform on a par with the sighted, the age range, in which conservation is reached is much more extended in the case of the visually handicapped.

The segregation of visually handicapped children, which is characteristic of the British - but not so much of the American - system of education rests upon a number of suppositions. One of these is that, as Wills (1965) puts it, the child "lacking a major sense such as vision would understand his world later and in a different way from a child with full sensory aquipment". There are, of course, other reasons for this segregation, such as the assumption that it is more efficient to house the specialist equipment and staff in one place. If the supposition that Wills refers to is well-founded, then the 'later' understanding of his world by the visually handicapped child may be brought forward or accelerated by the special and systematic techniques that can be deployed in a segregated system. Some support for a kind of developmental lag may be found scattered through the rather sparse literature reporting research in this area.

Gomulicki (1961), for example, in an investigation of the development of perception in the blind found five-year old blind children to be significantly inferior over a wide range of tactual and auditory perceptual skills as compared with a group of sighted peers. By the age of ten, the blind had largely caught up and Gomulicki inferred that the absence of the integrative function of vision served to make "the task of developing effective use of the other senses a particularly difficult one". Similar findings are reported by Menaker (1966) who compared blind and sighted subjects on tasks involving the tactile-kinaesthetic sense. The improvement with age on a sizeweight task was more rapid among the sighted. In a dissertation not seen by the author, Hartlage (1967) is reported to have compared the performance of sighted children and children blind from birth on concepts of a spatial and a non-spatial nature. The blind were inferior to the sighted at all ages on the spatial questions but were operating at a similar level on the non-spatial items. In the U.S.S.R., Zemtsova and Solntseva (Solntseva, 1966) demonstrated that at the pre-school period "there persists for a very prolonged time.... a marked generalization, and global, poorly differentiated recognition" of ordinary household objects, the blind child tending to label objects by their class rather than specifically. Difficulty was also found in recognition of smallscale models of familiar objects and the Russian investigators inferred that this was due to the "complexity and difficulty of formation .. of constant images, perceptions, and concepts".

Although some studies (e.g. Hunter, 1954) have reported superiority for the blind on some tactual perception tasks involving tactual recognition of geometric shapes and justments of 'straightness', the overall weight of what little evidence there is would seem to suggest that severe visual handicap is associated with greater difficulty or expenditure of time in attaining comparability with the sighted in some perceptual and cognitive skills. Further support for this interpretation may be found in the investigations carried out by Tillman (1967) and Zweibelson and Barg (1967). The former compared 110 blind and 110 sighted children in the WISC and summed up his findings as showing, for the blind, "a lack of integration among educational experiences" with each bit of knowledge being "isolated and cast into a separate frame of reference". Verbal

abilities were seen as focussing on a "basic vocabulary without much elaboration", with the blind tending "to approach abstract conceptualization problems from a concrete and functional level" and therefore lagging behind their sighted peers. In their smallscale investigation using the similarities and vocabulary subtests of the WISC, Zweibelson and Barg also found significant differences, with the blind children operating at a more concrete, functional level of conceptualization.

In some of these studies, the investigators have drawn attention to the fact that the best of the blind children were performing as well as the best among the sighted. The inference is that visual handicap is not, per se, the cause of any observed, overall retardation of development. In the ligth of their examination of some 295 blind pre-school children in the United States, Norris, Spaulding, and Brodie (1957) went so far as to say that the "child who has had favourable opportunities for learning nursery school program with sighted children". In the absence of any means of ensuring that these "favourable opportunities" are available for all blind children, the school is left with the twin tasks of identifying the underpriviliged when they arrive and providing the appropriate compensatory stimulation. For the teacher, Piaget's approach to the investigation of cognitive development has the advantage of being, at least potentially, both diagnostic and educative; as Lovell and Ogilvie (1960) have put it, Piaget's "experiments are in themselves learning situations". In the investigation reported here, which is part of a series of replications with visually impaired subjects of the classical Piagetian conservation experiments, the aim was to explore the problem of the suggested developmental lag of the visually handicapped child from a different standpoint and to evaluate Piagetian-type tasks as simple diagnostic tools for use by teachers of the visually handicapped. While the procedures detailed by Piaget (e.g. Piaget and Inhelder, 1941, p. 7) were to be followed in principle, some minor modifications similar to those used by Lovell and Ogilvie and Elkind (1961) were adopted and are described below.

Method

Subjects

One hundred and eighty-nine children registrered as blind or partially-sighted participated in this part of the study. They were drawn from two schools, one a residential school for the blind and the other a day school for the partially-sighted. Both were 'all-age' schools, with an age-range of 5-17 years. At the primary school level, the children would represent the full ability range but at the secondary level there would be a curtailment of the I.Q. distribution as a result of operation of grammar school selection procedures. As categorisation of a child as visually handicapped depends upon an ophthalmologist's evaluation of measurable visual acuity and field of vision, a 'blind' child may be one who is totally and unquestionably without vision, as in the case of bi-lateral retinoblastoma involving excision of both eyes; at the other end of what is a continuum of visual defect, the child may be one who has moderate acuity but a very restricted visual field. When the partially-sighted are included, this continuum is extended considerably. For the purposes of this study, the subjects were assigned to one of three groups. Group 1 were those who could count the investigator's fingers, the subjects being allowed to move their position and distance to obtain the best optical conditions. Group 2 consisted of those who had 'objectsperception' or could see a moving hand at the position and distance most convenient to them. Group 3 comprised the totally blind and those with 'light perception', i.e. those who could tell they were facing a window in daylight conditions or could visually recognise when the electric light was switched on and off. No selection of subjects was made; all those in the age range 5.0 to 15.11 inclusive were tested.

Apparatus

Five balls of plasticine were made. All were different in colour, and all very clearly different in size except for two which were made from similar quantitites of plasticine. To maintain a similar feel and consistency, the balls were immersed in warm water between testing sessions.

Procedure

Each subject was tested individually, the interview being tape-recorded, and each was asked to feel the five balls of plasticine on the tray in front of him. It was made clear that two of the balls had been made from the same amounts of plasticine, and S's first task was to find these two balls. Once this had been done, E removed the other three balls while S held the two that were alike. He was then asked to give E one of the two balls and was again questioned as to whether E had the same amount of plasticine as himself. If there was any doubt in his mind, he was told he could do whatever he wished to make the two balls alike. Four further questions were then asked:

1. Prediction. "If we roll my ball into a shape like a sausage by pressing down on it, will there be as much plasticine in my sausage as in your ball?"

(E and S together then rolled his ball into a sausage.)

2. Judgment. "Is there as much plasticine in my ball as in your sausage?"
3. Explanation. "Why do you say that? Can you give me a reason?"
4. Reversibility. "What would happen if we rolled my sausage into a ball? Would there be as much plasticine in may ball as in yours?"

If a "Yes" had been given to questions 1 and 2, and a satisfactory explanation given in response to question 3, the interview was closed after question 4. If anything other than a set of three correct responses was given, the procedure was repeated, but the questions and deformations were in respect of the ball held by S. If the same pattern of answers emerged, the interview was closed. It the pattern changed, the procedure was repeated for the last time, with E's ball again being the object to be deformed. Question 4, suitably changed, followed in each case.

Scoring

Each S's last set of responses was used for deriving a conservation score. Two methods of classification were used. Method 1 involved using questions 1-3 inclusive, with each conservation response being scored 1 and each non-conservation response being scored 0; for each S, there was, therefore a maximum conservation score of 3. In Method 2, S was classified as a conserver only if all three responses were correct; a less than perfect score entailed classification as a non-conserver.

Results

Table 1 shows the number and percentage of conservation responses made at each age level by subjects in each category of visual impairment. For comparison, the appropriate section of the results obtained by Elkind with sighted subjects is included. The precentage of conservation responses made by Elkind's 7 year olds was 70 %, a figure that steadily increased from then on. In the present study, the 70 % level was not reached until age 9.0 - 9.11.

x)

Table 1. Number and Percentage of Conservation Responses (N=189) Method 1.

