



# Information Design on the Adaptation of Evaluation Processes' Images to People with Visual Impairment

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**Abstract.** It is a right for people with visual impairment to have access to tests and evaluation processes of various kinds. That way, adapted tests must present themselves in a way that visually impaired candidates can demonstrate their knowledge in the same way as the others. In this context, the importance of adapting images and complex information to an adequate comprehension of the questions is highlighted. The aim of this present paper is to explore the adaptation processes of tests for people with visual impairment, as well as to explore the role of information design on the production of tactile images to assist the evaluation process. Through a literature review, this paper presents five examples of tests applied to visually impaired candidates, focusing on the way tactile images were presented and how the candidates participated on the process. As a result, the importance of the adapted image as well as the need of evaluation processes that explore diversified means of comprehension is verified.

**Keywords:** Information design · Evaluation processes · Images  
Visual impairment

## 1 Introduction

According to Masini [1], from the educational point of view, people with visual impairment are divided in two groups: blind and subnormal vision. This classification is made according to visual acuity, being blind the individual that has 20/200 vision on the better-seeing eye, with best correction, and subnormal vision or low vision the one that has 20/70 vision on the same condition.

Blindness can be characterized as congenital or acquired. The first happens before or during birth, and the second is acquired at any other life stage, due to health complications or accidents, for example [1].

For many years, people with visual impairment were considered incapable of any physical or intellectual activity. Only after the end of the 1950 decade that blind people inclusion became a public policy. In 1990, inclusive education arises, where each individual's peculiarities are considered in the pedagogical process. From this, an increase in the admission of visually impaired people at schools, universities and public office jobs was verified [2].

Brazilian law n°. 8.112, dated December 11th, 1990, describes in the 5th article §2nd the right of disabled people to apply for public office jobs, guaranteeing up to 20% of the positions exclusively to these people [3]. Each official notice establishes how these people will be placed and which devices will be available during the test, a right to the blind candidate, for example, is a Braille test and a reader (person who reads the test). The reader is also a right supported by the law, according to decree 5.296, subsection 59 dated December 2nd, 2002.

The regulations on selective processes that include people with disabilities are important mainly for college entrance exams. Decree No. 2998 of December 20, 1999, regulating Law No. 7,853, dated October 24, 1989, provides the National Policy for the integration of people with disabilities in universities. The Article 27 establishes, in addition to Braille and reader, additional time for test execution and adaptations previously requested by the student, according to the degree of disability.

It is important to think, however, about the interpretation problem when the reader faces images in the tests. Borges [4] explains the context of the college entrance exam for UFRJ, in which the Braille test and reader were used. According to the author, the application formula was not particularly effective for issues with graphs and maps, with mathematical and/or chemical formulas and showed other types of representation which verbalization by the reader is difficult, such as cartoons and comics.

As Thurlow et al. [5] point out, adapted tests should be designed to enable students with disabilities to fully demonstrate their knowledge in academic tests, minimizing obstacles or disorders arising from their disabilities. This way, the importance of considering accessibility of images and complex representations in the evaluation processes, besides the process of text adaptations for the correct interpretation by the visually impaired candidate, where the information design becomes fundamental.

Information design, as its name suggests, can be seen as a design process for the purpose of informing people, involving both the communicator and the recipient of those messages [6]. Information, Waller [6] argues, comes up during this design process, through the need to explain something to the recipient.

As a complement, the International Institute for Information Design (IIID) exposes information design as 'defining, planning, and modeling the contents of a message and the environments in which they are presented, with the intention of satisfying the information needs of the recipient' In the original: 'defining, planning, and shaping of the contents of a message and the environments in which it is presented, with the intention to satisfy the information needs of the intended recipients' [7].

In these definitions of Waller [6] and IIID [7], a visually impaired recipient, for example, should be taken into account in the elaboration and manipulation of the information so that the goal is fulfilled and the recipient understands the message. This means presenting the visual information in an accessible way, through touch or audio, for example. Considering the limitations of visually impaired people, their rights, the role of information design as a process for efficient communication, Gruenwald [8] argues that complex images and concepts demand features such as tactile images, for example.

This paper aims to bring up how the images in evaluative processes are being adapted for this public.

As a way of exploring the problem, this paper is a review of the literature, exploring the process of adaptation of evidence for people with visual impairment, as well as the role of information design in the production of tactile images that assist in the evaluation process.

