CANADIAN BRAILLE AUTHORITY
L'AUTORITÉ CANADIENNE DU BRAILLE
REPORT OF TACTILE GRAPHICS SUB-COMMITTEE PART 3

2003

Compiled Under the Authority of the

CANADIAN BRAILLE AUTHORITY

by

Canadian Braille Authority
English Braille Standards Committee
July 10, 2003

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"Promoting Braille as a Primary Medium for Blind Persons."
"Favoriser le braille comme média privilgié des personnes aveugles."

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PREFACE

CANADIAN BRAILLE AUTHORITY

A Report of the Tactile Graphics Sub-Committee Part 3

One of the most important devices by which information is communicated at all levels of education and in many professional fields is the illustration, diagram, or graph.
[G.J. Vermey, *Observations on Raised-line Drawings*.]

Visually displayed information is necessary for the development of concepts for education, employment, and orientation and mobility. In order to ensure that people with a perceptual disability have the same access to readable materials as persons without a perceptual disability, standards of production are essential.

Phase III of the English Braille Standards, Tactile Graphics Sub-Committee of the Canadian Braille Authority involved creating a tactile graphics testing kit, testing focus groups across Canada and into the United States, and recording test results.

The fourfold purpose of this report is to: (1) summarize the results of the tactile graphics testing; (2) list the general and specific recommendations for production methods based on the results of the testing; (3) make suggestions for further research on the topic of tactile graphics production; (4) set forth specific recommendations as a separate set of guidelines for all tactile producers and braillists to use as a reference. *Part II: Interim Measures January 1996;* Report of Tactile Graphics Sub-Committee will be revamped to reflect the recommendations.

*GRASP: **G**raphic **R**esearch **A**nd **S**tandards **P**roject*, a *Research Report* written by Dr. Cay Holbrook, University of British Columbia, details the procedures, rationale, results, and analysis of the tactile graphics test.

1. INTRODUCTION

BACKGROUND AND MANDATE

The English Braille Standards Committee of the Canadian Braille Authority (CBA) recognizing the need for investigation of and research into production standards for tactile graphics, in 1992 applied to the Canadian Braille Literacy Foundation for a research grant.

An initial grant was awarded in 1993, for which funds were provided by the National Secretariat of the Government of Canada, and the Canadian National Institute for the Blind.

The original proposal had five primary objectives:

1. To ascertain how tactile graphics are currently produced in Canada. (Completed in Phase I)

2. To determine (through research) which production methods best meet the needs of the user.

3. To establish standards for tactile graphics production across Canada.

4. To develop a central catalogue of available drawings that would help eliminate duplication of work.

5. To promote braille literacy through equal access to information.

In 1995, CBA published the results of **Phase I** of this project in 2 parts. *Part 1: Research Findings and Recommendations* and *Part 2: Interim Measures* were to be used and elaborated on by the other two phases of the project.

Phase II of the project looked at the production and use of tactile graphics from an educators' perspective. Although this report was completed it has not been published.

A grant for **Phase III** was provided in 1998, a completion date set and the chair for the Sub-Committee appointed. The Sub-Committee was made up of a combination of tactile users, educators of the visually impaired, and tactile producers.

As noted above, Objective 1 had already been accomplished by **Phase I** of this project. Objective 4 was deemed to be beyond the knowledge and ability of the project members and it was left to another CBA project that was being formed to look at this problem. Objectives 2, 3, and 5 became the specific goals of this phase.

In addition to the original objectives stated for **Phase I**, the Recommendations listed at the end of the *Phase I Report* were also to be considered:

1. A multi-level certification process be developed for educators, proofreaders, and producers of tactile graphics.

2. Research and testing be conducted in order to establish standard design practices.

3. The production of tactile graphics for early-learning materials be encouraged.

4. Testing be conducted on the suitability of current production methods for various types of graphics.

5. The CBA seek help in designing catalogue procedures for tactile graphics. (Left to be developed by separate cataloguing project.)

6. The *Interim Measures* be revised, expanded, and adopted, to be used as standard guidelines for tactile graphic production.

7. A Tactile Graphics Standing Committee be established.

With the exception of Recommendation 5, all recommendations from **Phase I** became part of the review and task process for **Phase III**.

This report covers **Phase III** of the project.

2. ACTIVITIES

ESTABLISHMENT OF THE SUB-COMMITTEE

The Tactile Graphics Sub-Committee for **Phase III** of this project was made up of representatives from production centres, tactilists, educators and consumers to provide a wide variety of perspectives on tactile graphic, design, production and use.

The following individuals served on the Sub-Committee:

Co-Chairs:
- Constance Craig, Tactile Co-ordinator, CNIB Library for the Blind – Toronto, member of BANA Technical Committee on Tactile Graphics
- Pierre Ferland, Proofreader, Institut Nazareth et Louis-Braille - Montreal

Members:
- John McConnell, Atlantic Provinces Special Education Authority, Provincial Supervisor, Programs and Services for Students who are Blind/Visually Impaired - Fredericton
- Freya Martinot, Vision Consultant for Students who are Blind/Visually Impaired - Winnipeg
- Diana Bissett, Tactile Proofreader, CNIB Library for the Blind - Toronto
- Inez Miller, Braille/Transcription Services Coordinator, University of Alberta - Edmonton
- Irene Miller, Supervisor of Braille Production, Materials Resource Centre for the Visually Impaired - Edmonton

The Sub-Committee was joined by Cay Holbrook, Ph.D., Associate Professor, Program for Teachers of Students who are Blind or Visually Impaired, University of British Columbia, Vancouver to advise and direct the research components of this phase of the project.

After initial meetings the Sub-Committee was also expanded to include members of the BANA Technical Committee on Tactile Graphics:
- Lucia Hasty, Consultant, Colorado Instructional Materials Centre for the Visually Handicapped - Colorado Springs
- Diane Spence, Director, Braille Services, Region IV Education Service Centre - Houston
- Robert Jacquiss, Computer Programmer - Oregon
- Howard Vreeland – Connecticut

The committee had input and support from Edie Mourre, Director of Transcription, CNIB Manitoba Division – Winnipeg; Debbie Sitar, Vision Consultant – Winnipeg; and many other contributors from braille production centres in Canada and the United States.

PRODUCTION METHODS USED IN STUDY

Tactile graphics used in this research project were produced using the following methods. These production methods were selected because they are the most commonly used in textbook materials throughout Canada and the United States at the current time. The reproduction of copies does not ensure consistency in final tactile graphic.

Microcapsule paper

This paper produces a raised drawing when an image is photocopied or drawn directly on the paper, and then exposed to heat. This project included two brands of microcapsule paper and two different models of processing equipment.

Flexi-Paper is produced by Reprotronics, Inc.

Swell-Touch Paper is distributed in the United States by American Thermoform Corporation. It is sold in Canada under the brand name *Zy-Tex*. Both papers are made by the Zychem Limited, United Kingdom.

In Canada, the most commonly used heat processor for microcapsule paper is the Minolta or Matsumoto Stereocopier. In the United States, the Tactile Image Enhancer (TIE) produced by Reprotronics is often used to deliver heat to the microcapsule paper.

Thermoform

American Thermoform produces the EZ-Form machine, a heat and vacuum process producing a plastic copy from a paper master graphic. *Brailon*, the plastic paper on which copies are produced, is available in many sizes and in three thicknesses – regular, heavy and extra heavy.

