Graphic design for blind users: an industrial case study

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ABSTRACT
Our main objective is to design a representation for blind visitors to help them to better understand modern and contemporary paintings translated into eight levels of relief for a famous French museum. Because accessibility for handicapped people has become a current social problematic, there are more and more exhibitions in museums dedicated to blind and partially-sighted public. Although some laws and rules are set to simplify access to cultural places for disable people, norms do not yet exist to design tactile pictures in exhibition spaces for the blind public. So, how to translate into tactile and kinesthetic senses, a visual information as the size of a work of art?

Our object of research is unusual because it deals with a recent field of research that is to say there are no previous studies or feedback to explain how to design tactile paintings. Moreover our subject of research is dedicated to people with specific needs because of their perception of their environment. We chose an iterative approach by organizing semi-directed individual interviews with four visually-handicapped, thanks to two tactile panels and tactile models designed to communicate them our concepts. Our experimental results show that the anthropometric signage that we designed is rather readable, understandable and useful according to these four late blind participants. Our concept is validated as well as our approach which consists in transferring theoretical data from cognitive psychology and physiotherapy to product design. The validation with these final users shows that we could translate empirical information into conception criteria for other tactile supports to be designed.

Keywords: sensory, tactile, blindness, design, museum accessibility
1. Introduction: the industrial context
Reading this article, you call on your sight, a sensory modality enabling you to perceive nearly simultaneously all the elements featured in our environment [1] [2] because sighted people perceive space in an allocentered manner that is to say thanks to exterior elements [3] [4] [5]. For example, you perceive rapidly and nearly simultaneously the size of this page, the way it is composed, its color and typography…
Sight is one of the five sensory modalities the human being has along with hearing, smell, taste and touch. In our societies, a lot of information is conveyed by sight [6]. Indeed, information is often graphic, in other words, written, colored, and/or drawn. Yet, how does it work for people with sensory disabilities? Do blind people have access to visual information? Although they have access to the written culture, thanks to braille, which is a universal form of writing with six or eight dots [7], how does it work with images, for example, with pictorial art?
This question was the starting point of a research project carried out within eyewear company Alain Mikli International. This project has the following industrial objectives: conceive an exhibition of modern and contemporary paintings for visually-impaired people inside a French museum. In 2003 already the Alain Mikli International Company designed the travelling « Touch and See » exhibitions translating into eight levels of reliefs Yann Artus-Bertrand’s photographs on a cellulose-acetate support for the blind and partially-sighted audience. Today, ten modern and contemporary paintings part of the museum’s collection were translated using this same process exclusive to the Alain Mikli International Company (cf. figure 1).

![Figure 1. the exhibition inside the French museum](image)

2. From context to state of the art: the blind visitors
Blind people, the visual acuity of whom is below 1/20 according to the World Health Organization can make out their surrounding by touching, kinesthesia ¹, hearing and smell. The way they discover space, using other sensory modalities than sight lead to a specific perception due to the abilities and limitations of each sense. For example, touch differs from sight because of its sequential character [4] due to the reduced tactile perceptive field [4] (equal to the size of the pulp of each finger), which enables, by successive steps to build a mental image based on tactile data [8] such as texture, hardness and temperature, which seem to be elements of tactile identification (cf. table 1) [3] [9].

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¹ kinesthesia: muscular and tendinous simultaneous sensations.
Table 1. Comparison between visual and tactile perceptions

<table>
<thead>
<tr>
<th>SIGHTED PEOPLE: visual perception</th>
<th>BLIND PEOPLE: tactile perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>With sight, every element of the objects can be seen nearly simultaneously it’s a matter of few milliseconds in a glance [11]</td>
<td>« What jumps to eyes does not to hands » [4]</td>
</tr>
<tr>
<td>Objects are mostly represented visually [12]</td>
<td>Mental pictures based on originally tactile information [8]</td>
</tr>
<tr>
<td>Spatial properties are more prevailing for a visual exploration [3] [13]</td>
<td>Material properties such as textures, hardness, and apparent temperature would constitute important clues in the haptic identification [3] [9]</td>
</tr>
<tr>
<td>Allocentered spatial representation (based on exterior landmarks) [4]</td>
<td>Egocentered spatial mental representation (based on the experience of one’s own body) [4]</td>
</tr>
</tbody>
</table>

