**Ergodesign & HCI**
número 2, volume 3, ano 3 ( 2015 )
ISSN 2317-8876, Rio de Janeiro - Brasil

PUC-Rio Pontifícia Universidade Católica do Rio de Janeiro
Departamento de Artes & Design | PPGDesign
LEUI | Laboratório de Ergodesign e Usabilidade de Interfaces

# BLIND PEOPLE AND SPATIAL REPRESENTATION: A SYSTEMATIC REVIEW OF THE LITERATURE

Carlos Henrique Berg[1], Angela Flores[2], Luciane Fadel[3], Vânia Ulbricht[4]

Universidade Federal de Santa Catarina, Campus Reitor João David Ferreira Lima

Florianópolis – Santa Catarina – Brasil – CEP: 88040-900

[1]chbplan@gmail.com, [2]arqangelaflores@gmail.com, [3]liefadel@gmail.com, [4]vrulbricht@gmail.com

**Keywords**: Blind, Spatial Representations, Systematic Review of Literature

## 1 Context

As the world population grows, so does the number of people with disability. In fact, this number can represent a quite portion of the population. For example, the Brazilian 2010 census reveals that over 506 000 people are totally blind.

These people have the right to access the knowledge and the education so that they can exercise full citizenship and thus have more opportunities in life. One of the most important aspects in the learning process is the construction of spatial representations.

Thus, to better understand the activities that involve the construction of spatial representations in blind people, this paper performed a systematic review. The review defined the following question: How do blind people build spatial representations?

Based on that, seven papers were extracted and 112 concepts contributed to the identification of processes for construction of spatial representations.

## 2 Method

The method adopted in this research is the systematic review in scientific database as suggested by the Cochrane Collaboration (2011). Systematic review is an accurate synthesis of researches related with a specific question.

The first step was the identification and selection of the papers .These papers were in six databases: IEEE Search System; SCOPUS; SPRINGER; Federal University of Santa Catarina Library, CAPES[1] Journals and Web of Knowledge.

The second one was the selection of the key words. The research found 81 key words, and after listed, accounted and sorted by number of citations it was possible to extract four of the most cited. Table 1 shows the key words and the quantity of the citations.

Table 1 – Key words and the quantity of citations

| Quant | English |
|---|---|
| 4 | Blind |
| 3 | Spatial representation |
| 2 | Spatial figure |
| 2 | 3D objects |

The authors, 2013

The search in database with these key words was made in 2013 with no restriction and initially found 10,823 articles. Full article constriction was applied within CAPES database.

The search excluded articles following these restrictions:

1st No one of the key words was found in the titles

2nd No one of the key words was found in the abstracts

3rd The article does not fit to the research topic

Then, only seven articles were selected for the research, as shown in table 2.

[1] http://www.capes.gov.br/ Coordination of Personnel Training in High Education (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Capes), foundation of the Ministry of Education, plays a key role in expanding and consolidating the strict sense graduate (masters and doctorate) in all Brazilian states.

Table 2 – 1 author, title and year of the extracted articles

| #1 Author | Título | Ano |
|---|---|---|
| AFONSO, Amandine | Structural properties of spatial representations in blind people | 2010 |
| HABER, Ralph N. | Properties of spatial representations | 1993 |
| LANDAU, Barbara | Spatial Knowledge and Geometric Representation | 1981 |
| LANDAU, Barbara | Spatial Representation of Objects | 1989 |
| MILLAR, Susanna | Spatial Representation by Blind and Sighted Children | 1976 |
| SCHMIDT, Susanna | Spatial representations in blind people | 2012 |
| TESHIMA, Yoshinori | Three-Dimensional Tactile Models | 2010 |

The authors, 2013

## 3 Results

The reading of the seven articles allowed identifying 112 concepts about the four key words. This concepts lead to identify the most important senses that blind people uses to build spatial representations, which are the tactile, the hearing and the haptic sensation.

Haber et al (1993) reasoned how so little is known about the brain functionality, but, some fields have success in understanding how humans create spatial representations. Spatial representations (SR) are the human ability to build knowledge using metaphors and make the relationship between the man and the world. The research of SR begins in the psychology study of the memory in sighted and blind people (HABER et al, 1993).