Degree of Vision	AGE LEVEL									
	5.0-6.11	7.0-7.11	8.0-8.11	9.0-9.11	10.0-10.11	11.0-11.11	12.0-12.11	13.0-13.11	14.0-14.11	15.0-15.11
Can count Fingers, using Vision	16/54=30% n=18	25/63=40% n=21	34/54=63% n=18	30/54=70% n=18	25/27=93% n=9	27/27=100% n=9	12/12=100% n=4	36/39=92% n=13	32/33=97% n=11	45/45=100% n=15
Can Perceive Objects/Hand Movements	0/9=0% n=3	3/6=50% n=2	2/3=67% n=1	3/3=100% n=1	4/9=44% n=3	- -	- -	- -	- -	9/9=100% n=3
Can Perceive Light or are Totally Blind	0/18=0% n=6	10/18=56% n=6	3/9=33% n=3	3/6=50% n=2	9/12=75% n=4	9/12=75% n=4	9/9=100% n=3	15/15=100% n=5	6/9=67% n=3	6/12=50% n=4
Total	16/81=20% n=27	38/87=44% n=29	39/66=59% n=22	44/63=70% n=21	38/48=79% n=16	36/39=92% n=13	21/21=100% n=7	51/54=94% n=18	38/42=90% n=14	60/66=91% n=22
Elkind study with sighted subjects (n=25)	5.0-5.11: 19%	6.0-6.11: 51%	70%	72%	86%	94%	92%	-	-	-	-

x) Maximum possible score per subject = 3

Table 2 shows the analysis based upon Method 2, with classification as 'conserving' being dependent upon correct answers being given to all three questions. This more stringent procedure results in the 70 % level not being reached until age 10.0-10.11, but the small numbers of subjects at each age level could easily account for such a change. No direct and clearly valid comparison can be made with other studies but Beard's (1963) investigation into conservation among sighted primary school children gave precentages of conservers in five agegroups. In the age-groups 4.10-15.9, 5.10-6.9, 6.10-7.9, 7.10-8.9, and 8.10 upwards, the percentages were 47 %, 63 %, 72 %, 70 %, and 86 %, with the 70 % level being located, therefore, in the 6.10-7.9 group.

In the Lovell and Ogilvie study the criteria for classification as non-conservers, transitional, and conserving are not made explicit and the age-groupings are rather different from those used in the present study. However, by allowing one conservation mark to each of their 'transitionals', and three to each of their conservers, a set of precentages of conservation responses may be obtained for each of the four years of junior school (7 to 11+). They are: 69 %, 80 %, 88 %, and 95 %. These may be compared with the percentages for the visually handicapped aged 7.0 to 11.11 (the two years 10.0 to 11.11 being combined), as derived from Table 1, viz. 44 %, 59 %, 70 %, and 85 %. (Worth noting here is the close similarity between the Lovell and Ogilvie findings, based on sighted children in Great Britain, and the Elkind findings, based on sighted children in the United States. In both cases, the precentage of conservation responses at each level is higher than the corresponding figure obtained with the visually handicapped.)

Out of 58 non-conserving subjects who gave 'explanations' for their judgments, 42 gave explanations of a perceptual nature, centering on such features as length, height, fatness, thickness, roundness, and weight (two only). Seven said the sausage had most "Because we've rolled it out.";

Table 2. Number and Percentage of Conservers (N=189). Method 2.

Degree of Vision	AGE LEVEL									
	5.0-6.11	7.0-7.11	8.0-8.11	9.0-9.11	10.0-10.11	11.0-11.11	12.0-12.11	13.0-13.11	14.0-14.11	15.0-15.11
Can Count Fingers, using Vision	2/18=11%	6/21=29%	11/18=61%	11/18=61%	8/9=89%	9/9=100%	4/4=100%	12/12=92%	10/11=91%	15/15=100%
Can Perceive Objects and/or Hand Movements	0/3=0%	1/2=50%	0/1=0%	1/1=100%	1/3=33%	-	-	-	-	3/3=100%
Can Perceive Light or are Totally Blind	0/6=0%	3/6=50%	1/3=33%	1/2=50%	3/4=75%	3/4=75%	3/3=100%	5/5=100%	2/3=67%	2/4=50%
Total	2/27=7%	10/29=34%	12/22=55%	13/21=62%	12/16=75%	12/13=92%	7/7=100%	17/18=94%	12/14=86%	20/22=91%

two gave this same reason in justification of their belief that the ball had most. Other explanations included references to colour (one only), strength, eating, and E's personality ("The ball has most because you're nice!"). Among the 117 subjects who were classified as conservers in Table 2, i.e. those who gave three correct responses, the explanations may be categorised as follows:

a) Plus/Minus (e.g. "None added or taken away."), 34 (29%)
b) Reversibility (e.g. "They were the same before."), 61 (52%)
c) Co-ordination of Relations (e.g. "The sausage is longer but thinner."), 9 (8%)
d) Shape (e.g. "It has only been changed in shape."), 9 (8%)
e) Identical Action (e.g. "The ball would be the same if rolled out."), 3 (3%)
f) Weight (e.g. "It would still weigh the same."), 1 (1%)

The youngest subject offering an explanation in categories (c) to (f) inclusive was aged 7 years 10 months.

In labelling category (b) as 'Reversibility', the practice adopted by Lovell and Ogilvie has been adopted. Another aspect of this problem was tackled by the use of Question 4 ("What would happen if we rolled my sausage into a ball? Would there be as much plasticine in my ball as in yours?"). All those conserving said that there would be the same amount of plasticine in both balls. Among the non-conservers, 30 out of 58 (52%) said there would be the same amount in both balls, while 28 (48%) said there would not. Analysis of the tape-recordings of the responses did not produce sufficient clarification on this issue and it is not possible, therefore, to say with certainty whether all the 52% were demonstrating reversibility as opposed to making a correct 'guess'. Nevertheless som of these subjects did justify their answer by referring to the initial equality and this would seem to indicate that reversibility may be a necessary but not a sufficient condition for attainment of conservation. The small numbers of subjects in some of the cells made it impossible to evaluate differences among the categories of degrees of residual vision.

Discussion

The increase in conservation responses with age that has been demonstrated by Piaget and other investigators working with sighted subjects in further confirmed in this investigation with the blind and partially sighted. The necessarily tentative comparisons with some of these other studies would seem to suggest that while the best of the visually handicapped attain conservation as early as six or seven years and are therefore equal to the best of the sighted, there is a greater spread among them, with a substantial number not conserving until beyond the age of nine or ten. These findings are in line with those of Gomulicki on the slow development of perceptual skills among the blind. How far this developmental lag is attributable to restrictions in the extent and quality of the visually child's learning experiences and interactions with his environment is difficult to assess. It may be that visual impairment reduces the number of those entirely fortuitous experiences in which for the sighted child, the inadequacy of his existing schemata is borne in upon him. A comparison of the home and other pre-school backgrounds of, for example, conserving and non-conserving blind six years olds would be one indirect way of testing the hypothesis that differences are traceable to the nature and complexity of the stimulation received. An alternative, and more direct, method of investigating this hypothesis would be through experimental comparison of different kinds and intensities of training, along the lines of those used by Smedslund (e.g. 1961). The importance of the school in making good these deficits (if these are, in fact, the cause of the observed wide disparities in performance) would seem to need little underlining. Whether or not the needs of the visually handicapped child are best served within our present segregated system, provision for accurate diagnosis, and appropriate compensatory teaching, must be made. In so far as Piagetian conservation tasks have both a diagnostic and a learning component, their value to teachers of the visually handicapped is considerable.

Although the present study was unable to show any differences attributable to degree of vision, the need for further research on this aspect of the problem is clear. With the possible exception of comparisons between the totally blind and the partially sighted, further advances in our understanding of the effects

of visual handicap will depend on the development, by ophtalmologists and other specialists, of more refined measuring procedures. At the moment, classification has to be on a somewhat coarse basis, with the groupings lumping together subjects with widely differing levels of visual efficiency.

Piaget's use of the term 'reversibilité' has been a source of some difficulty and misunderstanding but if it has been correctly interpreted in this study, then it would appear that, as Lovell and Ogilvie found, the attainment of reversibility is not of itself a sufficient condition for the attainment of conservation of substance.

