Abstract:
Orientation of a person with visual impairment is a process of using all senses to establish one’s spatial position (Hill, 1986). Through special exercises and by using tactile maps a child with visual impairment can learn to understand her position in space, to assess the relationships between the objects in space, to perceive the space from different positions, and to locate herself on the map (Ungar et al., 1994, 1996, 1997). Tactile maps are effective tools when learning routes and when familiarizing with new environments. A person with visual impairment needs instruction in order to learn to read and to understand tactile maps. This paper describes a tactile map program developed for preschoolers with visual impairment. The children learned about the concept of the map, spatial concepts and dimensions, directions, systematic exploring techniques, alignment of the map, map symbols, how a two-dimensional tactile map depicts a three-dimensional model, and to read a tactile map.

Introduction
The family of the child with visual impairment is confronted with many parenting worries. Several questions come up regarding cognitive, motor, social, educational, behavioral, and sensory development. Among other things, the parents have to deal with issues of safety, independence, encouragement of natural curiosity, and guiding exploration. One of the major concerns is how the child with visual impairment can safely develop independence.

Orientation and mobility
Through Orientation and Mobility (O&M) instruction, a child with visual impairment can develop different skills that are important for independent and safe travel in familiar and unfamiliar environment (Hill & Ponder, 1976). One element of orientation is the familiarization with the environment; it can be carried out by different methods: by route learning, by comprehensive mapping, and by using tactile maps.

Children needing O&M instruction have had little, or no time, to build up concepts based on sight like adults who have lost vision later during their life. They do not have adult spatial concepts. Children with visual impairment, therefore, must develop concepts from other sources so that effective two-way communication can be achieved (Millar, 1995). Visual impairment of a child requires learning to use tactual, auditory, olfactory, and kinaesthetic senses when developing concepts. Mastery of age-appropriate concepts is necessary when the child with visual impairment is learning travel skills, and teaching such concepts is a part of orientation instruction. Instruction may focus on certain kinds on concepts, such as positional (e.g., above), directional (e.g., on the left), and environmental (e.g., a city block). Throughout their whole life time, children with visual impairment must explore, synthesize, and reconstruct spatial information that sighted children can acquire at a single glance (Bigelow, 1992).

If the child is given a special learning environment where exercising spatially related activities is possible, even very young children with visual impairment can improve their managing of spatial relationships and sensory experiences (Nielsen, 1991). One way of teaching concepts is to take the child to the natural environment to experience concrete objects so learning could happen in concrete learning sessions. This is not always possible, however, because of the object’s size (e.g., airplane), or of its intangible character (e.g., parallel traffic lanes). Another method is to use tactile representations of the object. For example, such representations can be a small scale model or a tactile map.

Tactile maps
A tactile map is one tool of bringing out the layout of external space for a child with visual impairment. It can provide a vicarious source of spatial information which preserves all the interrelationships between objects in space but presents those relationships within one or two hand-spans. Tactile maps can usefully be used to introduce children to particular spaces, such as classroom or a playground.

The combination of using a tactile map together with direct travel experience is very effective way to familiarize with a novel space (Ungar et. al., 1994, Espinosa et. al., 1998) However, tactile maps are not widely used in O&M training because persons with visual impairment claim they are inexperienced to use maps, or they may lack instruction in map
exploration skills. This is the case especially among the persons who are congenitally blind. Consequently, it is important to start map instruction as early as the child is cognitively mature enough.

Most of the research in the field of tactile maps has been concerned with the design and the production of the maps but not so much in exploring and reading methods (Ungar et al., 1995). Tactile maps have to be produced in such a way that every component is distinct and easily identifiable, and its form has to be logically simplified. Whatever the technique is tactile images have to be produced with special allowance for tactile perception. Most common techniques for producing tactile maps are thermoform, swell or microcapsule paper, collage, German film or Ritmuff, and Computer graphics embossed by Braille printers (Eriksson, 1995). Inkjet is the latest technical innovation and a valid method when producing tactile diagrams and maps (McCallum & Ungar, 2003).