Press Braille

This process is available in larger braille printing houses. A metal plate (usually zinc) is produced as a master copy of a page. The plate and paper are then placed in a press where the raised image from the plate embosses the paper. This study included *APH Press Braille* from American Printing House for the Blind, Louisville, KY, USA.

Polymer and Powder Deposit Methods

Two commercial processes were included in this study. The companies generously contributed the samples used in the project.

Graphtact is a trademark of Braille Jymico, Quebec City, Quebec. A graphic is produced with a process similar to an inkjet printer, but depositing a polymer-like substance rather than ink. Graphics are produced for customers through contract with Braille Jymico.

Tactile Vision, also a Canadian company, uses a powder deposit method with heat. The equipment is especially built for the company, and is not commercially available. Graphics are produced for customers through contract with Tactile Vision.

TACTILE GRAPHICS SURVEY

The next objective of the newly formed Tactile Graphics Sub-Committee was to identify and gather feedback from students who read tactile illustrations. To accomplish this, the Sub-Committee set out to develop and circulate an extensive testing kit that would cover the production of tactile graphics from their acceptance through design, execution, and final reproduction. Questions on tools, materials, techniques, standards and general decision-making procedures were written, reviewed, revised and included. (See Appendix C for the complete Test Booklet.)

The questions were designed to garner responses from students about their interpretation of the graphics presented in each of the test kit modules. Questions were developed for each module and addressed such issues as:

- Details of graphics (e.g., how many sides are on this shape, how many textures are on each strip)
- Identification of graphic (e.g., identify the shapes in each row)
- Ease or difficulty of interpretation of graphic (e.g., which is the easiest symbol to distinguish, which directional line is clearest)
- Preference for graphic or production method.

REGIONS OF TESTING

Modules were tested with individuals in:

- British Columbia
- Colorado
- Saskatchewan
- Texas
- Manitoba
- Ontario
- Quebec
- New Brunswick
- Nova Scotia

SUB-COMMITTEE MEETINGS

1998

May 1 Unofficial meeting with President of CBA [Darleen Bogart], Phase I members [Edie Mourre, Constance Craig, Pierre Ferland] and one Phase II member [Debbie Sitar] to discuss the Phase II report and to work on outline for Phase III.

May 26-29 Constance Craig and Pierre Ferland went to San Marino in hopes of finding a suitable researcher and to bring themselves up to date with international research. Attempt to find a researcher was unsuccessful.

Oct 12 Official notification of creation of Phase III to Co-Chairs and budget, mandate and original proposal provided.

Nov 9 All members of Phase III identified except researcher.

Nov 27-28 Winnipeg meeting looked at *Interim Measures* and Phase III mandate. Outline of how to tackle project was determined and tasks assigned.

1999

Feb 25 After talking to seven Canadian researchers, still unable to find one with necessary credentials.

Mar 25 Content for Module 1 [sides and angles] and possible covering letter circulated.

Apr 8 Dr. Cay Holbrook agreed to be the Researcher.

Apr 30 BANA Technical Graphics Committee invited to come to June 27-28 meeting. Meeting extended to three days.

Jun 10 Draft of Module 1 completed and copies made for meeting. Collection of potential materials for Modules 2-5 assembled.

Jun 26-28 Winnipeg joint meeting of BANA and CBA. (clarification of goals – target population, production methods, methodology)

- Day 1 First meeting of the newly formed BANA Technical Standing Committee on Tactile Graphics – Lucia Hasty (Colorado), Diane Spence (Texas), Robert Jaquiss (Oregon), and Howard Vreeland (Connecticut). [CBA Phase III members attended as observers and were invited to participate]. BANA wished to adopt CBA *Interim Measures* as their starting base. BANA Committee also express interest in working with CBA Phase III on their project.
- Day 2 CBA Phase III meeting [BANA members asked to participate freely.] Dr. Cay Holbrook in attendance. Critiqued Module 1 and discussed how Modules 2-7 should be finalized.
- Day 3 Cay recommended that a small Pilot Project with only a couple of guidelines be tested. Testing revamped and creating revised Modules [1-3] and other assignments given out. Both CBA and BANA members formally voted to cooperate on a joint venture for GRASP (new name formed - **G**raphics **R**esearch and **S**tandards **P**roject).

Sep 30 BANA board meeting approved proposal for two committees working on joint endeavour.

Nov 30 Interim report and revised time line for Phase III.

2000

Feb 11-12	Winnipeg meeting to discuss interview criteria, focus group criteria, module design, and content.
Feb – Jun	Circulate changes to modules and create forms (consent, ethics, etc.)
Mar 13	Conference call to discuss modules, forms, and test subjects/sites.
Apr 6	Conference call to discuss revisions that were suggested for the various modules.
Apr 28-29	Montreal meeting to collate test kits, do a practise run and review protocols and procedures for testing diagrams. Debbie Gillespie and Betty Nobel participated in the practise run. More changes are required to test kits.
Apr – Dec	Revising test kits and sending to Researcher.
Oct 9-10	Lucia Hasty and Constance Craig attended the First International Conference on Tactile Diagrams, Maps and Pictures in Hatfield, England, and presented a review of GRASP.
Nov 1	University approval received for using “subjects”.
Nov 3	Amedeo D’Angiulli, post-doctoral student, will be working with Dr. Cay Holbrook on project.
Dec 13	Conference call to review each module, study information/protocol sheet, discuss current status potential testers and instructions to testers, set up timeline for distribution of test materials.

2001

Jan - Feb	Tests are translated into French.
Apr 12	Confirm test subjects/sites.
Apr - May	Testing kits sent out to test sites.
Apr 20	Initial focus group testing completed in Winnipeg.
Apr 21	Conference call to discuss testing procedure changes.
Apr 26	Testing done in New Brunswick.
May 02	New Test Booklet contains all the movement, additions, re-wording and deletion of question agreed to in conference call and from testing in Winnipeg.
May – Jun	Further focus group testing.
Sept	Cay and Amedeo start analysis of data.

2002

Jan 15	Draft copy of Research Report.
Feb 14-16	Winnipeg meeting to review Research Report.
Aug 5	Revised copy of Research Report.
Oct 30	Lucia Hasty presented a report on GRASP to BANA Board, with recommendations to consider.

2003

Mar 1	Draft Report for Phase III.
Mar 12	Conference call to discuss revisions to Research Report and Draft Report for Phase III.
Apr. 8	Revised copy of Report for Phase III.
Apr. 12	Present Phase III Report and Recommendations at CBA Board meeting.

By the fall of 2001, all of the testing had been completed and the members of the Tactile Graphics Sub-Committee met in Toronto for a discussion to review the results. The purpose of this meeting was:

1. To collate and review the responses to the Tactile Survey;

2. To discuss the results of the testing;

3. To draw up a set of recommendations and guidelines.

3. CONCLUSIONS

The five primary objectives of the original proposal have been reviewed and addressed by this Sub-Committee. This Sub-Committee has provided a solid foundation on which the *Interim Measures* can be revised and expanded. Updating the *Interim Measures* will be an on-going project.

By the end of Phase 3, the Sub-Committee had:

1. Conducted research and testing on a national and international basis.
2. Compiled and analysed data from testing.
3. Suggested guidelines for the suitability of production techniques and methods for various types of graphics.
4. Set the groundwork for updating and completing the *Interim Measures* into standard guidelines for tactile graphic production.

