Three points in one dot!

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While there are various educational materials to support children in learning Braille, few of them deal specifically with the sense of touch of preschool children. Even less choose to combine this issue with a focus on both blind and sighted people participating in a common learning process. Furthermore, the few existing materials remain extremely expensive and therefore unsuitable for private use. Building upon a previous research project[3], the prototype material of "Max in Space" aims to improve the current situation by approaching the problem from a design point of view as well as from an educational and technical one. "Max in Space" is intended as an early educational tool that prepares blind and severely visually impaired children for Braille acquisition and involves parents, siblings and friends in the process.

Keywords: Education for the blind, communication design, blind children, preschool, educational material, Braille, seeing environment, highly visually impaired

Même s'il existe différents outils pédagogiques permettant aux enfants d'apprendre le braille, rares sont ceux qui font spécifiquement appel au sens du toucher des enfants de niveau préscolaire. Plus rares encore sont ceux qui choisissent d'aborder cette problématique en s'intéressant à la fois aux voyants et aux non-voyants impliqués dans un processus d'apprentissage commun. Les rares outils existants demeurent en outre extrêmement coûteux et sont donc inadaptés à une utilisation privée. Se basant sur des recherches antérieures, le projet pilote « Max in Space » vise à améliorer la situation actuelle en abordant ce problème sous l'angle du design mais aussi de la pédagogie et de la technique. « Max in Space » est conçu comme un outil pédagogique préparant dès le plus jeune âge les enfants non-voyants ou malvoyants sévères à l'apprentissage du braille tout en impliquant leurs parents, frères, sœurs et amis dans le processus.

Mots-clés : Éducation des non-voyants, design de communication, non-voyants, enfants, niveau préscolaire, matériel éducatif, braille, entourage voyant, malvoyance sévère

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State of the art and desiderata

Preparing the ground for Braille acquisition

Reading Braille is a complex process involving specific sensory and motor capacities that sighted people rarely use to such a degree in every day life. Therefore, blind children must be carefully prepared for and taught these capacities in appropriate pedagogic contexts. The "Emergent Literacy" approach (Stratton, Wright 1991; Rex et al. 1994; Wormsley 1997; 2003) as applied to learning by the blind adopts principles of perceptual psychology to sketch out a pedagogic framework. This is oriented towards already developed individual competences, and suggests a variety of easy and motivating means to familiarize children with Braille long before they enter school. One of the main focuses of this approach is on developing an appropriate script design.

As previously stated there are only a small number of teaching materials for blind children currently available. The majority of these are focused on tactile needs, and are therefore produced with thermoforming which is a costly technique. Their content follows the approved pedagogical steps for learning Braille, but the problem is the material itself is not always sufficiently engaging or motivating for young children. A further barrier is the fact that these materials are very expensive and therefore unsuitable for private use.

More so than sighted children, blind children are only confronted with written language if their environment is specifically outfitted (presence of Braille labels, inscriptions, etc.) and if opportunities arise for direct tactile contact with Braille (Rex et al. 1994; König, Holbrook 2000). The necessity for specific measures is underlined in developmental psychology studies (cf. Tröster, Brambring 1990; Warren 1994; Ferrell 2000; Brambring 2005), which observe a considerable delay in the development of motor and haptic capabilities in blind children as compared to their sighted counterparts. It is assumed that due to the visual stimuli offered; sighted children engage in exploratory action earlier and are able to collect more tactile experience than their blind fellows (Lang 2008b). Moreover, blind children gain less experience with books (Harley, Truan, Sanford 1997), since there is a very limited range of useful and entertaining tactile picture books featuring Braille script. As a result, when entering school, blind children often have less previous knowledge of and experience with writing and show less motivation for reading than sighted children do (McComiskey 1996; Greany, Reason 2000).