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FACTORS UNDERLYING THE ABILITY TO LEARN BRAILLE IN FORMER READERS OF INK-PRINT

Summary

This paper discusses some of the teaching and organismic variables associated with success in learning braille by people who were able to read ink-print before the onset of blindness. The teaching variables were size of braille cell (two levels) and grade of braille (uncontracted braille as opposed to a contracted form). The organismic variables were personality factors, tactual discrimination ability, age, sex, degree of residual vision, and short-term memory capacity (digits). The results showed a significant interaction between size of cell and grade of braille, with the large cell, contracted treatment leading to superior performance on a variety of braille post-tests. Organismic variables of importance were intelligence, tactual discrimination ability, sex, and the personality factors of desurgency and self-sufficiency.

This paper is a selective summary of just one of a series of studies that have now been completed and written up in a report entitled "Programmed Instruction and Braille Learning. An Experimental and Multivariate Investigation of Some Teaching and Psychological Variables." Stencilled copies of the full report are available on request to the Research Centre for the Education of the Visually Handicapped, School of Education, University of Birmingham.

The purpose of this investigation was two-fold. In the first place, it was intended that a self-instructional programme should be devised to enable newly-blinded adolescents and adults to learn braille in the absence of a regular teacher. Secondly, it was hoped that, through the use of survey, correlational, and experimental methods, some light might be thrown on the relative value of differing teaching approaches and on the importance of various 'organismic' variables, such as touch, age, personality, sex, degree of residual vision, and short-term

memory, to the process of learning braille. The linking together of these two aims was to be made by the use of the techniques of programmed learning. The self-instruction materials comprised a linear programme through which the learner progressed in a series of steps consisting of instruction - activity - confirmation. The investigation of the teaching methods and the learner characteristics demanded that control be exercised over other known external determinants of learning, the most importance of which was considered to be the 'teacher variable'; the programme would make it possible to use the same 'teacher', employing a variety of methods and unaffected by fatigue, by differing rapport with different learners, and by a varying enthusiasm from day to day and week to week.

The independent variables used in the experimental phase of the study were identified by means of a questionnaire survey of current methods of teaching braille to the newly-blinded. This survey (which is not reported here) isolated two major sets of independent variables. Firstly, there was a roughly equal division of opinion as to the merits of starting with an expended braille cell. Justification for this approach consisted of arguments to the effect that the braillette board or giant cell made it easier in the early stages for the learner to discriminate one pattern from another. Opposition came from those who believed that such discrimination involved a different perceptual skill from that involved in identifying standard-size cells and that the practice entailed a subsequent 'un-learning'. Secondly, there was a difference of opinion and practice as to whether to start with Grade 1 or to incoporate right from the beginning some of the elements of Grade 2 (in this case, the Simple Upper Wordsigns).

Subjects and Methods

44 adults, registered as blind and aged 20-80 years, drawn from rehabilitation centres for blind and from persons resident in their own homes took part in the experiment. The sample contained 31 men, 13 women.

A ten-lesson self-instruction programme was prepared, presentation being by means of tape-recorded instructions and brailled booklets. Subjects were assigned to one of four treatment

groups - uncontracted, small cell group; contracted, small cell; uncontracted, large cell; contracted, large cell. Tests were administered to obtain scores on pre-braille tactile discrimination ability, short-term memory capacity (digits), 16 personality traits, and subjects were also categorised as to age, sex, and degree of residual vision; after completion of the learning, braille tests were administered and scores also obtained on the subjects' attitude to braille and their experience of learning braille.

Discussion

The experimental part of the investigation revealed that a trend discernible among the blindfolded, sighted subjects in Study 4 for higher performance by those using the large cell version of the teaching programme was confirmed with the blind subjects. However, the significant interaction between cell size and grade of braille showed that large cell treatment was significantly more beneficial only when combined with the contracted braille. The higher means of the uncontracted, large-cell group, while not significant, are, nevertheless, seen as suggestive, taken together with the results of Study 4, of a possible real overall superiority for the large-cell treatment. The need for further experimentation seems clear, with attention being focussed upon the nature and timing of the transfer from large to small cell. The higher performance of the large-cell group may be explicable in terms of task difficulty, the task having two components - one perceptual and the other cognitive. If the tactual and spatial elements of the large cell are well above the subject's recognition thresholds, then the cognitive component of the task, the actual verbal labelling of the stimuli, can come into operation more quickly. In Hullian S-R terms the closer temporal contiguity will increase the habit strength.

The more favourable attitudes to their experience of learning braille of those who uncontracted braille and those who had large cell is possibly to be explained in terms of cognitive load. This would be in part consistent with the explanation already suggested for the more favourable attitudes also expressed by the sighted subjects towards the uncontracted braille (Study 4). The similarity in attitudes between the blind and the sighted in relation to grade of braille may be

seen as strong evidence for supposing this particular finding to have some universal validity.

The personality variables on which high and low braillists differed significantly were B (crystallized intelligence), F (Surgency/desurgency), and Q_2 (Self-sufficiency), the high scoring braillists having higher scores on B and Q_2 and a lower score on F. In addition, they obtained significantly higher scores on the pre-braille tactile discrimination test. The difference on Factor B needs little comment, general mental capacity being certain to be significantly related to any activity in which learning is involved. Of interest outside the immediate concern of the project are the differences on F and Q_2. In Study 4 these two factors were also found to be important, but in the reverse direction. The more surgent, group-dependent subjects are now doing less well. On common-sense grounds the more self-sufficient person might be expected to reach higher levels of achievement and certainly this is the pattern found in most other investigations. However, it is not so much that here success is correlated positively with Q_2+ as that poor performance is associated with Q_2-. It is the more highly group-dependent subject who is coping less well in the self-instructional situation; the high scoring braillist is, in fact, about average on this factor. The difference on factor F is more marked, with both groups diverging more - and in opposite directions - from the mean. The more surgent, enthusiastic, talkative, expressive subjects are obtaining lower braille scores, while the more desurgent, introspective, serious learners are performing better. This clear-cut difference between the blind and sighted subjects may best be interpreted in terms of the Furneaux (1957) and Lynn (1959) findings discussed in Study 4, that is in terms of extraversion being advantageous at school level but having detrimental effects on educational achievement beyond school level. F+ and Q_2- are both important components in Cattell's second-stratum extraversion factor, and it would seem, therefore, that Studies 4 and 5 may be offering further evidence for the 'switchover' theory. Cattell and Butcher (1968, p. 189) have themselves suggested that the surgency factor (F) may be related to scholastic achievement in opposite directions at seventh-grade level and university.

The uni-directional deviations of both groups from the mean of the whole group on personality facts A (affectothymia) and Q_3 (self-sentiment development) are suggestive of non-linear relationships. If they are non-chance deviations, they are difficult to interpret. It may be that the good-natured, co-operative, adaptable, A+ subject fits readily into the structural pattern of the self-instructional programme, and these characteristics therefore facilitate success, particularly when combined with self-sufficiency and high intelligence. The other observed characteristics of high affectothymia, viz. lower dependability "in precision work and in exactly meeting obligations" (Cattell and Eber, 1964, p. 11), might inhibit success when in combination with other detrimental traits, e.g. poor tactual ability. The Q_3- pattern may be interpretable in a somewhat similar fashion. It is important in the second-stratum factor of anxiety, and the person low in self-sentiment may gain support from this kind of teaching system and, if possessing other beneficial characteristics, score highly; if poor self-sentiment should go with, for example, poor touch and below average intelligence, then the trait may be gravely disadvantageous.

A point worth nothing is the relatively high mean age of the whole group, i.e. 49 years. It would seem that age as such was not a very important variable in the learning of braille, at least in the sense that there was no significant correlation between it and braille reading performance. Degree of residual vision, as measured here, also had no clear-cut relation to performance. Sex, however, had; women, on average, achieved higher scores.

If the results may be brought together in one sentence it would take the form of a verbal equation specifying a high tactual ability woman, characterised as affectothymic, intelligent, desurgent, and using a large-cell, contracted braille teaching programme.

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METHODS FOR CONVEYING GRAPHICAL INFORMATION TO THE VISUALLY HANDICAPPED

The visually handicapped have, compared to other groups with information handicaps, had an advantage at school, as the main source of knowledge has been the spoken word of the teacher. The difficulties have been more pronounced in the independent study for the blind, but here the increased possibilities to use the talking-book have been very helpful.