5. Reached the following conclusions from the testing:

MODULE 1

Module 1A: Polygons

Medium used: (Zy-Tex) Swell-Touch Paper and Heavy Thermoform Plastic

This module was designed to determine whether angle indicators helped in shape recognition and to see which outline or filled shape seemed to be the easiest to read.

Outcome:

- Indicator dots were helpful, both inside and out. Line indicators preferred over dot indicators for both mediums.
- Solid outline and smooth texture preferred. Secondly, a texture was preferred over no fill.
- Note: Heavy patterns, lines within shape interfered with identification.
- Heavy Thermoform Plastic had significant preference/advantage in almost half the shapes. In the remaining shapes thermoform was slightly easier to read than the Swell-Touch Paper, but not significantly more. In no instances was the Swell-Touch Paper more accurate/useful for the task.

Module 1B: Point Symbol Size

Medium used: Flexi-Paper and Brailon Thermoform Plastic

The purpose of this module was to determine the most readable point symbol designs and to discover what the minimum readable size might be for each symbol and medium.

Outcome:

- Easiest symbols to identify, in order: square, triangle, circle. Most difficult to identify are the cross and the star.
- Size of shape should be .7 cm or greater.
- Brailon Thermoform Plastic overall was preferred over Flexi-Paper and had significant difference in accuracy.

MODULE 2

Module 2A: Arrow Lines and Heads

Medium used: Graphtact Plotted Ink Image and Heavy Thermoform Plastic

The purpose of this module was to determine the best design for directional line shafts and heads. In addition, this module asked participants to examine the placement of braille labels.

Outcome:

- Solid circles, increasing in size, were not recognized as directional arrows. (11)
- Circles, with or without fill, were not recognized as directional arrows. (19). The statistics show that the question about the direction of double-pointing arrows may have been confusing for subjects.
- An arrowhead without fill and an arrowhead that is spaced a bit from the shaft may be the easiest to follow.
- Test results indicate a possible difficulty in reading diagonal dashed or dotted lines.
- Label placement needs to be greater than 2 mm and less than 12 mm. *Guidelines for Mathematical Diagrams*, copyright 1983, Chapter 4: Diagram Element Labels, states that the label should be “no closer than 1/8 in.” (about 3 mm)
- No significant preference was indicated between Heavy Thermoform Plastic and Graphtact Plotted Ink Image.

Module 2B: Measurement Indicators and Labels

Medium used: Graphtact Plotted Ink Image and Brailon Thermoform Plastic

The purpose of this module was to determine the proper placement of distance markers and labels and the need (or lack of need) for arrow heads within a tactile diagram.

Outcome:

- Very difficult and at times impossible to match segment with measurement it corresponds to. Distance indicators were confused with the building.
- The diagram is read more easily if a different kind of line other than what is used for the structure, is used to show measurement (e.g., dashed versus solid).
- The distance markers may be more easily read when outside the distance indicator.
- No indication of need (or lack of need) for arrow heads was indicated.
- Brailon Thermoform Plastic seemed to be easier to read.

MODULE 3

Module 3A: Textures

Medium used: Flexi-Paper and Brailon Thermoform Plastic

The purpose of this module was to determine which textures could be differentiated using various production methods and whether texture recognition was improved by contrast between textures, a real line, or a space (dead zone).

- Preferred texture to read: big patterns (dots and brick).
- A definite contrast in textures is required; height being a factor.
- A real line or space (dead zone) improves readability.
- Success at reading Brailon Thermoform Plastic was considerably higher.

Module 3B: Embedded Symbols and Labels

Medium used: APH Press Braille, Tactile Vision Offset Ink Image, and Heavy Thermoform Plastic

The purpose of this module was to determine the effect of dead zones, symbol shape (or braille labels, keys) and texture on the ability to locate and read embedded information.

- Dead zones around symbols and braille keys greatly improve the readability of symbols within textured areas.
- Easiest shape symbols to identify with dead zones: square, circle, and triangle. Most difficult to identify: cross and empty rectangle, even with a large dead zone.
- Braille lettered keys with dead zones and containing a dot 3 or dot 6 are read more easily than ones with just upper dots.
- Symbols were easier to read on the fine-dot background.
- Heavy Thermoform Plastic showed the best readability, followed by APH Press Braille. *

* Note: Shapes are not solid on APH Press Braille as on Tactile Vision Offset Ink Image and Heavy Thermoform Plastic.

MODULE 4

Module 4A: Line Strengths

Medium used: Flexi-Paper and Heavy Thermoform Plastic

The purpose of this module is to determine the effect of pattern and width on line strength and readability and to examine symbol recognition on lines.

- Easiest symbols to read within a line: hollow symbol with dead space, hollow symbol, significant dead space around any symbol. Most difficult symbols to read within a line: triangle and star.
- Lines are easiest to follow when the line strengths are bold solid, dashed, and dotted.
- The thin dashed line is better than the thin solid line.
- Empty shape symbols are easier to read than solid.
- Participants had, overall, greater success at detecting differences between lines on Heavy Thermoform Plastic rather than on Flexi-Paper.

Module 4B: Crossed Lines

Medium used: (Zy-Tex) Swell-Touch Paper and Brailon Thermoform Plastic

The purpose of this module was to determine whether some line styles and strengths can be confused with other line styles in a complex environment and to examine what factors make it easier or harder to follow a line when it is bisected by, or interrupted by, another line.

- Bold solid lines are easiest to read. Fine solid lines are most difficult to read.
- Lines of the same strength whether solid or dashed, are difficult to distinguish from each other.
- Different types of lines are followed more easily when crossed (e.g., solid crossing dashed).
- Curved lines are more difficult to follow.
- Brailon Thermoform Plastic may be easier to distinguish line differences on.

MODULE 5

Note: The possibility that incorrect answers obtained in all three parts of Module 5 may be due to a function of knowledge about graphs should be carefully considered.

Information gained from the testing and analysis while not conclusive did suggest the following practices be considered carefully by tactile graphic producers and perhaps be tested further.

Module 5A: Bar Graph

Medium used: Brailon Thermoform Plastic and Tactile Vision Offset Ink Image

The purpose of this module was to determine the best style of presenting material in a bar-graph format.

- Spacing between bars on a bar graph was a not a factor. Bars with spaces or no spaces were equally acceptable to the reader.
- Having a light grid in the background was helpful to the reader but it needs to be kept in the background.
- Having the grid cross the bars seemed to add too much information or cause confusion in both mediums.
- For a bar graph, having the grid lines perpendicular to the bars only seemed preferable. A full grid with lines running both parallel and perpendicular to the bars was thought to make the bar graph more tactually confusing and difficult to read in both mediums.
- There was no preference made as to which medium might be easier to read.

Module 5B: Line Graph

Medium used: Tactile Vision Offset Ink Image and Brailon Thermoform Plastic

The purpose of this module was to determine the best style of presenting material in a line graph format.

- A solid plotted line is easiest to follow. Dashed lines were confused with the grid background in both mediums.
- A background grid is helpful only if the plotted lines and points are raised higher than the grid.
- Open points on the plotted solid line were tactually equivalent to solid points on the plotted solid line and were not able to be differentiated tactually on the plotted line.
- The legend should be placed outside and above the graph itself, not enclosed by it.
- There was no preference made as to which medium might be easier to read.

Module 5C: Complex Graph

Medium used: (Zy-Tex) Swell-Touch Paper and Brailon Thermoform Plastic

The purpose of this module was to examine how much information can be contained on a complex graph and to explore how much braille should be placed on the axes.