Studies show that beginning readers initially perceive embossed writing as merely texture and only learn to spatially interpret Braille signs through the development of systematic reading movements that provide a spatial frame of reference (Millar 1994; 1997). Even more so than with visual reading, there is no initial discrimination of characters, only that of texture patterns. In terms of the process of reading acquisition, this means that early exercises in tac-

tile discrimination only make sense when using original size Braille signs (since enlarged signs completely upset the texture). Given that only two-handed methods enable fast and fluent reading (Mousty, Bertelson 1985; Foulke 1991; Wright et al. 2009), two-handed touching strategies (e.g. tactile perception of patterns and lines with fingertips) must already be developed from an early stage (Lang 2003).
The "Emergent Literacy" approach focuses on: "Broad experiences to build understanding for stories; language skills, including word meanings; listening to stories read aloud; and scribble or doodling with Braille" (cf. Stratton, Wright 1991; Wormsley 1997; 2003). However, the specific implementation and production of materials is left to individual teachers, as confirmed by a survey conducted at German schools for the blind, where the staff questioned said they were required to produce their own materials to prepare pupils for reading (Lang 2003). The German-speaking teaching materials market currently offers just a single package ("Auf der Taststrasse zur Punktschrift"; Lang 2005) designed to introduce blind children to Braille in accordance with the "Emergent Literacy" approach. In eight related volumes with increasing complexity, the children develop in a playful, motivated and activity-based manner an ability for subtle haptic discrimination and differentiation (e.g. identification of different forms, finger exercises, recognition of patterns and Braille, etc.). An evaluation of this aid proved its considerable educational benefits (Lang 2003). However, due to its size and price, the package is largely unsuitable for private use and is bought and used exclusively by institutions (schools, early education institutions, etc.).

Integrating visual and tactile demands

Educational materials design is aimed at sighted as well as blind and visually impaired learners. In the aim of ensuring unhindered access to education for all, the UN Convention on the Rights of Persons with Disabilities of 2006 declares in its article 24 the necessity of measures that would facilitate Braille acquisition, and in doing so explicitly mentions the need for appropriate educational techniques and materials. Given that disabled and non-disabled children increasingly find themselves in common learning contexts, teaching materials for Braille should be accessible in principle also to sighted children, as well as parents, siblings and friends.
Argyropoulus et al. (2008) point to the fact that successful Braille acquisition crucially depends on the mindset of the learner's sighted environment. Educational materials are therefore required to meet both tactile and visual demands. This criterion will also do justice to the needs of severely visually impaired children, who in certain areas (e.g. reading) must resort to techniques designed for the blind, but may otherwise also be able to use their visual capacities in appropriately structured contexts (e.g. strong contrasts of colour and brightness, simple designs).

With this in mind, the idea of a "Tastsehen" ("touchsight") method, originating in the early 20th century (Wanecek 1925), gains significance. Regarding the reading of Braille by the severely visually impaired, Heller (1985; 2006) observes that supplementary visual information (e.g. concerning the spatial alignment of text lines or the movement of the hands) can facilitate the tactile reading process. Reading to learners is particularly helpful for written language acquisition (Feneberg 1994; Brügelmann 1995; Dehn et al. 1999). While sighted children, when being read to, are able to simultaneously perceive the visual appearance of the writing, to observe the direction of lines and to acquire first word structures or phoneme/grapheme relations, these types of information tend to remain inaccessible to the blind (Lang 2003). The exception is where the text is also provided in Braille in such a way that it can be related directly to the normal writing, e.g. by being set directly above the normal lines. However, this method requires considerable space, since Braille does not allow for the free manipulation of spacing between dots and words.

A further challenge lies in the question of how to illustrate texts for blind children. Acquisition of picture recognition capacities differs fundamentally in sighted and blind children. Around the age of 1,5 years, sighted children will start to recognize pictures as representations of real-world objects without any specific instruction. Blind children do not develop analogous capacities with regard to tactile pictures; indeed, interpreting tactile pictures must be learned in explicit ways (cf. Messerschmidt 1951; Hudelmayer 1983). Illustrations therefore must be unambiguously recognizable by tactile means, but should also be visually attractive so that sighted readers may appreciate the illustrated stories. This aspect can be of crucial importance to the reading motivation of the blind child (Lang 2011). Understanding tactile illustrations requires a grasp on the abstraction between the real-world object and the relief picture. Moreover, object shapes depend on perspective (lateral vs. top view, etc.), which blind children find difficult to access, and needs to be gradually developed cognitively from a secure body schema (Lang 2008a). Compared to visual picture recognition, tactile interpretation of relief pictures requires considerable effort (at both cognitive and motor levels) and time. In general, it must be emphasized that well-designed tactile pictures make for an important source of fascination and motivation for blind children (Lang 2008a). Communicative exchange between the blind child and their sighted environment also depends on the fundamental design criteria that govern the design of any educational publications. This means that any such materials must above all meet the criteria of readability and uncomplicated structure (Müller-Brockmann 1988; Maxbauer 2002), while being aesthetically adequate and reflecting contemporary tastes. Layout, typography (Forssman 1990; Wilberg, Forssman 1997), the ergonomics of reading (Swann 1987), and the use of colour (Frieling 1968) – especially where colour itself figures as a learning task, such as when the actual existence of various colours is the topic – are of particular relevance here.