If traditional educational methods and traditionally designed instructional aids were the basis for the planning of future education of the visually handicapped, we should be able to create instructional systems with methods available today that would give the blind almost the same education that the sighted get. This is however not the case. The educational development during the latest years have been characterised by an increased use of visual media. Within a few decades, we will probably have computerbased instructional systems as a common aid in the school. The picture is a central part of many such systems and also of many conventional text-books. With methods available today, it would be very difficult to use instructional aids that will be considered necessities in normal schools in schools for the visually handicapped.

If we want to avoid a situation where educational methods for the blind lags the common educational development with several decades, we have to develop methods for conveying graphical information to the blind.

Differences in the senses' organisations of information

What possibilities to convey graphical information to other sense modalities than sight do we have then? If you with the expression "convey" refer to a presentation of a physiological stimulation, there are several technical possibilities to construct aids that achieve this goal. But as i obviosly is not the same stimulation being received, as that building up the visual figure, there must be an implicit assumption that the structure

of the visual figure automatically is transfered to the new medium. There are several reasons to doubt this.

First, there are differences in the information-handling charactere of the sense that can't be over-looked. Vision, for examples has a much greate capacity than audition to receive simultaneous stimulation. The displays that can be used visually can for example convey a very complex set of symbols, and you can analyse the set, symbol for symbol, and be able to compare any one of them with any of the others. If you want to do this with an auditive display you have to remember each of the sequencially received symbols in the set.

Second, there are connotations to stimuli that are specific for the sense the stimulus is received through. So, for example do we have a complex system of visual symbols to convey information of three dimensions in two-dimensional pictures. These kind of symbols is very often intuitively used.

Third, there are symbols to stimuli in the same sense as those mentioned above, but in this case they are used with a conscious purpose. I will give an example of this with a quotation from the aricle "Visual communication" by June McFee: "Out of individual or collective experience, symbols are invented to express the nature of experience. The symbols are expressed through visual design to project their meaning, and the meaning is responsed to in terms of the readiness of the viewer. For example, a curving line with an arrow point at the top means curving road ahead to most drivers. The symbol illustrates the problem of driving on a curving road.- it communicates a shared experience. But to people who don't drive, or have had experience in driving only in flat open country, or haven't seen such a sign, or have had very treatening experience with such driving situations, the symbol will communicate somewhat different things. A visual symbolic message is not a direct transfer of one person's experience to another person, but is mediated through each step from the initial experience of the sender to the response of the receiver."

This example shows that a common frame of reference is nessecary if this kind of visual information is to be communicated.

Such a common frame of reference is very often missing in communication between the visually handicapped and the sighted. To make communication possible in this case you have to create a system of reference symbols that are common to the blind and the sighted. The different characteristics of visual, auditive and tactile information sometimes makes it impossible to make the reference system compatible to both the blind and the sighted. In such cases you have to change the physical character of the symbols used. Nolan & Morris give an example of this in their final report on their investigations of tactile maps:

"In 1966, Schiff, Kaufer and Mosak described efforts to develop a linear symbol having structural properties which would convey "different direction" and which would lead to quick tactual recognition of the information symbolized. In designing his "tactual arrow", Schiff attempted to "caitalize on any stimulus characteristic which might aid in conveying the concept for which the symbol will stand". He achieved this end by developing a tool that embossed a symbol resembling the teeth on a saw with the edges slightly smoothed. This symbol when scanned with the fingertips in one direction (forward) felt smooth, and when scanned in the opposite direction felt sharp (backwards). Eighty percent of blind subjects tested expressed preference for this symbol over an embossed visual arrow."

In this case it is not the symbol content the arrow convey that is differently understood by different categories of people (as were the case in the example from McFee), but the arrow itself. Tactile recognition of a line is a sequential process, while visual recognition is an immediate event. Tactile recognition therefor places a heavier load on short-term memory, which results in greater information-loos. In the example from Schiff, the visually handicapped person has to explore the whole line before he can say in which direction it points when the arrow is of "visual" construction, but with the tactile arrow, he knows through the whole exploreing-process in which direction it points.

In the same way that tactile information places heavier load on STM, auditive information does it too.

The problems I have outlined here require a solution if the visually handicapped should be able to gain knowledge from the information conveyed by pictures and graphs in text-books.

Recommendations for verbal discription of figures in the talking book

There are a lot of practical conclusions primarily for verbal descriptions of graphical information in the talking-book, that one can draw from the outlined differences in character of information through different sense-modalities.

First, you ought to distinguish between figures that describe or define relations between concepts and abstractions of processes, and figures illustration an object which is told about in the text. The first type of graphical information is a substitute for verbal information and can therefore also be reverted to verbal information. The second type of figures tell you what something looks like and it is doubtful if there is any meaning in describing such figures verbally. One can eventually discuss if they can be of a little value conveyed as tactual information.

Second, due to the heavy load verbal descriptions places on STM, you ought to make verbal descriptions of graphical information short.

Third, for the same reason as the second, keep the sentece-structure simple!

Fourth, tables can be split in the same two categories as figures. The first category is then those tables that show a trend or the like, and the second category are registers or indices.

Fifth, the talking-book has the advantage that it is not restricted by typography. Thus, you can move figures and tables to their proper place in the text.

Sixth, the visual symbols that stand for different concepts in a figure fill no purpose in a verbal description of the figure (e.g. different colours to discriminate between different concepts).

Several of these principles are empirically testable. The principle to make verbal descriptions of figures short is supported by the results of a study I have made on the comprehensebility of verbal descriptions of figures in talking-books.

The implications of human information handling capacity to verbal discriptions of graphical material.

According to what I earlier said about limitations due to sensemodality-specific limitations in information transfer, verbal information places heavier load on STM than visual information. A consequence of this ought to be that verbal descriptions of figures containing many interrelated structural units are more difficult to understand than figures containing few interrelated units. If you set the goal that the talking-book-listener should have a detailed apprehension of the figure, the verbal description of the figure must consist of all the structural units in the figure plus all interrelations between these units. This is what you get when you look at the figure. To get the holistic comprehension of the figure you have to keep all the parts and the relations described verbally in STM before this can be schieved. As STM has a very limited capacity to store information, much of the information necessary to get the holistic comprehension is lost before it can be processed together with the rest of the information. Therefore you have to compress the information in a few very information structural units, giving the listener a rougher comprehension of the figure, but a comprehension that can be reached for all figures.

STM can keep about seven structural units during a short period without losing anything. If you assume that information about relations between the visual units in the figure places only a part of the load on STM that the units themself place, the limit for how comples a verbal description of a figure may be, must set very low, perhaps as low as 3-6 chunks. To test if the notion of "structural units", or "chunks" and STM is applicable on this problem area, I studied the effect on understanding of visual figures from verbal description when the complexity of both the figure and its description was varied. The result of the study was that the rough descriptions produced better understanding regardless of the complexity of the figure. The result did confirm the initial hypothesis in this part, but it

did not confirm the hypothesis that the advantage of rough, low-complex descriptions over the detailed, high-complexity discriptions, should be highest when you had a high-complexity figure.

The solution to the problem that High-complexity figures are hard to understand with a verbal description is, I suggest, that you direct the verbal description to a goal, to the intention the figure-drawer had when he drew the figure. In this way you can divide the figure in pàrts that each form one chunk of what was earlier six or seven and in this way reduce the load on STM.

Problems in the conversion of graphical material to tactile form

The same principle holds for the transfer of visual information to tactile, only that in this case it is not possible to change the psysical image to a simpler one. Instead you've got to divide the tactile figure in smaller part and instruct the blind verbally how to explore the figure tactually. The main problem here is however to find a technical solution that structures the figure into smaller parts. The usual relief map presents all of the material continously, and it is not possible to control the blind's exploration of the figure if you tell him just to take one part at a time. The above mentioned necessary technical solution has been presented by a swedish electronical development group. It consists of a drawingboard where the instructor (a teacher or a text-book-writer) draws a picture on normal paper with a special pencil that convey the picture-information through an electronical device to a tactile display where the same picture appers in the form of tactual points that the blind student can explore. The instructor can stop at any time during the figure-drawing and give the pupil verbal instructions for his tactual recognition of the figure. I believe that this way of presenting graphical information substantially raises the limit for the figure-complexity the human beeing can handle.