- A lighter background grid is helpful.
- It is helpful to identify each line / value on the grid; staggered format for the horizontal axis is a successful method if necessary.
- Bars with the full width of a column rather than partial are preferred.
- A difference in height of components of the graph should be used.
- Dashed plotted lines are easily confused with the background grid lines.
- Points should be considerably “larger” than grid and plotted line.
- Separate graphs for a line graph and a bar graph would be preferable rather than mixing the two on one background grid. Having two graphs on one grid is confusing and presents too much tactual information to be read and understood.
- Strong differences in textures is required tactually to differentiate bars from other graph elements such as a background grid.
- Legend symbols and definitions (keys) should be placed before the graph.
- Brailon Thermoform Plastic appeared to be the easiest medium to read.

MODULE 6

Module 6: Pictures

Mediums used:
Lion: Tactile Vision Offset Ink Image, Heavy Thermoform Plastic, APH Press Braille, (Zy-Tex) Swell-Touch Paper
Potato Plant: APH Press Braille, Tactile Vision Offset Ink Image, Brailon Thermoform Plastic, (Zy-Tex) Swell-Touch Paper
Domed House: APH Press Braille, Heavy Thermoform Plastic, Tactile Vision Offset Ink Image, (Zy-Tex) Swell-Touch Paper

The purpose of this module was to determine if tactile pictures of objects can be identified by touch and whether responses about tactile pictures differed according to production method.

- Pictures may be identified generally, but not specifically. (e.g., animal rather than horse)
- Heavy Thermoform Plastic gave the best representation. Other methods faired a bit lower.

4. GENERAL RECOMMENDATIONS

SUMMARY

It is recommended that:

1. empirical testing of *Interim Measures* guidelines take place, to move towards standardized design of tactile graphics.

2. the revised and updated *Interim Measures* be adopted and used as standard guidelines for tactile graphic production.

3. a multi-level certification process be developed for educators, proofreaders, and producers of tactile graphics.

4. the production of tactile graphics for early-learning materials be encouraged.

5. a Tactile Graphics Standing Committee be established.

RECOMMENDATIONS

Recommendation 1

Empirical testing of Interim Measures guidelines take place, to move towards standardized design of tactile graphics.

Rationale:

Developing guidelines for tactile graphics that contains standardized design is critical now that textbooks and educational materials contain so much graphic material. Braille readers will benefit from coordinated efforts to make sure that tactile graphics contain more similarities than differences. In this way, interpretation of tactile graphics will be more efficient. However, since standard design is not currently in place, it is critical that the initial effort to develop these guidelines be done in a thoughtful, data-based manner.

Empirical testing of *Interim Measures* Guidelines should be conducted with a variety of subjects, including children and adults with various levels of knowledge and experience regarding tactile graphics. In addition, the expertise and opinions of experienced producers of tactile graphics and teachers of students with visual impairments can be combined to validate findings of empirical testing by applying it to practical settings and collecting data related to this application.

Recommendation 2

That the revised and updated *Part II, Interim Measures*, as set out in the *Tactile Graphics Survey,* be adopted as *Standard Guidelines for Tactile Graphic Production* and be followed in the production of tactile graphics.

Rationale:

The responses to the Tactile Graphics Testing Kit indicated that there were certain design and production practices that needed to be standardized.

The adoption of these *Standard Guidelines* will provide a basis for further research for both the large production houses and *Phase IV* participants of this project. Both small and large producers should find these guidelines a useful decision-making tool and the guidelines will, it is hoped, generate further discussion and testing.

Recommendation 3

That a multi-level certification process be developed and established to cover the design, production and quality control procedures of tactile graphics. This system might include certification in:

1. Tactile Appreciation (for educators)
2. Tactile Comprehension (for proofreaders)
3. Tactile Creator, Non-copy Production (originals for pre-school and "instant" diagrams that cannot be reproduced or copied)
4. Tactile Technician, Computer-designed Graphics (for Swell-Touch Paper or Graphtact producers)
5. Tactile Designer, Orientation and Mobility Graphics (for tactilists and orientation mobility instructors)
6. Tactile Designer, Thermoform Masters (for collage, foil and sculpture producers)
7. Tactile Instructor

Rationale:

The establishment of a national certification process for designers of tactile graphics would ensure that producers use standard symbols and procedures. In addition, training would give support to individuals working in isolation.

Recommendation 4

That the design and production of tactual early-learning materials be encouraged and developed across Canada.

Rationale:

In a study of a large group of kindergarten through Grade 2 students, Kershman in "A hierarchy of tasks in the development of tactual discrimination" [*Education of the Visually Handicapped*, 1978] was able to rank the order in which tactile skills were acquired as follows: (1) large solid geometric shapes; (2) flat figures smaller than solid geometric shapes; (3) embossed-dot geometric figures (filled) smaller than the flat figures; (4) raised-dot (or solid line) line figures; and (5) braille figures. Kershman's results stress the need for the early introduction of tactile graphics in the life of future braille readers as an aid to the development of braille literacy.

The results of the Tactile Graphics Survey, Part 1 and the Winnipeg meeting of the Sub-Committee clearly showed that Canada is woefully deficient in tactile graphics that could be considered early-learning material. What there is tends to be available only in scattered localities and they are mostly made by parents, teachers and volunteers working for individual schools or organizations without any experienced help or published guidelines. This material varies greatly in quality and, since the location and content of these "libraries" are unknown to most lending agencies, inaccessible to the general population.

Recommendation 4: *Rationale* (cont.)

Jane Corcoran (former Chairman, BANA Mathematics Technical Committee and CTEVH Tactile Chairman) clearly stated the significance of early exposure to tactile graphics. "They [children with a visual impairment] should have more exposure to tactile illustrations, not less [than sighted children]. The more tactile material he has in the elementary grades, the more experienced a reader he will be when enrolled in algebra and calculus and engineering; classes in which he cannot succeed without the concepts and/or information contained in the figures." [*NBA Bulletin*, Fall 1990]

Recommendation 5

That a Tactile Graphics Standing Committee be established under the Canadian Braille Authority and that such a committee should be made up of producers, educators and consumers from across Canada and include representatives of both official languages.

Rationale:

Tactile graphics are requested for many reasons and for a variety of purposes: as illustrations for textbooks in mathematics, history, geography and the sciences; to illustrate history and travel books as well as the occasional fictional or general collections book; to show business or administrative data, such as personnel or financial reports, in an easy-to-read spatial format; as large print or braille accompaniments for taped material; to display orientation and mobility information realistically and to provide essential job-support material such as keyboard and switchboard layouts. A small, restricted sub-committee, whether under the auspices of the English Braille Standards or the Educational Standing Committees, cannot possibly address all the needs of the potential consumers, each with his or her own special perspectives, requirements and problems.

As noted earlier, standardization of tactual materials, tools, symbols, design, format and production methods is still in its infancy and certification of tactilists is non-existent. To achieve success in any area of standardization, input and cooperation is required from a great variety of interest groups including braillists with specializations in textbook, literary, mathematical and early-learning material transcription; educators knowledgeable in the problem of teaching visually impaired students from kindergarten to the post-secondary level; rehabilitation and children's consultants; tape transcribers; orientation and mobility instructors; and consumers of all ages, experience and ability.

Without a full standing committee to work on the process of certification and the development of standards for all user groups, mediums and purposes, tactile graphic production will remain an unregulated poor relative of braille rather than the powerful and positive aid to the visually impaired it could be.