Technical realization and reproduction

Current printing techniques for Braille, embossed surfaces, and relief pictures, include embossing, thermoforming, hot stamping and printing on thermo sensitive capsule paper. Their use depends on the specific needs and purposes at hand. Although each has individual advantages with regards to tactile feeling, these printing methods continue to involve high production costs and limited flexibility in the choice of materials, colours and formats. Rapidly developing 3D-printing technology is appropriate for individual items and smaller series of prototypes and models, but it remains unsuitable at this point for wide use in barrier-free communication design. Less expensive methods such as inkjet and screen-printing are, in turn, not sufficiently developed in terms of printing speed and required projection levels for Braille dots and reliefs.
Although a long and costly development process will most likely be involved, existing printing techniques that have not been widely used for Braille and relief production thus far might offer new design and financial perspectives, provided certain appropriate modifications. Such a "diversification" might represent a first step towards the democratization and economy of Braille and relief printing, in that it would make educational materials affordable for private use also. This would in turn promote early involvement of the sighted environment in the learning processes of the blind child, thus contributing to optimal early fostering. An essential initial step would then have been taken towards fulfillment of the central demand of the UN Convention on the Rights of Persons with Disabilities for barrier-free access to education.

"Max in Space" – a prototype

The educational materials prototype "Max in Space" described below builds upon the research project "Dot for Dot" completed in December 2011 at the Research Area Communication Design of Bern University of the Arts. "Max in Space" approaches the challenge of designing educational materials for blind and severely visually impaired preschool children with a concern for design-related, pedagogical and technical issues. It consists of a book intended for use as a complementary early educational tool, involving the blind child's sighted environment of and gently introducing her to Braille.

Insights from the preliminary research project "Dot for Dot"

At the beginning of the project, the research team focused essentially on an exchange with the project partners "Stiftung für blinde und sehbehinderte Kinder und Jugendliche" (foundation for blind and visually impaired children and youths) and "Schweizerische Bibliothek für Blinde, Seh- und Lesebehinderte"

(Swiss national library for the blind and visually or reading impaired). In order to gain a better grasp of the methods and materials of special education teachers and early educators, as well as the everyday lives of blind and visually impaired children and their families, various visits and "shadowings" were arranged with project partners. In addition, professor Markus Lang of the Institute of Special Needs Education at Heidelberg University of Education acted as an advisor to the project.
The noted observations and the insights gained from the visits, and from the literature search conducted in parallel were discussed and further elaborated upon by the research team and the partners in a subsequent workshop. The following criteria for the material and formal conception of educational materials to familiarize blind children with Braille were identified in the workshop:

a) Functional demands on educational materials:
- Contextually embedded topics related to both 3D and everyday life
- Inducing play
- Switching and interplay between senses
- Familiarization with Braille
- Involving the blind child's sighted environment in the learning process

b) Formal demands on educational materials:
- Uncomplicated, reduced relief pictures
- Combining Braille and normal writing
- Adequate levels of projection for dots and reliefs/surfaces
- Nice-to-touch materials
- Strong colour contrasts (with view to use by visually impaired children) and rich variety of colours for sighted siblings and parents inclusion
- Handy format and easy reproduction affordable price

Based upon these functional and formal requirements for blind preschool children's educational materials, the project team derived three narrowly related objectives to be kept in mind when developing the educational material prototype :

1.Elaboration and fulfillment of didactic and pedagogic criteria that govern familiarization with Braille.
2.Visually attractive design for the sighted environment that adhere to tactile conventions.
3.Democratization of existing printing technologies for the flexible and economic production of Braille and relief prints.

Conception and realization of "Max in Space"

Based on the above functional and formal criteria elaborated in the workshop and the desiderata drawn from researched literature, experiments and test prints, the prototype of "Max in Space" was conceived and produced (fig. 1).