Beside the direct transfer of information in the classroom, this "figuredrawer" can also function as an aid in self-instruc-

tion. This is possible because the figure-drawer can be used together with a tape-recorder which can store the tactile figure-information. The electronical signals representing the figure can in this case be placed in a talking-book in it's proper place in the book. The student has the tactile display of the figure-drawer in front of him when he listens to the talking-book, and when a figure appears in the text he gets it in tactile form on the display where he can explore it according to verbal instructions given in the talking-book.

A preliminary evaluation of the figure-drawer in the education of the blind was made at the Tomteboda-school last spring. This evaluation-period revealed a lot of problems in connection with the use of the figure-drawer.

I intend to make a broad evaluation of the figure-drawers ergonomic and pedagogical characteristics, based on some of the problems that appeard during the testperiod at Tomteboda.

The methods for conveying graphical information I have outlined here are just a few of all possible solutions to the problem, and solution which are mainly intended to overcome the difficulty with sequencial representation of the originally simultaneous visual figure. I think there are a lot of other important problems in the transfer of graphical information that deseves through investigations. I have for example not mentioned the psychophysical problems with tactile maps, and just touched the problem of differences in semantic value of words that hinder the communication between the blind and the sighted.

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SYMBOLS FOR TACTILE MAPS

Introduction

Tactile maps have been used for more than 200 years (Heath 1958), but it is often pointed out that they do not function satisfactorily. The main problem is that it is not known how to translate visual maps into tactile ones. This is not made in any simple way, e.g. by giving embossed lines the same function as ink-print lines. Enough is not yet known about the principles for the function of the hand as a source of information.

The basic research has up til now not given information useful for the construction of tactile maps. The most related work is that on "active touch" (Katz, 1925; Révéz, 1950; Gibson, 1962, 1966; Krueger, 1970), but even this is not directly relevant.

Aim

The aim of this paper is to review the work in tactile maps made from the point of view of application. It is mainly concerned with discrimination of symbols in vacuum-formed plastic. Three kinds of symbols are studied: point symbols, linear symbols and areal symbols. Most of the research in this field was done by Carson Y. Nolan and June Morris, American Printing House for the Blind, Louisville, Kentucky, and William Schiff, who worked for Recording for the Blind, New York City. The presentation here is mainly based on their work.

Point symbols.

Braille characters are sometimes used on tactile maps. They may be confused with other symbols with a small surface, and in order to diminsh that risk it has been proposed that they should be given another height than the background (Wiedel&Groves, 1969). The research on the Braille characters themselves was recently summarized by Nolan & Kederis (1969). Schiff (1966) studied embossed versions of upper-case letters and found most of them usable. Exceptions were D, G, K, M, N, Q, V, W and X.

Nolan & Morris (1963, 1971) studied other kinds of point symbols in a series of experiments, one group of 14 plastic symbols given in Fig. 1. The symbols were compared in pairs, and the subjects indicated if they seemed the same or different. A visual inspection of the data indicates that the following kinds of point-symbols often are confuse:
1. Evenly embossed surfaces and embossed contours of the same form, e.g. symbols 1 och 6, 3 and 8, respectively, in Fig. 1.
2. Forms other than the most simple (i.e. circle, triangel, square), e.g. symbols 8 and 9, 4 and 7, respectively, in Fig. 1 (in an experiment where symbols 7 was somewhat smaller and horizontally oriented).

The main criteria used by Nolan & Morris (1963, 1971) for accepting a symbol were (1) confusion with any other symbol should be less than 10 %, and (2) the average confusion with the other accepted symbols should be 5 % or less. On these and a few other criteria Nolan & Morris recommended the symbols identified by an asterisk in Fig. 1. Symbol 1 has to be modified, however. Instead of an evenly embossed surface it should be a surface successively increasing towards the middle ("hill") to avoid confusing with symbol 6.

The recommendations are given for the sizes given in Fig. 1. Nolan & Morris (1971) concluded from experiments on size that the originally used sizes were near the optimal.

The experiments demonstrate that fairly many usable point symbols are available: Braille characters, certain upper-case embossed letters, and the embossed symbols, marked in Fig. 1. It is to be noted, however, that the result is restricted to the set of symbols studied in the same experiment. Confusion of letters from different sets is of course possible.

Linear symbols.
Nolan & Morris (1963, 1971) also studied linear symbols in a series of experiments. The 13 symbols used in one of the experiments are shown in Fig. 2. A visual inspection of data from this and other experiments indicate that the following kinds of symbols often are confused:

1. Single straight line and double line of the same width, e.g. symbols 31 a and 32 in Fig. 2. (Cf point 1 concerning confusion of point symbols).
2. Straight line with crossing short bars (symbol 33) and "Spiral" line (symbol 36).
3. Some kinds of broken lines, e.g. symbols 37 and 39a, as well as symbols 37, 38 and 41.

After elimination of some linear symbols Nolan & Morris (1963) recommended the lines marked by an asterisk in Fig. 2. A later experiment with partly the same linear symbols (Nolan & Morris, 1971) gave basically the same result. Only one of several new linear symbols, mainly variants of interruped lines, was accepted (a double line of points). In one experiment with 21 linear symbols used by American Printing House and embossed in paper only 7 were accepted (Nolan & Morris, 1971). It is noticeable that more complex lines consisting of different part symbols are unsatisfactory. It is, e.g., difficult to discriminate tactually a line consisting of alternating a point and a dash from a line consisting of alternating three points and a dash.

Nolan & Morris (1963, 1971) criteria for accepting a symbol are not too rigorous, probably depending on their program of finding a larger number of acceptably discriminable symbols. If the demand on the number of symbols is decreased the criteria for acceptance can be made more rigorous. The aim of a not yet published experiment by the author together with two co-workers was to obtain five linear symbols with still less confusion. Nine of the lines were chosen from two experiments by Nolan & Morris (1971) and the tenth line was used at the Tomteboda school (Stockholm) production of maps (see Fig. 3). This set of lines were studied in an identification experiment where the subjects were given one of the lines and had to chose its correspondence among all the ten lines. This method seems to be rather close to the real map reading situation.

All ten lines were acceptable according to Nolan & Morris' criteria, four of them had less than 1 % of confusion. With also other factors taken into consideration a fifth line was chosen. These five lines are marked by an asterisk in Fig. 3..

Schiff et al. (1966) invented and studied in experiments a line intended to be a "tactile arrow". This line was perceived to be smooth when scanned in one direction, and sharp when scanned in the other.

All linear symbols discussed so far were raised. Nolan (1971) demonstrated that this type of symbol is better than an incised symbol.

Again it is found that a smaller number of utilizable symbols, at least up to ten, is available, and five lines with nearly perfect discrimination can be found as described above. Schiff's "tactile arrow" seems to be an excellent symbol.

Areal symbols.

Tactile textures were studied already by Katz (1925), and the first studies of areal symbols for tactile maps were performed by Heath (1958) and Culbert & Stellwagen (1963). Starting their discussion from the two later studies Nolan & Morris (1963, 1971) studied areal symbols in a series of experiments. The textures used in one of the experiments are shown visually in Fig. 4. Visual inspection of data from this experiment indicates that the following kinds of areal symbols often are confused:

1. Symbols consisting of straight parallel lines with different direction. e.g. symbols 61 and 62.
2. Symbols consisting of continuous straight lines and of dashed lines with too small in-between spaces, e.g. 61 and 67, as well as 62 and 68.
3. Symbols consisting of continuous straight lines and of slightly curved lines, e.g. symbols 61 and 65.
4. Symbols mainly differentiated by the forms of their parts, e.g. symbols 70 and 72.
5. Symbols with similar contours, e.g. symbols 66 and 71.

Nolan & Morris recommended the symbols marked with an asterisk in Fig. 4. It is to be noted, that this recommendation is restricted to this set of symbols. In another experiment with partly other textures a somewhat different result was obtained (Nolan & Morris, 1971).