5. APPENDIX

APPENDIX A

FINANCIAL REPORT

Budget Record to Dec 31, 2002

	Debit	Credit	Balance
Jan-Dec 1998			
CBLF Grant		77,000.00	
CBA Admin Fee	15,400.00		
Meetings/Travel	4,379.12		
		57,220.88	
Jan-Dec 1999			
Meetings/Travel	7,158.77		
		50,062.11	
Jan-Dec 2000			
Meetings/Travel/-			
Pilot Testing Materials	10,926.09		
		39,136.02	
Jan-Dec 2001			
Research	6,000.00		
Meetings/Travel	1,591.13		
		31,544.89	
Jan-Dec 2002			
Meetings/Travel	8,062.13		
Conference calls	478.49		
Research Materials/-			
Transcription/Analysis	3,106.59		
		19,897.68 *	

* There are still outstanding fees for research and production costs.

APPENDIX B

FORMS USED FOR TESTING

1. Letter to Administrator

[letterhead- maybe that of the agency who is conducting study with students from that school agency/entity]

Dear *[Administrator*],

[*Student(s)' name]* has been invited to participate in a research study on tactile graphics. Thirty students throughout Canada and the U.S. will participate in the research project. The results will assist in establishing guidelines for production of tactile graphics in braille textbooks in both countries.

A summary of GRASP, the research project is attached, as well as a copy of the permission form for participation to be signed by the student and parent.

We are asking for your support in this student's participation. We would like to schedule the research session on *[date*] at *[location- school building, etc.*].

We look forward to including this student *[these students*] in this most important data-gathering project.

Sincerely,

_____	_____
[name of TG Committee member]	*[name of local teacher of students with vision impairment]*

2. Consent Form for Children

Department of Educational and Counselling Psychology, and Special Education
Faculty of Education
The University of British Columbia
2125 Main Mall
Vancouver, BC Canada V6T 1Z4

Consent Form for Children

Braille Authority Tactile Graphics

Principal Investigator: Cay Holbrook, Department of Educational and Counselling Psychology, and Special Education, Tel: (604) 822-2235. Associate Professor.

Co-Investigator(s): Amedeo D'Anguilli, Department of Educational and Counselling Psychology, and Special Education, Tel: (604) 822-5720. Postdoctoral Fellow.

Purpose:

The purpose of this project is to examine how easily children and adults who are blind use and understand a variety of tactile graphics. The participation of adults and children who are blind is necessary because this project will help design graphics that specifically reflect the preferences and needs of these individuals.

Study Procedures:

The participants will be asked to touch tactile displays and they will be asked some questions about the graphics contained in the displays. The arms and the hands of the participants will be the focus of the videotape during tactual exploration of the displays, consequently, the verbal answers of the participants will be also audio recorded. The testing plus videotaping will take place approximately an hour to an hour and a half. The session includes time for breaks and debriefing.

Confidentiality:

Any information resulting from this research study will be kept strictly confidential. All documents will be identified only by code number and kept in a locked filing cabinet. Participants will not be identified by name in any reports of the completed study. Data records will be kept on a locked computer hard disk.

Debriefing:

Following testing and videotaping, the participants will be debriefed on the contents of the different factual activities in which they have been involved.

Contact:

If I have any questions or desire further information with respect to this study, I may contact Cay Holbrook or one of her associates at (604) 822-2235.

If I have any concerns about my treatment or rights as a research subject I may contact the Director of Research Services at the University of British Columbia, Dr. Richard Spratley at 822-8598.

Consent:

I understand that my child's participation in this study is entirely voluntary and that he/she may refuse to participate or withdraw from the study at any time without jeopardy to any further services from the institute for the blind.

I have received a copy of this consent form for my own records.

I consent / I do not consent (please circle one) to my children's participation in this study.

_____

Subject Signature Date
(or Parent or Guardian Signature)

_____

Signature of a Witness Date

3. Consent Form for Adults

Department of Educational and Counselling Psychology, and Special Education
Faculty of Education
The University of British Columbia
2125 Main Mall
Vancouver, BC Canada V6T 1Z4

Consent Form for Adults

Braille Authority Tactile Graphics

Principal Investigator: Cay Holbrook, Department of Educational and Counselling Psychology, and Special Education, Tel: (604) 822-2235. Associate Professor

Co-Investigator(s): Amedeo D'Anguilli, Department of Educational and Counselling Psychology, and Special Education, Tel: (604) 822-5720. Postdoctoral Fellow

Purpose:

The purpose of this project is to examine how easily children and adults who are blind use and understand a variety of tactile graphics. The participation of adults and children who are blind is necessary because this project will help design graphics that specifically reflect the preferences and needs of these individuals.

Study Procedures:

The participants will be asked to touch tactile displays and they will be asked some questions about the graphics contained in the displays. The arms and the hands of the participants will be the focus of the videotape during tactual exploration of the displays, consequently, the verbal answers of the participants will be also audio recorded. The testing plus videotaping will take place approximately an hour to an hour and a half. The session includes time for breaks and debriefing.

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Any information resulting from this research study will be kept strictly confidential. All documents will be identified only by code number and kept in a locked filing cabinet. Participants will not be identified by name in any reports of the completed study. Data records will be kept on a locked computer hard disk.

Debriefing:

Following testing and videotaping, the participants will be debriefed on the contents of the different factual activities in which they have been involved.

Contact:

If I have any questions or desire further information with respect to this study, I may contact Cay Holbrook or one of her associates at (604) 822-2235.

If I have any concerns about my treatment or rights as a research subject I may contact the Director of Research Services at the University of British Columbia, Dr. Richard Spratley at 822-8598.

Consent:

I understand that my child's participation in this study is entirely voluntary and that I may refuse to participate or withdraw from the study at any time without jeopardy to any further services from the institute for the blind.

I have received a copy of this consent form for my own records.

I consent to participate in this study.

_____

Subject Signature Date

_____

Signature of a Witness Date

4. Tactile Graphics Study Draft Letter Seeking Participants

Tactile Graphics Study- Draft Letter Seeking Participants

June ?, 1999

Re: Tactile Graphics Study 1999-2000

Dear Colleague:

The Canadian Braille Authority is an organization devoted to the promotion of braille as a primary medium for blind persons.

The Authority has been involved in a number of research projects to investigate standards for teaching and learning braille and the current tactile project is one such study.

We are seeking teacher and student participants for a study of tactile graphics produced with standardized production methods and techniques. Study participants will be provided with modules of diagrams, graphs and asked to respond to questions about the modules presented. Participant responses, comments and observations will be recorded and analysed. The outcomes of the study will be reported widely and form the basis for recommendations for tactile graphic production techniques.

We are encouraging school age braille/tactile graphic users, of a variety of ages, and their teachers to participate. Please express your interest by responding as soon as possible with the following information:

Child's Name:

Age: Grade Level:

Visual Acuity: Braille User: Print user:

Teacher's Name:

Address:

5. Introduction Letter

(CBA logo) *(BANA logo)*

*G*raphics *R*esearch and *S*tandards *P*roject (*GRASP)*

Currently there are no established guidelines for the production of graphs, diagrams, maps, and other graphic material in tactile form for braille textbooks in North America. The Canadian Braille Authority (CBA) in collaboration with the Braille Authority of North America (BANA) has identified the production of tactile graphics as a project of significance for the development of high quality braille materials.