Figure 1. "Max in Space"

Material structure of the prototype

The educational material prototype is designed to supplement formal early education and offers targeted incentives to train and develop fundamental tactile abilities at home. "Max in Space" is the first issue of a proposed series of books. The idea is to devote each issue to a general topic that encompasses the individual learning tasks. These build upon each other and are methodically tailored to familiarization with Braille. Max the little Braille dot is the main character, and in the first story he takes the children on a trip into space. There, he gradually encounters the basic geometric figures: the triangle, the square and the circle. The story ensures the contextual embedding of the learning tasks and is intended to provide motivation. The didactic aim of the book is tactile introduction to the elementary geometrical forms, their features and differences, along with experiencing and understanding size relations, proportions and locations. Each double page provides a type of suggestion box where parents may find ideas for games, songs and tasks suited to the story at hand. Thus, 3D and everyday life relevance, interplay between the senses, family involvement, and physical activation of the blind child are all actively fostered.

Formal structure of the prototype

The prototype's format was chosen such that text and forms can be printed at an adequate size, while ensuring a handy and reduced format suitable for preschool children. Beyond its manipulation, the project team felt it important to stick to formal conventions for magazines and books for the sighted as closely as possible in order to minimize visual barriers. Thus, the book features a stitched binding. The paper used is sturdy yet comfortable to the touch.
In the forty-page book, left-hand pages are text-only and right-hand pages are picture-only. Throughout the book, this pattern is strictly adhered to and allows for simple navigation and orientation (cf. fig. 2). The text on the left page is printed in embossed Braille and non-embossed normal writing. In the blank line beneath each Braille line, intended to help the child with orientation during the first reading attempts, the normal text appears. This allows sighted companions to read the text along with the child, or to read it to them, and at the same time to become acquainted with Braille (cf. fig. 3). The picture page consists of rich-contrast relief pictures. Colours are chosen according to the topic at hand; in the example, the background always remains in black, coherent with the space theme. Although the project team's main focus was on blind rather than visually impaired children, a range of colours as rich in contrasts as possible was sought out nevertheless in order to cater to the latter's needs also. Moreover, the colourful design is attractive and stimulating for the sighted environment. This offers an opportunity to make colour variety a theme in the communicative exchange between the blind child and his/her sighted companions. "Max in Space" was printed by means of three different techniques so as to be able to compare results. These were subsequently evaluated in collaboration with experts from project partners. According to the experts, the required projection levels for Braille writing and reliefs were achieved, although some of the techniques used have left room for optimization.[4] (fig. 2, 3)

Figure 2

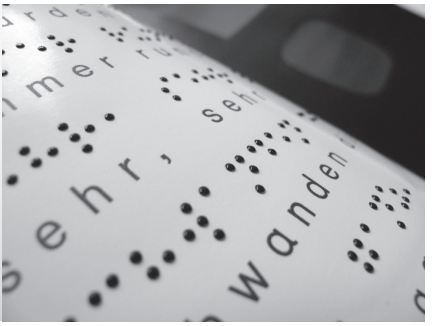

Figure 3

4 *A detailed description of the printing and binding techniques and papers tried out is provided in the final report on the research project „Dot for Dot", Research Area Communication Design, Bern University of the Arts, to appear in Dec. 2012.*

Further prospects

Besides the need to improve printing results with regards to choices of materials, binding and printing techniques, the prototype remains to be thoroughly evaluated. In order to seriously identify the prototype's qualities and shortcomings, a procedure of evaluation including blind preschool children, special teachers and the children's sighted environment (parents, etc.) will be required. Since the target group of blind preschool children is rather specific and consequently very small, such a procedure will involve great organisational and temporal demands to achieve a significant outcome. These may only be met with the support of institutions for the blind and with appropriate financial means. The project team hopes to gain important insights from this evaluation, such that the further development and actual production of further issues of the "Max in Space" prototype can take place. These books offer concrete opportunities for inclusive teaching and learning contexts, and will hopefully spark important impulses in the current academic debate on inclusion.

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Ellipsis points are three spaced periods (. . .), sometimes preceded or followed by other punctuation. They must always appear together on the same line, but any preceding punctuation may appear at the end of the line above (see also 11.64). MLA Handbook for Writers of Research Papers.Â Three dots shows that something was deleted. If the sentence ends at that point, there still needs to be a period. (In the Law Review style books, we did not have a space bnetween the three dots and the final period. Perhaps they do now.) Peteron May 21, 2009 6:55 am.