Late blind, unlike congenitally blind enjoy a past visual experience. However, the visual sensory modality is characterized by a fast recognition [10] [11] of objects thanks to their geometrical shapes [3] [13], a peripheral perceptive visual field [4] and an allocentered spatial representation [4] (cf. table 1). In pictorial exhibitions, this visual memory enables them to rediscover the artistic works using another modality while benefitting from visual memories [4] contrary to early blind whom memory is not based on visual elements.

3. From context to state of the art: the accessibility of museums

Very often in museums, the following statement is written « it’s forbidden to touch » the works on display as François Vanbelle reminds us [14]. Visits - the ethimology of which means to see - are therefore only visual for sighted people and «[encourages] them to discover the collections, while maintaining a distance between them and the work» [15]: the artistic works on display are therefore discovered thanks to the cartel which informs us on the context in which each painting was realized and about the work itself, which refers to its format and iconography.

To make museums accessible to people with visual disabilities, tactile visits «targeting this audience» are organized and propose the opposite approach, as Marie de Ramefort outlines [15], offering to make accessible by touch, the works visual information: by exploring the original works, or their reproductions (facsimiles), tactile maps, scale models, tactile pictures, whether they complement or not the comments made by the lecturer, the audioguide, or the audioscriptor (cf. figure 2). Therefore, before our exhibition was implemented, the pictorial works were presented verbally by a lecturer: this exhibition thus brings to both, visually-impaired audience and museum, a new mediation tool. Broadening its offer, the museum shows that accessibility for people with disabilities is a current social issue.
Today in France, thanks to the February-11th-2005 act, and because the population is ageing there are more and more visits for the visually-impaired audience. These visits are organized around two sensory modalities: the tactile supports and/or sound-based information knowing that every adaptation is used solely in the museum that developed it. However, although sets of rules exist regarding the reception of people with disabilities inside the buildings, these rules concern the building’s architecture only. Although more and more visits organized for people with disabilities there is no representation standard defining the elements which are indispensable neither to translate them into tactile elements nor to interpret them using this sensory modality.

4. From remarks to the research problematic

In the sound-based visits organized by the museum, visually-impaired visitors often ask to the lecturer about the size of the painting on display. Figures and comparison, by mimicry in front of the work were used to explain its size. However, in the tactile exhibition we have developed for the museum, tactile paintings are exhibited in a dedicated place and they cannot be translated at a scale 1 for technical reasons: the technical process we use does not allow conceiving a tactile picture bigger than an A3 format. Although both, iconography and context in which the work was made were translated by the levels of relief and by the explanatory captions, how to translate the size of the painting in a graphic manner? What tactile device should be conceived in order to replace the comparison with the original work?

In order to convey the artist’s intentions to the visitor we must indeed design a tactile device explaining the real size of each painting knowing that today, painters work on a wide variety of sizes (cf. figure 3). We must design it knowing that there are no standards of representation which could help us achieve it and that some research is
necessary to translate in an accurate manner this piece of information because blind people have specific needs. The problematic of our research project would be as follows: how to translate the representation scale of a tactile painting and a pictorial work to reach an objective that are, both, informative for the blind user and artistic so as to translate the artist’s intentions?

5. Design and development of a tactile representation

5.1. From the analysis of what exists to the birth of the concept

Designing tactile pictures is a new field of research. There is therefore very little past explicit knowledge that we can use in the design of our tactile supports. The only available data can be found essentially in cognitive psychology and in physiotherapy which notably aim to study blind people. For our research project, we must therefore transfer this data related to the human being, to the design of objects. We « translate » behavior-related information to blind people’s needs into specifications. These goals designed in our design specifications become then design criteria once the product was approved by users.