"The Canadian Braille Authority is dedicated to the promotion of braille as the primary medium for persons who are blind." (CBA Mission statement) "The mission of the Braille Authority of North America (BANA) is to assure literacy for tactile readers through the standardization of braille and/or tactile graphics."

Because the inclusion of tactile graphics is of critical importance in high school braille textbooks, CBA and BANA have committed to work together to determine the most effective and efficient ways to produce easily understood graphic material in braille textbooks. From information gathered through this research project, standards will be established and guidelines for production of tactile graphics will be developed and published under the auspices of Braille Authority of North America (BANA).

The purpose of this project is to examine how students who are blind respond to a number of independently produced tactile graphic displays representing objects, graphs, diagrams and maps, and produced by a variety of commonly-used production techniques. The following objectives will be addressed:

1. Test the effectiveness of a variety of production methods used for tactile graphics.
2. Test the effectiveness of a variety of design components used in tactile graphics, including lines, textures, and symbols.
3. Test the effectiveness of a variety of formats used in the production of tactile graphics.

Research design and interpretation will be completed by staff at University of British Columbia, Dr. Cay Holbrook, assisted by Dr. Amedeo D'Angiulli. The study, including sessions with participants, will be conducted by members of the Tactile Graphics Committees of CBA and BANA, who are jointly sponsoring this research project.

Participants have been selected by members of the joint committee, who have worked with their local professionals who provide services to students who read braille. Students were selected to meet the following criteria:

1. congenitally blind with visual ability no greater than light perception
2. proficient braille reader, using braille as primary reading media
3. grades 9-12 [college age?]

Participants in the study will be videotaped as they examine a series of tactile graphics displays. They will be asked questions about the graphics contained in the displays, and will be asked to comment on the clarity of the items presented. The participants will be encouraged to contribute suggestions for improvements in presentation of the information.

6. Consent Form for Videotaping

As described in the Consent Form for participation in the Braille Authority's tactile graphics study, GRASP, all sessions will be videotaped, focusing on the hands of the participant as the tactile graphics are explored. In agreeing to participate in the research, you have given permission for videotaping of the testing sessions. This permission allows for recordings to be reviewed only by members of the research team.

Conclusions drawn from this research project will be used for two purposes:
1. To develop international guidelines for production of quality tactile graphics, and
2. To develop training materials for producers of tactile graphics, to support those guidelines.

Some of the video footage taken while the participant is reading tactile graphics would be useful teaching aids for training sessions of producers. The research team requests your permission to use appropriate video footage for those training purposes. Permission for this use is NOT required for participation in the research project.

I give my permission for use of video footage of _____ for training purposes.

Name

_____ _____
Signature Date

I do not grant permission for use of video footage of _____ for uses other than required for analysis of this research project.
Name

_____ _____
Signature Date

APPENDIX C

STUDENT TEST BOOKLET

GRASP

Student Test Booklet *

Please complete this booklet for each subject and return entire booklet for analysis

* This Student Test Booklet has been modified for this report. Only a single set of questions for each module has been included and the spaces for answers and extra print copies of the diagrams have been omitted.

STUDENT INFORMATION SHEET

1. Date of birth: _____ Date of test: _____.

2. Age: _____.

3. Grade: _____.

4. Gender: **M** **F**

5. Cause of visual impairment ***[if known by tester]***:

6. Light perception? No Yes Degree ***[if known]*** _____.

7. Approximately how many years of braille reading? _____.

8. Previous experience with tactile diagrams? ***[If needed, tester could ask additional specific questions]***

a. age/grade (first encountered) tactile graphics _____.

b. academic subjects (math, geography, biology, etc.)

c. production medium (stereo/thermo/paper, etc.) ***[They may need to answer this later while looking at the modules if unsure.]***

d. any training they received in how to read tactile diagrams/maps

9. Any other comments (e.g., note any other disability):

Contents - For Full Test Booklet

Module 1A: Polygons

Production Method: Stereocopy

1. Look at the shapes on each row of this page starting from the top. How many sides does each shape have? ***[Record answers on print copy of module - circle or highlight correct answers; write number of incorrect guess.]***

2. Each of these shapes on this page is produced in a different way. Examine the shapes in each row and rank them from best to worst according to how easy they are to understand. ***[This can also be marked on print copy with 1 - being Best & 4 - for Worst]***

3. **Look down column 1. There are two textures of shapes. Which texture do you like the best?**

Smooth/Black Rough Why?

4. **Look down column 2.**

a. Which outline do you like the best?
Solid Small Dash Large Dash Dotted
Why?

b. Which one do you like the next best?
Solid Small Dash Large Dash Dotted
Why?

c. Which one do you like next?
Solid Small Dash Large Dash Dotted
Why?

d. [For the un-chosen shape]: What do you think about this shape?

5. **Look down column 3.**

a. Which texture do you like the best?
Dotted Lines Grid Rough
Why?

b. Which one do you like next best?
Dotted Lines Grid Rough
Why?

c. Which one do you like next best?
Dotted Lines Grid Rough Why?

d. *[For the un-chosen shape]:* What do you think about this shape?

6. Look down column 4.

a. Does the addition of indicator dots or lines help you to identify or count sides on a shape?

Yes No Why?

b. Which indicator do you like the best?

Line Dots outside Dots inside None Why?

c. Which do you like next best?

None Dots outside lines Dots inside Why?

d. Which do you like next best?

None Dots outside lines Dots inside Why?

7. Have you ever seen angle indicators before?

No Yes If yes, describe.

Module 1B: Point Symbol Sizes

Production Method: Flexipaper

1. Identify the shapes in the top row from left to right. ***[Record answers on print copy of module - highlight (or) correct answers; write incorrect.]***

   Continue down the remaining rows, and identify from left to right. Go as far down the rows on the page as you can. If you don't feel you can accurately identify the symbols once they reach a certain size, try to separate them into groups of symbols that feel the same and ones that feel different. ***[Circle symbols that feel the same - use different colours for different groups or use letters A to D to show up to 4 separate groups.]***

2. For each row which point symbol is the:

   a. easiest to distinguish? ***[Mark print copy with an "E" for Easiest.]***

   b. most difficult to distinguish? ***[Mark print copy with an "H" for Hardest.]***

Module 2A: Arrow Lines & Heads

Production Method: Graphtact

1. Starting from the top going down, examine these numbered lines one at a time. For each numbered line, tell me whether the line contains information about direction and, if so, in what direction or directions the line points. ***[On the print copy, highlight/mark direction student points for each line whether the guess is correct or not.]***

Column 1:

a.	**Brl No. 6)**	Has direction	Does not have direction
b.	**Brl No. 2)**	Has direction	Does not have direction
c.	**Brl No. 7)**	Has direction	Does not have direction
d.	**Brl No. 11)**	Has direction	Does not have direction
e.	**Brl No. 12)**	Has direction	Does not have direction
f.	**Brl No. 10)**	Has direction	Does not have direction
g.	**Brl No. 20)**	Has direction	Does not have direction
h.	**Brl No. 5)**	Has direction	Does not have direction

Column 2:

i.	**Brl No. 18)**	Has direction	Does not have direction
j.	**Brl No. 22)**	Has direction	Does not have direction
k.	**Brl No. 24)**	Has direction	Does not have direction
l.	**Brl No. 9)**	Has direction	Does not have direction
m.	**Brl No. 3)**	Has direction	Does not have direction
n.	**Brl No. 21)**	Has direction	Does not have direction
o.	**Brl No. 13)**	Has direction	Does not have direction
p.	**Brl No. 14)**	Has direction	Does not have direction

Column 3:

q.	**Brl No. 1)**	Has direction	Does not have direction
r.	**Brl No. 8)**	Has direction	Does not have direction
s.	**Brl No. 17)**	Has direction	Does not have direction
t.	**Brl No. 4)**	Has direction	Does not have direction
u.	**Brl No. 16)**	Has direction	Does not have direction
v.	**Brl No. 19)**	Has direction	Does not have direction
w.	**Brl No. 15)**	Has direction	Does not have direction
x.	**Brl No. 23)**	Has direction	Does not have direction

Which arrow/arrows:

y. is the clearest? Say its number. _____.

z. is the least clear? Say its number. _____.

aa. have you seen before? Give numbers. _____.