O&M maps are large scale maps including significant features of the travelling environment as exits, stairs, elevators, escalators, immovable furniture, toilets, and emergency doors. O&M maps from outside include for example: locations of the buildings, streets, obstacles, landmarks, bus stops, and crosswalks. The study by Ungar et al. (1993) showed that children with visual impairment can understand a simple map and use it to make spatial judgments, and an appropriate training program might allow children with visual impairment to use maps in even more sophisticated way. Tactile maps provided a means of extending the child’s conception of the environment beyond that which could be gained from different experience. Tactile maps may thus have a role even in the earliest stages of O&M instruction in promoting the general spatial abilities of children with visual impairment. Tactile maps should be used in mobility training in order to emphasize the significance of orientation.

Research questions

Literature search brought out studies dealing with tactile maps as a means to develop spatial skills of children with visual impairments. Blades & Spencer (1986) examined young sighted children’s (aged 4-6 years) ability to use maps, and found that map reading can be taught to young children, and children can understand their own position in an environment. Ungar et. al., (1993) discovered that visual experience may not be a necessary requirement for the ability to form integrated, global impressions of the environment. They also found that both blind and low vision children could understand and use tactile maps, and, that children who were totally blind learnt the environment more accurately from the map than from direct exploration. The studies also revealed that children with visual impairment improved their skills in map exploration strategies through instruction, and even a short training period could improve the skills.

But how do children with visual impairment learn to explore and to read tactile maps, how much do they get instruction, what are the first maps like? The literature research did not find a description how maps are generally introduced for young children, and what the training is like. It was important to develop an effective and playful tactile-map program, and applications of maps for enhancing spatial understanding. The map applications were named premaps. The objective of this work was to develop for young children with visual impairment a teaching program for learning tactile maps as well as to instruct map reading strategies.

THE MAP PROGRAM

Task #1: The concept of the map

Objective: The child learns: (a) the concept of the map in general; (b) that the map is a representation of the real view; (c) that it should be directed according to the child’s body position relative to the environment.

Teaching materials: Five pieces of carpeting (50 cm x 140 cm) made of fabrics that have different tactile qualities, and different colours, the midline of each is marked with a tactile line; The map, which is made of pieces of the same fabric materials as carpets glued one after another on the pasteboard; Toys, pairs of the same creatures in big and small sizes, if possible

Procedure: In the first phase the child examines the view from the “bottom” of the fabric line (the view’s midline is vertical). The carpet pieces are put on the floor one after the other, in line; the same arrangement of fabrics is glued on the pasteboard in the same order as the layout on the floor. Thus the same layout is in sight both on the floor and on the map. The child explores the pasteboard map in order to recognize the fabrics, and compares it with the floor layout. The child starts to examine the map from the left upper corner. During the exploration the instructor names the sides of the map: the left, right, upper, and lower sides. After the exploration the child walks or crawls on all fours over the pieces trying to recognize the fabrics and to check the order in which they are arranged on the map. The map always has to be positioned in the same direction as the floor layout in relation to the child’s body position. The instructor puts the big toy on one of the pieces of fabric on the floor, and the smaller toy is put on the equivalent map location. The child explores the map, tells the location of the toy, and then goes to pick up the toy from the floor.
In the second phase the child moves to the other end of the fabric row where the view is thus reversed. After studying the layout the child has to turn the map 180° in order to have the equivalent view both on the floor and on the map.

**Task #2: The frames of the map and the directions**

**Objective:** The child learns to know that the map has frames, features that are referred to as the left, right, upper, or lower sides of the map. The child learns, for example, what the left or upper side of the map is and what it means when the object is said to be located, for example, in the upper right corner of the map; and so on. The child is guided to use the map successfully in relation to the frame of its four sides.

**Teaching materials:** A rectangular table; the child has to be able to reach all the edges of the table when positioned at the middle of the table’s lower edge; A rectangular magnetic board, no bigger than 30cmx50cm; 1-3 magnets, preferably different shapes; 1-3 small toys, such as a plastic box, a car, a teddy bear, and so on.