For our device, our first step of design deals with the collection of theoretical data taken from our bibliographical research in cognitive psychology and physiotherapy. For our project, two sets of theoretical data are determining factors: According to Yvette Hatwell, thanks to tactile perception, blind people have rather a egocentered spatial representation based on the experience of their own body in its environment and not based on exterior landmarks [4]. Then, Francis Raynard explains that blind people can assess the distance to walk by counting the number of paces they have to make [16] although blind people use others sensory references thanks to their white cane, the sound perception, etc. Based on this theoretical data, we formulate our resolution hypothesis which is: the tactile translation of the real size of the work, using the body as a reference, would bring an extra piece of information complementary to the figures mentioned in the descriptive texts to the blind visitors (cf. figure 4).

![Figure 4. Anthropometric tactile signage based on the size of hands (on the left) and on the size of the body (on the right)](image)

5.2. Designing tactile models

To convey our concept of tactile representation, we designed « good-feeling models » [17] in relief i.e. models with tactile sensations as the precise shape of the signage, its precise level of relief and a soft material by embossing and thanks to swell paper ¹ in order for users to approve on one hand the tactile validity of the

¹ swell paper: “white paper with thermally expanding plastic embedded in its coating that may be photocopied onto or drawn on with black ink. When passed through a heat bath, the coloured surface heats faster and images expand.” [18]
representations and on the other hand, the proper understanding of tactile propositions. As indicated by Yvette Hatwell [4], people must access, first, the shapes represented in relief, and then, the understanding of the tactile elements.

5.3. Assessment protocol
Four blind people took part in the semi-directed individual interviews that we organized, using two tactile works laid on a table (on a horizontal plane). Among ten tactile translations of paintings, we chose the one by Juan Gris (tactile signage based on the size of hands) and the one by Bernard Piffaretti (tactile signage based on the size of the body). We chose those two (cf. figure 5) because the anthropometric representations of the real scale are the smallest, therefore the most adapted to assess the tactile readability of the representation (by the term « readability », we mean the tactile identification of the shapes in relief). We therefore presented randomly to each participant, the tactile representation by Gris then the one by Piffaretti. Alongside with their understanding elements written in French.

In the first step of the interview that we recorded on an audiovisual support, we observe each participant discovering the tactile panels with their fingers (cf. part 6.2).

Before they started their exploration (they explored the panels in total autonomy, i.e. we did not give them any help at all) we indicated to them the size of each panel, touching slightly their outlines, after which, we indicated them orally the presence of elements such as: an explanatory text, an element to help them exploring, and a tactile picture. Each participant explored the tactile pictures as long as necessary and the related information while telling what they were doing: their remarks and reading the text out loud, etc.

In the second phase of this interview, we asked open questions to participants about, on one hand, the visits organized in museums for the visually-impaired audience and on the other hand the size of the works they explored (cf. part 6.3).

Figure 5. Composition of the two panels: Juan Gris’ panel (on the left) and Bernard Piffaretti’s panel (on the right)
6. Experimental results

6.1. The four participants’ profile (table 2)

Four people who became blind (i.e. late blind people) participated to our semi-directed interviews. The four subjects attend visits for blind and partially-sighted people in museums on a regular basis. Three of them are especially interested in modern and contemporary art since they participate to visits proposed by the French museum where our tactile exhibition is. One of these subjects had already visited the tactile exhibition on his own. He explored « Women in a hat », by Picasso.

<table>
<thead>
<tr>
<th>THEMES / QUESTIONS TACKLED</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of blindness</td>
<td>late</td>
<td>late</td>
<td>late</td>
<td>late</td>
</tr>
<tr>
<td>Number of visits in museums a year</td>
<td>3-4 times</td>
<td>twice</td>
<td>3-4 times</td>
<td>3-4 times</td>
</tr>
<tr>
<td>Interest for both pictorial works presented</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Already seen/touched both presented works</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes, already touched Picasso’s painting</td>
</tr>
</tbody>
</table>

6.2. The filmed exploration (table 3)

While filming this exploration, we noticed that three participants out of four used the signage (each of them was at least once in contact with the signage drawn in relief on both panels).