2. Each of the lines has had a number to identify it. Were any of these labels:

a. too close to the line? Give numbers. _____.

b. too far away? Give numbers. _____.

c. hard to tell which line they referred to? _____.

Module 2B: Measurement Indications & Labels

Production Method: Graphtact

1. The following tactile diagram is like an outline of a building where various segments or sections have been measured. Starting at twelve o'clock, following the building clockwise until you return to the top. As you go, tell me what measurement indicators you find, what they may measure and the distance or length of that segment.

[Highlight/check( ) numbers if matched with the correct measurement line or building segment. Highlight/check( ) measurement line if matched with the correct building segment. If participant misses a marker or segment, tell the subject that they have missed one and circle the miss even if they subsequently identify what it relates to.]

2. Which type of measurement indicator did you like:

a. the best? _____.
b. the next best? _____.
c. the least? _____.

3. Do you prefer the braille distance (i.e., the number) to be placed:

Above Below
or
Between the measurement indicators? Why?

Module 3A: Textures

Production Method: Flexipaper

1. **How many different textures can you detect on each numbered texture strip?** ***[Ignore unnumbered strip at the top for now.]***
   a. Strip 1: _____.
   b. Strip 2: _____.
   c. Strip 3: _____.
   d. Strip 4: _____.

2. When two textures are right next to each other, the contrast between them is called a "texture contrast". Some textures are easy to tell from each other, others are difficult. Look at each of the texture strips and rank the texture contrasts from easiest to hardest to detect. *[1 is Easiest.]*

a. **Contrast (Strip 1)** **Rank**
   Texture 1-2 _____.
   Texture 2-3 _____.
   Texture 3-4 _____.
   Texture 4-5 _____.

b. **Contrast (Strip 2)** **Rank**
   Texture 1-2 _____.
   Texture 2-3 _____
   Texture 3-4 _____.
   Texture 4-5 _____.

c. **Contrast (Strip 3)** **Rank**
   Texture 1-2 _____.
   Texture 2-3 _____.
   Texture 3-4 _____.
   Texture 4-5 _____.
   Texture 5-6 _____.

d. Contrast (Strip 1) **Rank**
   Texture 1-2 _____.
   Texture 2-3 _____.
   Texture 3-4 _____.
   Texture 4-5 _____.

Rank the top five textures according to the ones you like the best.
[Write answers below.]

e. First texture choice: _____.
f. Second texture choice: _____.
g. Third texture choice: _____.
h. Fourth texture choice: _____.
i. Fifth texture choice: _____.

3. Above the first texture strip is a row of small "legend" boxes containing some of the textures that appear in the numbered rows. For each legend/key texture, indicate where you find that same texture in any of the strips.

[Highlight/circle listed option if correct( ); indicate strip No. and texture No. for incorrect choices(X) - for example, a likely wrong choice for box 1 might be 4-2. Be sure to indicate all correct and incorrect choices for each legend/key texture boxes.]

Box 1: If **Strip 4/Texture 2** **X** Strip/Texture No.: **/** **/**
Box 2: If **Strip 4/Texture 5** **X** Strip/Texture No.: **/** **/**
Box 3: If **Strip 1/Texture 3** **X** Strip/Texture No.: **/** **/**
Box 4: If **Strip 1/Texture 1** **X** Strip/Texture No.: **/** **/**
Box 4A: If **Strip 3/Texture 4** **X** Strip/Texture No.: **/** **/**
[Flexipaper version only]
Box 5: If **Strip 2/Texture 2 & 4** **X** Strip/Texture No.: **/** **/**
[Can look at this as 1 area with another inside it]
Box 6: If **Strip 2/Texture 5** **X** Strip/Texture No.: **/** **/**
[Can look at this as 4 see above]
Box 7: If **Strip 3/Texture 6** **X** Strip/Texture No.: **/** **/**
Box 8: If **Strip 3/Texture 2** **X** Strip/Texture No.: **/** **/**

Module 3B: Embedded Symbols & Labels

Production Method: APH Paper

1. Look at each one of the numbered strips on this page. Explore from left to right and tell me what symbols or braille letters/numbers are written on the strip. ***[Highlight/check correct answers and write incorrect guesses on the print copy of the module. Circle or note missed symbols.]***

[Note: The subject may not be aware which symbol is the hardest to find (see question 2v) as they may not have found it. Even if found, some symbols may not be read correctly. These lapses need to be noted.]

2. Consider each strip again. Which is the easiest symbol or letter to identify?

a. **Strip 1**
- i. Easiest? _____.
- ii. Which is next easiest? _____.
- iii. Which is next easiest? _____.
- iv. Which is next easiest? _____.
- v. Most difficult to detect? _____.

b. **Strip 2**
- i. Easiest? _____.
- ii. Which is next easiest? _____.
- iii. Which is next easiest? _____.
- iv. Which is next easiest? _____.
- v. Most difficult to detect? _____.

c. **Strip 3**
- i. Easiest? _____.
- ii. Which is next easiest? _____.
- iii. Which is next easiest? _____.
- iv. Which is next easiest? _____.
- v. Most difficult to detect? _____.

d. **Strip 4**
- i. Easiest? _____.
- ii. Which is next easiest? _____.
- iii. Which is next easiest? _____.
- iv. Which is next easiest? _____.
- v. Most difficult to detect? _____.

3. Which texture do you find interferes:

a. the most with your ability to find and read the embedded symbols?

Strip 1 Strip 2 Strip 3 Strip 4

b. **the least with your ability to find and read the embedded symbols?**

Strip 1 Strip 2 Strip 3 Strip 4

Module 4A: Line Strengths

Production Method: Flexipaper

1. Look at lines 1, 2 and 3.

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Rank these lines from easiest to hardest to follow. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**
Line No.	____	____	_____.

2. **Look at lines 3, 4 and 5.**

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Rank these lines from easiest to hardest to follow. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**
Line No.	____	____	_____.

3. **Look at lines 6,7 and 8.**

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Rank these lines from easiest to hardest to follow. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**
Line No.	____	____	_____.

4. Look at lines 4 and 6.

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Which is the easiest to follow? Line 4 Line 6

5. Look at lines 5 and 7.

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Which is the easiest to follow? Line 5 Line 7

6. Look at lines 9 and 10.

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Which is the easiest to follow? Line 9 Line 10

7. Look at lines 11,12 and 13.

a. Do these lines feel the same to you? Yes No
If not, how are they different?

b. Rank these lines from easiest to hardest to follow. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**
Line No.	____	____	_____.