Five examples of test applied to visually impaired candidates were analyzed, observing how the images were translated to the tactile and how the candidates participated in the process. Adapted tests were considered both for students with acquired or congenital blindness and for students with low vision, even if tactile images are used more often by blind people. This article begins by discussing definitions of image in information design and the role in the evaluation process, followed by visual information access by people with visual impairment, presenting examples of adapted tests and concluding with a brief discussion and final considerations.

## 2 Image

There are several ways to define image, taking into account the study focus. [9] define image as 'a term we commonly use to designate graphic or verbal representations of something that exists or could exist'. The image is part of the visual and graphic language and appears as a way of transmitting certain information to the receiver of the message.

Horn [10] comments on the emergence of visual language because of the human's difficulty in expressing complex and abstract information, and subdivides it into primitive and property levels. Primitive level consists of words, shapes and images. Words are defined through the linguistic approach. Forms are characterized as abstract representations that stand out as units but do not resemble objects in the natural world, such as points, lines and arrows. Finally, images present themselves as a visible form that resemble objects of the natural world. Property level consists of primitive elements such as value, texture, color, orientation, size, location of two-dimensional and three-dimensional space, movement, thickness and illumination.

Considering the graphic language, Twyman [11] defines as 'graphic' what is drawn or made visible in response to conscious decisions, and as 'language' what serves as a vehicle for communication. For the author, the graphic language is divided into three levels: verbal, pictorial and schematic. In addition, Twyman [11] observes the possibility of representing visual information in different ways, such as tables, lists, maps, diagrams, etc.

Engelhardt [12] defines a graphical representation as "a visible artifact on a more or less flat surface, that was created in order to express information". From this definition, the author classifies the visual representations into ten primary types and six hybrid types. In the first, maps, illustrations, statistical graphs, time charts, link diagrams, grouping diagrams, tables, symbol compositions and written texts are inserted. In the second one there are statistical maps, route maps, statistical route maps, statistical time graphs, statistical link charts, and chronological link diagrams.

In the evaluation processes, Da Silveira [13] emphasizes the importance of the image mainly because it allows an immediate understanding and a faster reading than written

text. According to the author, the image increases aesthetic and communicative pleasure, helping spontaneous understanding of the information.

In these processes, there are numerous categories of images used to compose the questions and assist the candidate in the understanding process. In a college entrance test, for example, there are graphs, photos, geometric figures, cartoons, illustrations, among others. The role of these representations in evaluative processes is often crucial to solve a question.

Thus, it is necessary to reflect on the process of image interpretation by visually impaired candidates, so that the understanding of the adapted images allow equality comparing to sighted candidates.

### 3 Access to Visual Information by the Visually Impaired

Visual impairment is a classification that “encompasses people who have weak vision (or low vision), those who can distinguish lights but not shapes, and those who cannot distinguish even light” [14]. In this way, with the visual field compromised, the reception of visual information must be adapted.

The adaptation differs between people with low vision and blind people. For those with low vision, the aid comes with expansion of the information, guaranteeing sharpness and clarity in texts and images. It should follow accessibility recommendations such as high contrast and use of matte paper, for example [15]. In addition, when visual information cannot be magnified directly, the use of Assistive Technology (AT) is necessary, using magnifying glasses for example.

For blind people, the perception of what is visual happens through other senses. According to Sacks [16], with the visual cortex not being used for the action of seeing, it becomes “hypersensitive to all kinds of internal stimuli: its own autonomous activity, signals from other brain areas - auditory, tactile, and verbal areas - and thoughts, memories, and emotions.” Thus, it is possible to understand that the blind is stimulated by the body itself to receive visual information through audio and touch. The adaptation of materials that use visual information should be done for audio or touch, such as audio description of images, use of lenses, translation for Braille, creation of tactile images, among others. As AT, blind people use, for example, screen reader software and Braille printers.

In adapted evaluative processes, it is necessary to take into account the need to transpose the test to the tactile medium, for both texts (Braille) and for images (tactile images) and, for this, understanding how tactile perception works is fundamental.

Touch is a proximal perception, performed in a sequential-temporal way, that is, it is done at a short distance from the receiver of the message, unlike hearing and vision, where recognition is allowed at a distance, and is performed at the time when hands touch the object [17, 18]. In this way, the tactile reading is fragmented and sequenced, and early stimulation from childhood (or from the acquisition of blindness) is recommended, so that there is no overload in attention or memory [17, 18].