According to an agreement in a Scandinavian committee for the production of maps for teaching geography to the blind, four

different textures are used to indicate height over sea level. They are produced in plastic with the aid of cardboard, cloth, fine-grained and coarse-grained sandpaper (Andersson, 1969). As a symbol to indicate the sea plastic formed by canvas is used. It has been observed that some of these textures often are confused. In a series of experiments the author, together with several co-workers, is studying the effect of combining different sets of five symbols. These investigations are not yet finished.

Symbols on a heterogenous background.
In the experiments referred to up til now the symbols were studied in isolation, i.e. every symbol was a distinct figure on a homogenous background. On a map the background for every symbol is more heterogenous. In order to maintain the discriminability found in the experiments it is necessary that the distance between the symbols is not too small. Nolan & Morris (1971) recommended 0.09 inch (2.3 mm) as a minimum for the general case, and a still larger distance when the symbols get smaller. For point symbols it ought to be 0.15 inch (3.8 mm).

For nearly all experiments the three kinds of symbols were studied separately. This means that there is a risk of confusion between symbols of different kinds that is not predictable from the experimental result. The discrimination is also made more difficult on a map by the increase of the number of symbols. It can be expected, from general theories of perception, that the addition of more stimulus features differentiating the symbols will make them more easily discriminable. Schiff & Isikow (1966) demonstrated that such a redundancy has the expected effect on the interpretation of tactile histograms. If the bars are separated both in height and texture the result is better than if they are differentiated only in one of these variables. Nolan & Morris (1971) made a related experiment on the height of tactile symbols, and found that a map where point, linear and areal symbols were on different height over the background was better than maps with less differentiation in height.

Discussion

The research on isolated symbols has demonstrated that there is available several point, linear and areal symbols that are rather easy to discriminate, at least when exposed as figures against a homogenous background. If a necessary minimum distance between symbols is kept and if redundant information is given, these symbols ought to be discriminable also in the more complex context on the maps. But several other problems remain, especially how to organize the maps to give a good overview.

If a larger number of easily discriminable symbols is wanted, however, the experimental results do not give enough information. The desire for more symbols was basic for Nolan & Morris' (1963, 1971) research program, among other things because of the necessity of a larger number of symbols for standardization of tactile symbols. Despite a research effort during more than a decade the number of acceptable symbols in the same experiment has never been more than about ten. The reason is probably that our knowledge of what stimulus features are essential is so rudimentary.

Above some tactual stimulus features were discussed which are easily confused, at least when used in symbols of the usual size. It is more difficult to say which variables are suitable, as the accepted symbols differ in several respects. The most reasonable guess, however, is that height over the background and kind of transition from background to figure (sharpness) are essential (cf Schiff, 1966). Sharpness was used by Schiff, et al. (1966) to differentiate the two directions of their tactile arrow.

The search for relevant stimulus variables is difficult also because of our lack of knowledge about what aspects of the skin deformations that the sense-organs in the skin are sensitive to. The most reasonable alternative, however, is that they are sensitive mainly to movements in the skin tissues (Kenshalo, 1971, Shiff, 1966) proposed tentatively amount of deformation as a correspondence to height over background and speed of deformation as a correspondence to sharpness. A reasonable research program for the future study of tactile symbols would

be to make predictions from theories of this kind, construct new symbols experimentally. Up til now there has been to little of systematic research of this more basic kind.

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Fig. 1. Point symbols studied by Nolan & Morris (1963,1971). The symbols were the same size as in this figure. Recommended symbols are marked by an asterisk. (The verbal descriptions by the present author.)

Evenly embossed surfaces of different form

1 2 3 4 5

* *

Closed contours of different form

6 7 8 9

* *

Open contours of different form

10 11 12

* *

Combinations of smaller units

13 14

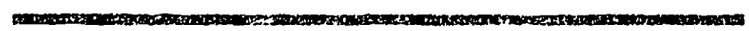
* *

Fig.2. Linear symbols studied in an experiment by Nolan & Morris (1963). The symbols were the same size as in this figure. Recommended symbols are marked by an asterisk. (The verbal descriptions by the present author.)

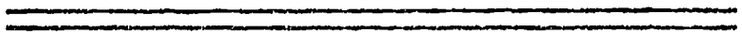
Continuous lines

Single straight lines of different width

31 a

31 b * 

Double straight line

32 * 

Straight lines with some features added

33 

34 

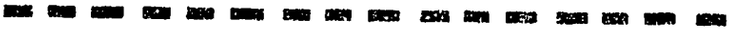
Curved lines

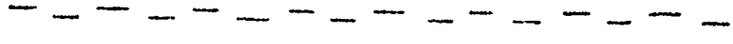
35 * 

36 * 

Broken lines

Only one kind of units

37 

38 * 

39 a * 

39 b *

40 

Two kinds of units

41

Fig. 3. Linear symbols studied by Belin & Nyman (1971). The symbols were the same size as in this figure. Especially recommended symbols are marked by an asterisk. (The verbal descriptions by the present author.)

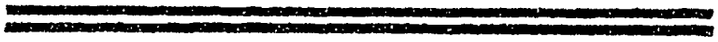
Continuous lines

Single straight line

42 *

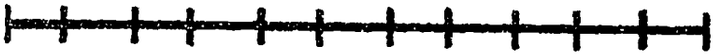
Double straight line

43 *



Straight lines with some features added

44



45 *

Curved line

46

Broken lines

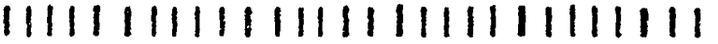
Single lines

47 *

48

49

50



Double line

51 *

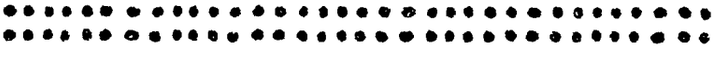


Fig.4. Areal symbols studied in an experiment by Nolan & Morris (1963). The symbols in the figure are in the same scale as those in the experiment but only a quarter of the area used. Recommended symbols are marked by an asterisk. (The verbal descriptions by the present author.)

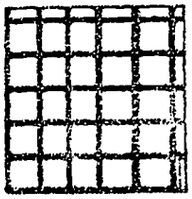
Continuous Lines

Straight Lines

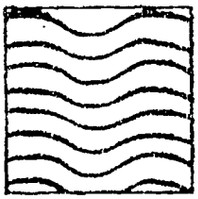
61  *

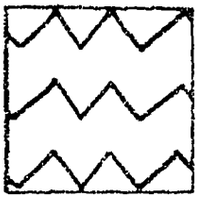
62 

63  *

64  *

Curved lines

65 

66  *

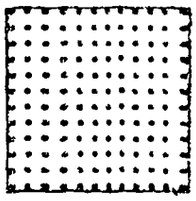
Broken lines

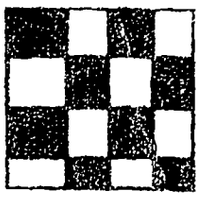
67 

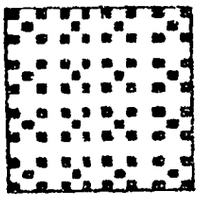
68  *

69 

Patterns consisting of smaller units

70  *

71 

72 

73  *

METHODS OF USING THE TALKING BOOK

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A visually-handicapped persons possibilities for acquiring information is limited and the aids presently have rather serious drawbacks.

To find out how the visually handicapped confront their problems in studying, we conducted an investigation of all those visually handicapped students in Sweden who, during the spring of 1970, used the study services of the Swedish association of the Blind and the Tomteboda school.

The result of this investigation showed that the problems can be classified, for the most part, under ten problem areas.
1. To quickly make the literature available in either braille or a talking book,
2. To find one's place in the talking books,
3. To keep up with periodicals and newspapers,
4. To be able to review literature quickly and effectively in preparation for examinations,
5. To understand figures and tables in talking books,
6. To use reference literature,
7. To use stenciled material,
8. To be able to read with adequate speed,
9. To be able to concentrate when reading talking books,
10. To take notes connected with the lessons.

Most of these problems are directly related to the student's ability to use the tape recorder as an information channel. We therefore found it necessary to concentrate our efforts on problems concerning auditory information in general and the talking book in particular.