8. Look at Line 14.

a. What shapes are the markers/point symbols on this line?
i. Shape 1 _____
ii. Shape 2 _____
iii. Shape 3 _____
iv. Shape 4 _____
v. Shape 5 _____
vi. Shape 6 _____

b. How many markers are hollow? _____

c. How many markers are solid? _____

d. Rank these markers from easiest to hardest to read. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**	**4**	**5**	**6**
Point No.	__	__	__	__	__	__.

9. Look at Line 15.

a. What shapes are the markers on this line?

i. Shape 1 _____
ii. Shape 2 _____
iii. Shape 3 _____
iv. Shape 4 _____
v. Shape 5 _____
vi. Shape 6 _____
vii. Shape 7 _____

b. How many markers are hollow? _____

c. How many markers are solid? _____

d. Rank these markers from easiest to hardest to read. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Point No.	__	__	__	__	__	__	__.

10. Look at Line 16.

a. What shapes are the markers on this line?

i. Shape 1 _____.
ii. Shape 2 _____.
iii. Shape 3 _____.
iv. Shape 4 _____.
v. Shape 5 _____.
vi. Shape 6 _____.
vii. Shape 7 _____.
viii. Shape 8 _____.
ix. Shape 9 _____.

b. How many markers are hollow? _____

c. How many markers are solid? _____

d. Rank these markers from easiest to hardest to read. ***[1 is Easiest.]***

Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Point No.	__	__	__	__	__	__	__	__	__.

Module 4B: Crossed Lines

Production Method: Stereocopy

1. Starting at the top left-hand corner of the page and going clockwise around the page, follow lines 1-10 from beginning to end. Rank these lines from easiest to hardest to read/follow. ***[1 is Easiest.]***

[Circle Group if unable to separate some parts of ranking.]

Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Line No.		__	__	__	__	__	__	__	__	__.

2. **Are there any lines that look the same?** Yes No If yes, which?
[Fill in as many combinations as subject lists.]

a. _____ & _____ (&) _____ (&) _____.
b. _____ & _____ (&) _____ (&) _____.
c. _____ & _____ (&) _____ (&) _____.
d. _____ & _____ (&) _____ (&) _____.
e. _____ & _____ (&) _____ (&) _____.

Module 5: Graph A

Production Method: Tactile Vision

1. **In this graph, how many different bars are represented?** _____

2. **Which bar would be the greatest/most?** _____

3. Look at the top two sets of bars and the second two sets.

a. What is different between the first two sets of bars and the second two sets?

b. Which is easier to read? ***[Spaced No space]***
Why?

4. In determining the value shown by a bar:

a. Does the background/grid help you differentiate the variables?
Yes No

b. Is it helpful or not for the grid lines to go through the bars, as shown in the third set of bars? Helpful Not helpful

c. Would the bars be easier to read if there were both horizontal and vertical lines in the background?
Yes No Why or why not?

Module 5: Graph B

Production Method: Thermoform

1. On this graph, which plotted line is easiest to follow?

Solid lines Dashed lines Equal

2. Which points are easiest to identify?

Solid circles & lines Open circles & solid lines

Solid circles & dashed lines Open circles & dashed lines

Seem the same

3. Do the lines of the background (i.e., grid):

a. interfere with the lines representing the graphed information?
Yes No No opinion

b. help interpret values (plotted points)?
Helpful Not helpful No opinion

4. Look at the key/legend showing what each line means. Does it provide you with the information you need?

Yes No

If no, is there a better way to do this? Describe.

Module 5: Graph C

Production Method: Stereocopy

1. There are a lot of variables or different types of information being shown on this graph. Can you tell me the first feature you identified?; the next;...?

[Number the items below from 1 (first) up to 15 (i.e., as far as participant gets in the identification). The same number should be given to features the subject finds at the same time or can't rank separately. Blanks indicate that the subject didn't find these features on their own (or that they didn't think of them as distinct features).]

List	**Rank** (order identified)
Legend/Key	_____.
Solid bars	_____.
Textured bars	_____.
Solid lines	_____.
Dotted lines	_____.
Points on line A	_____.
Points on line B	_____.
Axes lines	_____.
Axes arrows	_____.
Grid lines	_____.
Tick lines	_____.
Braille for line A	_____.
Braille for line B	_____.
Vertical axis Nos.	_____.
Horizontal axis Nos.	_____.

2. Does the background/grid help you find the value of information?
Yes No No opinion

3. Look at the value of the grid lines (ticks) shown below the graph.

a. Does each line/value on the grid need to be identified?
Yes No Sometimes

b. Does the staggered format for showing values help?
Helpful Not helpful Why or why not?

4. Look at the first 2 bars; and now the next two. Should bars be the full width of a column or partial width?

Full width Partial width Doesn't matter

5. When lines between points are concurrent with the grid lines, what would be the best way to show that clearly?

6. Describe what is "too many" separate pieces of information in a graphic like this. Can you list some criteria for "too much"?

7. What is your preference in relation to keys/legend to a graphic:

a. arrows/lead lines outside the graphic, pointing to the variables?
b. separate legend symbols & definition(s) before/above the graphic?
c. separate key/legend below/after the graphic?
d. key embedded inside the graphic?

Module 6A: Lion Picture

Tell the student:

Now I am going to show you some tactile pictures. The first picture has been produced in four different ways. Look at each of the pictures and I'm going to ask you a couple of questions. ***[Allow the student to explore all four pictures (make sure that the words on the pictures have been covered so that they don't see the label.]***

1. Examine this picture. What is it?

2. Which one of these objects do you think it may depict: ***[Highlight/circle answer]***

   CAR HORSE TABLE LION OCTOPUS

3. If the title of this picture was "Lion", how closely do you believe this title fits the picture? Rank from 1-7 with 1 being the highest ranking.

a.	APH Paper Version	1	2	3	4	5	6	7
b.	Stereocopy/Swell Version	1	2	3	4	5	6	7
c.	Tactile Vision Version	1	2	3	4	5	6	7
d.	Thermoform Version	1	2	3	4	5	6	7

Module 6B: Potato Plant

Allow the student to explore all four pictures (make sure that the words on the pictures have been covered so that they don't see the label).

1. Examine this picture. What is it?

2. Which one of these objects do you think it may depict: ***[Highlight/circle answer]***

   POTATO PLANT

   TREE

   THE HEART AND Its ARTERIES

   DOG

   OCTOPUS

3. If the title of this picture was "Potato Plant", how closely do you believe this title fits the picture? Rank from 1-7 with 1 being the highest ranking.

a.	APH Paper Version	1	2	3	4	5	6	7
b.	Stereocopy/Swell Version	1	2	3	4	5	6	7
c.	Tactile Vision Version	1	2	3	4	5	6	7
d.	Thermoform Version	1	2	3	4	5	6	7

Module 6C: Domed House

Allow the student to explore all four pictures (make sure that the words on the pictures have been covered so that they don't see the label).

1. Examine this picture. What is it?

2. Which one of these objects do you think it may depict: ***[Highlight/circle answer]***

   BOAT

   TREE

   DOMED HOUSE

   BASEBALL STADIUM

   SWING SET

3. If the title of this picture was "Domed House", how closely do you believe this title fits the picture? Rank from 1-7 with 1 being the highest ranking.

a.	APH Paper Version	1	2	3	4	5	6	7
b.	Stereocopy/Swell Version	1	2	3	4	5	6	7
c.	Tactile Vision Version	1	2	3	4	5	6	7
d.	Thermoform Version	1	2	3	4	5	6	7

APPENDIX D

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