In the case of tactile images, the adaptation can be made by various means of production, for example:

- **Craft process:** process that allows the use of the largest number of materials, such as string, cork, wood, clay, paper, among others. Does not focus on just one specific technique for production, and does not demand skilled labor.
- **Embossed printing:** printing of microencapsulated paper (alcohol microcapsules), made in two stages. First, print on special paper with black ink and, later, warming this paper, causing the alcohol to react with black ink and form the relief of the image.
- **Temperature:** uses plastic material, and is done by pressing a thin layer of plastic against a previously built mold.
- **3D printing:** rapid prototyping technology that allows both two-dimensional and three-dimensional printing, differing from embossing and thermoforming [19]. The most commonly used materials for 3D printing are plastic filaments.

Regardless of how images are used in evaluative processes, adaptation must be carried out in a rigorous manner, taking into account the difficulties of disabled people, their particularities, the way they understand information, as well as principles of information design.

## 4 Adaptation of Images in Evaluative Tests

As previously mentioned, it is a right of the visually impaired candidate to have a reader (a professional who assists in reading the test and completing the answers), as well as a Braille test or magnified for people with low vision.

The National Curricular Parameters (PCNs in Portuguese) highlight the selection of Assistive Technology instruments for candidate evaluation, as well as presentation of accessible images that facilitate the understanding of the questions by the candidates [20].

Hereafter, five examples of evaluation processes that include candidates with visual impairment, applied in different countries, are presented. In these examples, the role of the image and its interpretation, the use of Assistive Technology, as well as the adaptation process used are highlighted.

### 4.1 SARESP (School Performance Evaluation System of the State of São Paulo)

Fernandes and Healy [21], evaluated the process of adaptation and application of tests belonging to the School Performance Evaluation System of the State of São Paulo (SARESP). The tests, applied in the public and private network of the state, focus on the assessment of cognitive skills of reading, writing, and math acquired by students throughout elementary and high school. For students with visual impairment, the process consists of a Braille test and a reader (to assist when necessary reading the test).

In this context, the authors identified and described a series of problems faced by blind or low vision students, especially regarding the interpretation of images.

As an example, the authors cite questions 24 and 25 of the Literature test of the 7th grade applied in the year of 2005. In its elaboration, a comic strip of the “Menino Maluquinho” presented in colors in the printed test as in Fig. 1.



ZIRALDO. *As melhores tiradas do menino Maluquinho*. São Paulo: Melhoramentos, 2000. p.5.

**Fig. 1.** “Menino Maluquinho” comic strip used in a SARESP 2005 test. Source: Fernandes and Healy [21]

The questions are proposed as follows:

24 - In the penultimate box, the girl’s expression reveals that she was:

- (A) scared.
- (B) upset.
- (C) cheerful.
- (D) desperate.

25 - Among the resources used to tell the story of the boy Maluquinho, it is highlighted:

- (A) The background colors of each box.
- (B) The gestures and physiognomy of the characters.
- (C) The thoughts of the characters in balloons.
- (D) The noises of the environment where the story takes place [21].

According to the authors, the Braille test in analysis did not present any type of tactile image, using only subtitles to describe the representations. For the story referring to Fig. 1, the first comic is thus described, according to Fernandes and Healy [21]: “Girl talking to boy Maluquinho and says: I’m going to make a cake! Help me? Maluquinho replies cheerfully: only if you let me break the eggs!”.

Firstly, the inviability of question 24 requiring a detailed interpretation of facial expressions is stated: even if the reader describes them in great detail, the impartiality due to the professional personal interpretation would be lost. Likewise, question 25

requires reflection on colors used, gestures and physiognomy of the characters, thoughts and noises presented. For these concepts, just the description is not enough. Therefore, the need for image adaptations that are effective for the reader with disabilities and that transmit the information properly are stressed.

#### **4.2 University of Brasília (UnB)**

Soares and Rabelo [22] show the perspective of the University of Brasilia (UnB) in the application of the college entrance exam for disabled people. People with visual impairment can use a special room, and have access to resources such as magnified and super magnified tests, Braille tests, reader and aid to fill in the answer sheet and transcribe discursive tests.

According to the authors, in the case of magnified or super magnified tests, no modification of the original test is performed. However, for those who need the test in Braille or a reader, the university procedure is to remove figures, tables, references to texts, graphics, among others.

#### **4.3 Comprehensive Adult Student Assessment Systems (CASAS - United States of America)**

Posey and Henderson [23], through a focus group with 75 participants, between teachers and students with visual impairment, evaluated the adapted test from Comprehensive Adult Student Assessment Systems (CASAS). The test, intended for adults and widely applied in the United States, measures the literacy and basic skills required to enter the job market through 90 objective questions.