With regard to auditory information, we tried to analyse short-and-longterm retention of learned material, as well as to compare the retention of such material with the retention of the same material when presented visually. We also compared the retention capacity of the sighted and the visually handicapped with respect to auditory information.

Briefly, the results show that:
1. Visual information is generally superior to auditory.
2. The distinction between the two information media is greatest when retention is measured immediately after learning. After a week this distinction has been eliminated.
3. Comparisons between the sighted and the visually handicapped show that during the earlier school years (the first 3-5 years of school) the degree of retention is comparable, but that in the later school years (grade 6 and upwards) the visually handicapped are superior. This may be because the visually handicapped gradually learn to use auditory information more effectively than the sighted.
4. The effects of tiredness were observed among the sighted but not the visually handicapped when information was presented auditorily. This supports our observation under 3. above that the visually handicapped use auditory information more effectively.

The results thus show that auditory information is inferior to visual but that training and effective use of auditory material increases retention. This led us to investigate more closely different methods for the optimal use of the talking book as an information channel.

The talking book can be used in several different ways, but certain general problems remain. Below are some of the problems which are particularly marked.

A. Reading speed is constant and relatively low

Visual reading is characterized by the fact that the reader can vary his reading speed to conform to the amount of information. This is not possible with a tape recorder. The visually handicapped must listen to everything regardless of his own capacity and knowledge or differences in the degree of difficulty the material presents.

The talking book is usually read at a speed of 150 word a minute. This is a reading speed far below that of the visual, ordinarily about 250 words a minute, but definitely above the average reading speed for braille, which is about 100 words a minute.

The talking book is thus a faster information channel than braille. For this reason, among others, the talking book has become more and more common as an information medium. Moreover, not all visually handicapped people master braille.

In the investigation previosly referred to concerning the difficulties in studying which the visually handicapped encounter it was found that individuals often find the taped speed too slow. Other researchers e.g. Lown (1966) have investigated this and found that students need increased speed. One investigation showed that of 19 visually handicapped children, 17 wanted the speed increased if it could be easily accomplished.

There are basically three ways to increase speed. The following three methods are called "time compressed speech".
1. Talk faster when reading. The reader is instructed to increase his reading speed. The method is simple since no special equipment is needed.
2. Accelerated speech. Here the speed is changed by playing the tapes at a higher speed than that at which it was recorded. This change in speed is simple and cheap. The disadvantages are that the sound quality is changed: the pitch increases so that the speech has a "Donald Duck"-character.
3. Sampling method. This method, which was introduced by Grant Fairbanks in Illinois during the mid-fifties, consists of periodically removing small portions of the recorded text. Since the segment is small, no information is lost, and there is no change in the sound quality. However, the method requires rather expensive and complex equipment, so that there is virtually no possibility for a particular individual to increase the speed himself until it meets his own requirements.

I would now like to spend a few minutes explaining the research on compressed speech using methods 2. and 3. above.

There have been several investigations of compressed speech, and it has generally been concluded that comprehension decreases if the speed of the speech exceeds a certain limit.

E. Foulke, among others, has studied the sampling method with visually handicapped children. The aim was to study the amount

of material read as a function of reading speed. Comparisons were made with braille. The researchers studied about 300 visually handicapped children, and the results showed that reading speed can be increased from the usual (about 175 words per minute) to 275 words/minute with no significant reduction in learning when compared with braille.

Other investigations of the sampling method, e.g. Bixler and Foulke, conclude that increases up to 400 words/minute are quite tolerable. Indeed, a positive correlation has been found between a fast reader and the ability to learn to comprehend compressed speech (Goldstein).

As I mentioned earlier, the sampling method is an expensive and complicated method of compressed speech, and therefore not a method which can be used by individual students. The method of accelerated speech of the "Donald Duck" type can however be used advantageously by the individual talking book reader. This leads me to describe an investigation which shows the relation between the two methods.

Foulke found that with sighted subjects who are not accoustomed to a talking book, the sampling method is more effective than the technique of accelerated speech, (the Donald Duck techique), but that when the method is used with visually handicapped children, there is no significant difference between the two methods. Other researchershave come to the same conclusion, e.g. McLain, who showed that the sampling method only gives a result which is about 6 % better. It is nevertheless a fact that text converted by the sampling method is pleasanter to listen to.

Because of the relatively small learning advantage of the sampling method, we decided in our project that it would be more profitable to study in greater depth the effects of the accelerated speech technique (Donald Duck metod). We began our investigation with two different types of reading material: the one taken from non-fiction, the other from fiction. The running time for the texts was about 20 minutes. 150 sighted subjects participated in the experiments. The texts were played at normal speed, and with 20, 40 and 60 % increases respectively using the Donald Duck method. The subjects were randomly assigned to four groups. Each group was required to listen to both texts at both

normal speed and at one of the three test speeds. Comprehension was tested immediately after the reading, and again after three days. The results show no significant differences between normal speed and an increase by 20 % either with respect to immediate retention or on remeasuring three days later. When speeds were increased by 40 and 60 % respectively the results were significantly worse. This was true of both the fiction and non-fiction texts.

Using these results as a basis, we are now planning to study in greater depth the learning situation during accelerated speech, and we hope to find solutions to the following interesting problems:

1. What would happen if the students themselves could change the speed on an individual basis. In our experimentation to date we have only used specified speeds selected in advance.
2. If students are allowed to individually vary the speed, will they use this possibility on a long term basis, or will their use of the method decrease when their curiosity has been satisfied?
3. What will the long- and short-term results of the learning be? From the point of view of motivation, how will the students react to the method?
4. How will students use the method with different materials and with different individuals aims?

B. Difficulties in locating particular sections of a tape

The sighted, who can read the inkprint text, have no difficulties in skimming a text or finding their place in a book. The visually handicapped person's ability to do this is limited when talking books are used. In Sweden, as in other countries, technical solutions to these problems have long been sought. Among them are the following:

1. Position locators in braille
2. Tape length indicators, which look like a clock with braille dots and are located on the tape recorder reel.
3. Low frequency signals which on fast rewind occur as distinct signals at each new chapter. These signals are not heard when the tape is listened to at normal speed.

At the present time intesive research on these techincal methods of finding one's place is being conducted at the Institute for the Handicapped in Stockholm, to mention one place and within our own project we plan in the future make pedagogical evaluations of these techniques.

C. Difficulties in getting an overall picture of the material

In Sweden, as a means of solving this problem, we have provided each talking book with an index to the pagination in braille. The person recording the book gives the page number each time he comes to a new page. In this way, the student always knows where he is in the chapter. We do not know exactly where and how these page specifications should be given or if a better overall picture might be given by simple chapter summaries at the beginning or in the middle of the chapter, but later on we plan to investigate this problem.

D. Integration of braille and the talking book

Simply listening to material is a primarily passive learning situation. More active participation when the material is transmitted could probably be achieved if there were some form of text material in connection with the talking book. Altough I can not give any research results on this point, I can say however that we plan to study the effects of integrating such two channel transfers, e.g. by studying the effects of giving the reader key phrases and words (in braille) in parallel with the text being read. Other possible experimental conditions would be to give braille simultaneously with the talking book or to give two information channels only when there are headings. It is even possible that best results would be obtained if braille information were provided as a sort of summary at the end of each chapter. These are the problems areas which we hope to look at in the future. At courses in study-techiques for the visually handicapped which have been provided in Uppsala for several years, we have worked informally with these methods and the students subjective reactions have been positive. I should however mention that several researchers, e.g. Broadbent 1958 and Travers 1964 are skeptical about the value of transmitting information via several simultaneous channels as they believe there is a risk for blocking. The reception of infor-

mation is related to the degree of difficulty of the material and the speed of presentation, which makes it difficult to draw any definite conclusions.

E. The problem of active participation during the reading of a talking book

Reading a talking book can be characterized as a relatively passive learning situation, at least in the case where the visually handicapped individual simply listens to the text being read without talking notes or in some other way processing the material. We know from earlier research on learning that active processing of material by e.g. repetition from memory (Gates 1917 et al.) increases the amount of learning. In this connection, there is of course a problem in definiting "activity" An objective measure of activity could theoretically be achieved by measuring the brain's arousal function (Hebb 1966). Measuring the activity which is transmitted between the Formatic Retikularis to the cortex appears impossible at the present time.