**Procedure:** The child explores the table and the instructor explains the four-sided frame. The edges and the corners of the table are named. The table represents the view and the magnetic board is the map. First the child works with one of the boxes, which is described as “a flying treasure chest”. The instructor sets the box at a designated place on the table and shows its location to the child by putting a magnet on the map (i.e., the magnetic board) at the corresponding location. The child explores the map, verbally identifies the location of the box (the treasure chest), and attempts to locate the box on the table. Once the child is able to use the map successfully and to locate one object, the instructor can add another object so that the child has to specify two locations. The task becomes even more demanding when the child is asked to work with three magnets and toys.

**Task #3: Object localization on the map of three tapes**

**Objective:** The child learns to compare and to sort tapes of different lengths according to their materials and textures. After exploring the “tape map” the child is able to localize the position of an object placed at the end of one tape.

**Teaching materials:** Open space on the floor, or a rectangular table, the size at least 130 cm x 250 cm; Three tapes of different materials and of various lengths (e.g., 60 cm, 120 cm, 240 cm), and three shorter magnetic tapes (the lengths e.g., 7 cm, 13 cm, and 26 cm) covered with materials equivalent to the longer ones; A magnetic board; 1 -3 magnets; 1 -3 toy boxes or other small toys.

**Procedure:** The child sits at the point of reference, and the tapes are arranged in front of the child either on the floor or on the big table. One “treasure chest” (i.e., toy box, etc.) is set at the end of one strand. The same combination is arranged on the magnetic board that functions as the tactile map. The child explores the map and compares it to the tapes laid on the floor or table, and then indicates the end of the tape at which the box is located (one box is placed at the end of three tapes). A more advanced version of the task asks the child to place the object at the end of one tape and then show its location on the map to the instructor.

**Task #4: The map as a multipart entity**

**Objective:** The child learns to recognize diverse elements on the model map, and to distinguish a solid route by exploring the map and collecting information from the map. The child learns to track the route by following a line made of the different elements, and learns to compare the map with the actual layout.

**Teaching material:** A model map made of different materials that form a route (e.g., four foam plates, a rope, a plastic net, a miniature hoop, four pieces of carpet); The same materials in bigger size forming a corresponding route on the floor; Small and big toys.

**Procedure:** The map introduces a route with elements (as mentioned above) that follow each other and form a square shape. The instructor can name the elements, and invents a story that describes the child’s imaginary travel along the route. The child explores the map while listening to the description of the story’s successive stages of travel. The map search demands comprehensive map-exploring techniques, the ability to process tactile information, and tracing skills. Next, with the instructor’s assistance, the child builds the matching route on the floor using the same materials as on the map. The starting place or “home base” is the reference point for using the map and building the floor layout. The instructor sets a big toy at a particular location along the floor route and a small size toy on the corresponding location on the map route. The child explores the map, locates the small toy on it, and moves on the floor from the home base along the marked map route to get the toy.

**Task #5: The symbols**

**Objective:** The child learns certain, meaningful map symbols and marks. The child learns to trace raised lines when exploring the map.
Teaching material: Ritmuff-sheet, (a plastic sheet on which lines and marks, made with a pen or a stylus, product a raised line or mark that can be felt by fingers); 3 to 5 objects in different sizes and shapes

Procedure: The instructor puts one object on the Ritmuff-sheet and draws its outlines; the ratio of the drawing to the object, is 1:1. The child traces the line, and tries to recognize the shape of the figure. The figure is called a symbol, and represents the three-dimensional object in a two-dimensional form. The instructor adds objects one by one and draws their outlines; the number of objects may vary from three to five. The set-up forms a simple map. The child recognizes and describes the different symbols. The child compares the objects with the drawn symbols, and puts the correct objects on top of the matching figures.

Task #6: From 3-dimensional model to 2-dimensional tactile map

Objective: The child learns to: (a) explore a 3-dimensional model; (b) describe the arrangement of the objects displayed in the model; (c) compare the model with the 2-dimensional tactile map, which is drawn according to the model; (d) describe relationships between the objects, both in the model and on the map.