As an answer to the question « can you tell me the real size of both works you have just touched ? », the four participants told us the exact size of the paintings using the figures mentioned in the introduction of the explanatory texts. This result shows that participants are used to using figures and that they are braille users as they could access the braille-written information.

<table>
<thead>
<tr>
<th>THEMES / QUESTIONS TACKLED</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braille user</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Signage used by the participant</td>
<td>yes (once)</td>
<td>no</td>
<td>yes (once)</td>
<td>yes (once)</td>
</tr>
</tbody>
</table>
6.3. Open questions (table 4)

Three participants used the tactile signage spontaneously during the exploration. These three subjects understood its purpose without any oral explanation from us. The second subject who did not use the signage understood its role once oral explanations were given. In the end of each interview, each subject therefore understood on his own or with oral explanations the role of this signage. Three of these four subjects think that this anthropometric representation is useful because it is a complement to the figures while the fourth participant considers it useless.

Table 4. Open questions

<table>
<thead>
<tr>
<th>THEMES / QUESTIONS TACKLED</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readability of the signage without explanation</td>
<td>yes</td>
<td>yes (only for the hands)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Understanding of the signage without explanation</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Understanding of the signage with oral explanations</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Usefulness of this signage with oral explanations</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Comments on the signage</td>
<td>complement the figures</td>
<td>complement the figures</td>
<td>complement the figures</td>
<td>figures are enough</td>
</tr>
</tbody>
</table>

The graphic elements are rather readable, i.e. participants identified rather accurately the shapes drawn in relief. Indeed, the four of them understood that two hands were drawn while three of them understood that a figure was drawn without any explanation from us.

7. Discussion

The experimental panel and conditions - The assessment did not take place in a real-life condition, in the museum, i.e. the visitor did not have the help of a lecturer of an audioguide nor of a guide likely to answer his questions immediately to help him to go further in his exploration. Because of our experimental conditions, comprehension was more difficult for the participants but our protocol shows information understood spontaneously and in an autonomous way. The only indications given to the participants were about the size of
each panel, by tracing the outlines of the tactile supports and the indication of the presence of three types of information (the explanatory text, a tactile picture, and a device to help the exploration) in order for the subject to avoid, due to the sequential character of the tactile perception not to explore all the elements in front of him, as the subject did not know the size of the elements at his disposal (the pilot test proved that this step was indispensable to the proper exploration of the overall tactile supports).

The first results featured in this article show a panel composed with late blind only. We continue our exploration with other participants, whether late blind or early blind so as to collect more opinions from potential users of this device who do not have the same perceptions of paintings due to their past visual experience.

We must note that the limit to this research lies in the number of blind people (only 4) who assessed the tactile signage. However, although his assessment took place with a small number of participants (because of the particular profile of our potential users) the results are rather encouraging in terms of: tactile readability, understanding of the role of the signage and of its usefulness. These results confirm the positive reception of this device by visitors of the exhibition.

Experimental results - These first interviews allow to precise the role of this tactile signage for users and are considered as complementary to the figures because it does not give them any precise information but allow them to judge the real proportions of the work in comparison, using a familiar referent. These first feedbacks allow a validation of our hypothesis and, consequently, the product designed in relationship to the concept of anthropometric representation. It shows also that the transfer of theoretical data based on the abilities of blind people to the design of products is possible. This empirical data we used in our design specifications could therefore be translated into conception criteria for other tactile supports to be designed (representation of the scale on tactile models, on tactile illustrations, and etc).

8. Acknowledgements
We want to thank the blind people who, with their experience allowed us to enrich our work of research. We also wish to thank Stéphanie Buisine and Julien Nelson for their advice about the assessment protocol.

9. References


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