In this analysis, the authors verified the difficulty of Braille reading of some participants, mainly because they are used to a screen reader. There was also too much effort needed to interpret tactile maps produced with a 3D printer, since the adult audience in question was not familiar with the new technology. For a better applicability of the test with blind adults, the authors conclude the research recommending the test application in two distinct days for a new schedule, the inclusion of more detailed instructions for reading the tactile maps, as well as the elaboration of questions that are close to the blind adult's daily life.

#### **4.4 Evaluation in the UK**

Woods, Parkinson and Lewis [24] review the process of adapting and applying assessments for visually impaired people in the United Kingdom<sup>1</sup>

During the evaluations, students may request the following items: a person to read the exam (reader), electronic reading devices; extra time; a laptop to complete the exam, rest periods during the test, a person to transcribe the answers and a person to encourage the candidate and help them focus, known as 'prompter'.

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<sup>1</sup> In this context, refers to three of the four United Kingdom countries: England, Wales and Northern Ireland.

#### 4.5 Adaptive Content with Evidence-Based Diagnosis (ACED)

Hansen et al. [25] discuss the usability of the assessment system called Adaptive Content with Evidence-based Diagnosis (ACED), which provides audio-tactile graphs to assess algebra learning by visually impaired people. The system provides three different interfaces or modes: normal mode, low vision mode, and blind mode.

Normal mode uses regular-sized fonts and does not provide voice output. Works on a computer monitor with an optional keyboard and mouse. The low vision mode provides text and image magnification, descriptive audio on the content and speech synthesis used only to reproduce the typed characters in open response questions. Finally, the blind mode resembles the low vision, except for also using a tactile device known as Talking Tactile Tablet (TTT).

The tactile tablet is a digital input device that uses paper to create 3D overlays and connects audio files to describe overlays. The device, connected to a computer that uses the ACED, allows through its tactile surface that students with visual deficiency interpret diagrams, graphs and maps, producing a tactile image with description in audio. When a student touches the tablet, the location of the touch is sent to the computer, which then plays the contents or instructions. Blind mode also plays characters and words as they are typed to guide the user to input their answers.

## 5 Discussion

Sitlington [26] states that adapting a test is effective when scores of students with special needs increase, while those who do not require special aid keep the same score on the test.

In the examples collected, there are adaptations that aim at the total integration of the visually impaired person, as well as evaluations that disregard the importance of the tactile image, thus harming the candidate's score. As the example of SARESP and UnB, which simply describe the images or discard them, deprive the visually impaired candidate of the same information as the others. In these cases, only the Braille test and the learner are not enough, considering the difficulty of verbalization or transcription of complex information, such as graphs or chemical and mathematical formulas, for example.

The role of Assistive Technology in image interpretation is emphasized in UK-based assessments as well as in the ACED system. In both cases, the availability of technological resources put the candidate with visual impairment at the same level as the others, giving full conditions for the interpretation of images and complex information. However, the context of the candidates who will make use of these resources should be considered. Taking CASAS as an example, some candidates had difficulties in interpreting tactile maps produced by 3D printers because they were not familiar with the new technology.

According to the role of information design, the need for evaluation processes that elaborate the content is reinforced so that the receiver fully understands the message. Within the universe of the visually impaired person, this study brought up the importance of the tactile image as well as technologies that aid in its interpretation.



This article has raised five examples, Brazilian and foreign, to understand the context in which the problem is embedded. However, to draw further conclusions, it is necessary to consider the wide range of existing evaluative processes and their peculiarities: in each location the tests for candidates with special needs will be applied in different ways and using various resources.

## 6 Final Considerations

The present study sought to demonstrate the image role in evaluative processes for people with visual impairment, and to point out information design as essential in these processes. The literature review provided examples of assessments that almost completely disregarded the role of image comprehension by visually impaired candidates, as well as examples that have used several alternatives to provide equal conditions of interpretation.

Being an article of exploration of the literature to point out examples of evaluative processes for people with visual impairment, it does not intend to exhaust the discussion about the subject, but rather to open the range of research possibilities.

Therefore, it is necessary to carry out new studies that will explore the various possibilities of adapting tests and images through guidelines and information design concepts that collaborate with the presentation of content comprehensible by all visually impaired candidates, in evaluative contexts.

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