Afonso (2010) claims that SR includes metrical information and Landau (1989) provide strong evidence of the possibility that the spatial representations of children include metric data. Haber et al (1993) demonstrated that children SR incorporate geometric proprieties. Still, Landau (1989) propose that SR as a mechanism sensible to Euclidean Relationships, wherein the inference rules are specifically applied, creating the perception of new relationships without need to produce a spatial representation.

Studies in other cognitions areas revealed the spatial knowledge as a rich system in blind children (LANDAU, 1989). In addition, the research pointed that the haptic abilities, objects spatial representations and simple maps (LANDAU, 1989), are useful to build SR.

Afonso (2010) argues that the verbal information and speech seem to be transformed into spatial representations, incorporating the metric distances between different locations on a navigable environment.

Teshima (2010) considers that blind people can recognize three-dimensional ways of haptic sensations and beyond that.

The difference between blind and sighted people does not lie in the inability of blind people to process spatial representations, but is their limited use of efficient strategies to build and use this type of representation (Schmidt et al, 2012). For Landau et al (1981) blindness in children severely limits the exploitation of opportunities and its ability to develop a good SR.

## 4 Considerations

This paper describes the systematic review to identify concepts that can be used to answer the question of how blind people make spatial representations. The review selected seven papers and within them identified 112 concepts from the key words.

As the main concepts about how can blind people build spatial representations are the following topics:

◊ despite the disabilities the mental process of blind and sighted is the same

◊ blind people build spatial representations by the touch, speech and haptic sensations.

◊ blind people work with map-links

◊ in the case of the blind, the greater the stimulus and the experience, the greater the repertoire of elements to representation

Researchs from Landau et al (1981), Alfonso (2010), Haber et al (1993) and Millar (1976), claim that blind people showed use Euclidean metrics and ratios for navigation.

Thus, based on this systematic review, the main way to build spatial representations in blind people are tactile, haptic and verbal descriptions. The use of maps is very common, and the greater blind people's repertoire, the better their browsing. The final consideration was that despite the disability, it was found no difference between the sighted and blind people for the construction of SR.

## 5 References

1. AFONSO, Amandine et al. Structural properties of spatial representations in blind people: Scanning images constructed from haptic exploration or from locomotion in a 3-D audio virtual environment. Memory & Cognition, Orsay, v. 5, n. 38, p. 1-14, 2010.

2. COCHRANE COLLABORATION (United Kingdom). Cochrane Handbook for Systematic Reviews of Interventions. 2011. Avaliable at: <http://www.cochrane.org/>. Access in: 01 sept. 2015.

3. HABER, Ralph Norman et al. Properties of spatial representations: Data from sighted and blind subjects. Perception & Psychophysics, Chicago, v. 1, n. 54, p.1-13, 1993

4. LANDAU, Barbara; GLEITMAN, Henry; SPELKE, Elizabeth. Spatial Knowledge and Geometric Representation in a Child Blind from Birth. Science, Philadelphia, n. 213, p.1275-1277, 11 set. 1981.

5. LANDAU, Barbara. Spatial Representation of Objects in the young blind child. Cognition, New York, n. 38, p.145-178, ago. 1989.

6. SCHMIDT, Susanna et al. Spatial representations in blind people: The role of strategies and mobility skills. Acta Psychologica, Torino, n. 142, p.43-50, 2012.

7. TESHIMA, Yoshinori. Three-Dimensional Tactile Models for Blind People and Recognition of 3D Objects by Touch: Introduction to the Special Thematic Session. In: ICCHP, 2010., 2010, Namiki. LNCS 6180. Berlin: Springer-verlag, 2010. p. 523 - 514.

## 6 Acknowledgments

This research is part of the project “Inclusive Learning: Accessible environments with learning objects about graphic representations” supported by CAPES Brasil, edict 01/2009/CAPES/PROESP and the Project CHAMADA UNIVERSAL – MCTI/CNPq Nº 14/2013, under the coordination of the Dra. Luciane Maria Fadel and the CNPQ.