We have therefore defind activity operationally as observable manipulative behavior of the learning material.

In the preceding, I have given a short summary of some of the research on compressed speech. In accordance with the above definition of activity, the method of accelrated speech (Donald Duck) in which the student himself determines the speed, can be counted as an activity method.

In what follows I would like to revies some methods concerning activity, whose effects we have begun to study, and, in addition, preliminary results and some of the problems we encountered. In these experiments we worked with different experimental conditions and took into account previous experiences with both learning experiments using constructed questions and programmed learning.

The aim was, while holding time factors constant, to try to find which of the different recording methods are most effective in learning a certain kind of material. In the experiment we only sighted subjects in grade 8 of the comprehensive school. The amount of material learned was tested both immediately

after instruction and again after a week. We found difficulties in adequatel motivating the students to do their best. In this investigation we used money to motivate the subjects but we realize that different children react to this form of reward differently. We expect that we will probably investigate other means of reward or no reward at all later on.

In order to study the effect of different methods, we used as a first control condition a group which only listened to the material without any manipulation at all. I call this condition 1.

When, in subseqent conditions, we allow each student to construct questions himself, it will be necessary to find out if the questions "themselves" and the process of making up the questions have an effect on learning or if learning i related to the pauses which necessarily occur in the reading when question are constructed. In order to control this factor, the next reading will be with pauses inserted. The text length between pauses is about three minutes. The pauses last around 20 seconds. I call this condition 2.

The use of questions in teaching has frequently been shown to be effective. To find out if questions interspersed in the text make learning easier in and of themselves or if it is because they guide the reader, the third condition is listening to the talking book with questions inserted after each section. The text length is about 3 minutes and the time allowed for questions about 20 seconds per section, so that the conditions are comparable to the preceding experimental situation. I call this condition 3.

To test the effect of the placement of the questions, condition 4 is identical to the preceding except that the questions come before each section of the text.

So that it can be determined by condition 6 below if it is the construction of the questions and the students' answer which account for improved learning or if improved learning depends on the students thinking through the particual section, condition 5 consists of listening to and repeating each section of the text from memory.

In our next experimental condition the students will listen to the talking book but will themselves construct questions which they will record on another tape recorder. The answers to the questions can be recorded on the second channel of this recorder thus the student constructs a kind of programmed compendium which he can use to review the contents of the talking book. In this experimental condition, the student is not allowed to back up the tape, since we wish to hold the number of repetitions under control. I call this condition 6.

The seventh experimental condition is identical to 6, but the individual is allowed to back up the tape.

The results of these seven experimental conditions are now under investigation.

The main problem areas in the analysis are:
1. Which method is best?
2. Why is it best?

To determine this we plan to study how different individuals construct questions and to study, among other things, how much of a section on a tape the students listen to before they stop to construct questions. In addition we will study the strategies they use as a function of intelligence and factual knowledge. Other important problems are whether the students learn only facts which are related to the questions or if they also learn facts in the text material which do not directly depend on the questions, i.e. a sort of transfer analysis.

In conclusion I would like to say that we would be grateful for observations and constructive criticism of our experiments on active methods of reading talking books.

Stockholm den 19/10 1971

Nils Trowald

DISCUSSION AND RECOMMENDATIONS

The three day working conference in Stockholm on educational research for the visually handicapped was the first of its kind, anyway in Europe and probably in the world. The participating researchers did not know each other in advance and knew fairly little about the research being carried out by the others. Naturally the atmosphere was therefore very favourable for discussion. And the time for discussion was generally considered to be too short.

During the seminars many valuable remarks were made concerning designs of investigations and the evalutation of research findings. In the field of Braille research the Swedish group was inspired to reproduce an investigation formally carried out both in the United States and Great Britain. It was also agreed that research on symbolisation and information capacity in tactual graphs and maps is a matter of common interest. In other areas of research - e.g. research on listening, evaluation of verbal discription of graphs and cognitive development in congenitally blind children - it was agreed that the group conducting research in one of these areas should keep the others informed about further developments and results.

In the concluding discussion the following agreements and recommendations were made:

1. New conference suggested

The conference very clearly demonstrated the possibilities of coordination and cooperation in educational research for the visually handicapped. It was therefore recommended by the participants that a new conference should be organized in the near future. This second conference might either be "zooming in" on one problem of mutual interst (symbolisation in tactual maps was mentioned as a possible subject) or once again have the same broad nature as the first conference and then also include research groups from other countries. Becker-DDR, Tobin-Great Britain and The PUSS-project-Sweden accapted the task of preparing a new conference.

2. Documentation needed

It was stated by the participants that the situation is unsatisfactory in the field of documentation of research and exchange of information. The discussion showed that this is a complicated problem with many dimensions. The "International Research Information Service" (IRIS), American Foundation for the Blind, has rendered many excellent services to educational researchers but does not have the necessary facilities for covering the whole field of information for visual impairment on an international basis. It was emphasized that we need both a documentation center storing and giving access to research findings and an instrument for providing researchers all over the world with information concerning running research activities and project planning in the field. Many conceiveable solutions were mentioned during the discussion. The documentation service could be obtained by joining a general documentation system like the ERIC (Educational Resources Information Center). A parallel European system, EUDISED, (European Documentation and Information System for Education) is at present being developed by the Counsil of European Documentation Centre for Education in Europe. If such a solution could be generally accepted by researchers in the field the remaining task of providing up to date information about research activities could be given to a special institution like IRIS. It was strongly emphasized that world organisations like the World Council for the Welfare of the Blind (WCWB) and the International Council of Educators of Blind Youth (ICEBY) must take an active part in solving these problems. The Division of Social Affairs at United Nations Office at Geneva of UNESCO was also mentioned as an organisation which ought to be activated on this matter.

It was decided that the group appointed to prepare a new conference should also work out recommendations concerning documentation and exchange of information. These recommendations should if possible either be made to the executive committee of the WCWB meeting in Moscow in May 1972 or the the world congress of the ICEBY held in Madrid in July 1972.

3. Report on conference

Finally it was agreed that the Swedish group should prepare a report on the present conference containing the papers presented and a summary of the concluding discussion. This report should be given the widest possible circulation among researchers, organisations, institutions, schools etc. in the field of blindness.

CONFERENCE PROGRAMME
18-20th of October, 1971

Monday, 18

8.00	Breakfast at the hotel
9.30-10.00	Conference is opened at the National Board of Education, lecture room, 6th floor. J. Orring. Ch. Hedkvist.
10.00-11.50	"A futuristic view of education" Lecture, T. Husén, Sweden
12.00-13.00	Lunch at the National Board of Education
13.30-14.15	Presentation of the Tomteboda School and its program. T. Gissler.
14.30-18.00	Presentation of projects by participants - comments, discussion. Place: Tomteboda School
19.00	Dinner with the Association of the Blind at Restaurant Gondolen.

Tuesday, 19

8.00	Breakfast at the hotel Seminars. Place: The National Board of Education, room 522. Topics:
9.00-10.20	1. Methods and technical aids in the education of the partially sighted. Chairman: W. Boldt. Introduction: M.I. Zemtzova
10.30-11.50	2. Cognitive growth of the visually handicapped child. Chairman: M.I. Zemtzova. Introduction: M.J. Tobin
12.00-13.00	Lunch
13.30-14.50	3. Factors underlying the ability to learn braille by children and adults. Chairman: K-G Ahlström. Introduction: M.J. Tobin

15.00-16.20	4. Methods for conveying graphical information to the visually handicapped. Chairman: K.P. Becker. Introduction: M. Myrberg
17.00-18.00	Dinner
18.30-20.00	5. Learning methods in connection with auditive information Chairman: M.J. Tobin. Introduction: N. Trowald.

Wednesday, 20

8.00	Breakfast at the hotel
9.00-9.50	Place - The Handicap Institute:
9.00-9.50	Presentation of Swedish technical development projects for the visually handicapped. J-I. Lindström
10.00-11.50	Possibilities of international cooperation and coordination in the field of educational research - discussion. Chairman: K. Lundström.
12.00-13.00	Lunch
13.30-14.45	Discussion continued
14.45-15.00	Conference is closed Ch. Hedkvist

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