Teaching material: Small models of houses, trees, lakes, sandboxes, swings, pathways, and so on, each having a piece of Velcro-strip glued to the bottom; Styrofoam® board covered with soft cloth (30x40 cm); Ritmuff-sheet; Cardboard box (30x40 cm) having a lid and with the front side cut out

Procedure: The child builds her own 3-dimensional fantasy layout on the Styrofoam® board using small models. The instructor puts this layout into the cardboard box, draws a corresponding 2-dimensional tactile map on the Ritmuff-sheet, and sets the map on top of the box. Because the front side of the box is cut out, the child can touch and explore both the layout in the box and the tactile map on the box, simultaneously. Thus, it is possible to make comparisons between the 3-D model and the 2-D map, and to determine spatial relationships between the objects.

Task #7: An unfamiliar room

Objective: The child learns to use both a small model made of Lego bricks and a Ritmuff-map to explore an unfamiliar room and to familiarize herself with the furniture arrangement. The child learns to locate different objects on the map and to describe relationships between their locations. Finally, after exploring the map, she is able to travel from the home base to different objects.

Teaching material: Lego™ bricks; Ritmuff sheet; Regular kindergarten furniture (tables, chairs, a cabinet, a bookshelf, etc.)

Procedure: The instructor prepares a small model of the arrangement of objects in an unfamiliar room using Lego™ bricks (Lego™ bricks are usually available in every preschool, and because all children play with them, there is an opportunity to share activity with other children). The same layout is drawn on the Ritmuff, and the child explores and compares the model and the Ritmuff-map. After searching both the Lego model and the Ritmuff-map, the child explores the room, and moves around to find objects that she locates on the map. The child travels between different designated objects. By changing the observation point, the child also is encouraged to examine the layout from different positions in the room.

Task #8: Recognition of the map symbols

Objective: The child learns what a map key is, can identify the map symbols in a map key, and can find and recognize symbols on the actual map. She learns to explore the entire tactile map systematically, from left to right and from top to bottom.

Teaching material: A tactile map made on micro-capsule paper (the map is preferably derived from the child’s daily environment); Four map symbols, which are chosen from the map and drawn on separate slips of paper; The map key for the map symbols on the map with the explanations of the symbols written both in Braille and in print

Procedure: The instructor gives the child the symbol slips, one by one (four in all), and explains what each symbol represents. The child looks for each symbol on the map key. After recognizing the given symbols in the map key, the child explores the tactile map from left to right and from top to bottom, trying to find and locate these four symbols on the map. In the next stage, the child explains the relationships between the objects on the map, and travels an imagined route by negotiating the tactile map with her fingers?

The study

The research was a multiple case study describing instruction of four children with visual impairment in map reading skills. Two subjects were congenitally blind, one had profound visual impairment, and one was partially sighted. They all took part in a regular preschool program; their age was between five and six years. At the end of the program the
children were assessed by using the Wechsler Preschool and Primary Scale of Intelligence, revised, (the verbal part). The map program was designed by the work of one pilot case. The data was collected by direct observation of the teaching sessions, by videotaping the sessions, writing case reports, and analyzing the performance of each child by each exercise.

Three children (one was blind, one with profound vision impairment, and one with low vision) were able to finish the program. These children were able to read a map at the end of the program. One child who was blind enjoyed the map work although four last tasks were cognitively too demanding for him.

References:


**A biography: Helinä Hirn**
Mrs. Helinä Hirn has been working at the Finnish Federation of the Visually Impaired more than 20 years. Her responsibilities have varied from teaching O&M in the rehabilitation centre and establishing O&M instructor education in Finland to the present work as a coordinator in the field of accessibility. She cooperates with the authorities in the issues dealing with the Accessible Environment and Design for All.

She has got her education in O&M in England at the National Mobility Centre and at the Vanderbilt University in the USA. Her presentation describing the tactile map program for preschoolers with visual impairment is a part of her doctoral studies and is based on her experience in practice that tactile maps are not very common in O&M training.