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30 Visualità della scrittura nelle arti e nella comunicazione visiva
a cura di Valentina Manchia e Salvatore Zingale

Pictograms as Visual Communication Tools for the Autonomy and Accessibility of Persons with Intellectual Disabilities

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Abstract
The social inclusion of persons with disabilities is a priority in a growing number of countries. Their level of autonomy, with or without technical aids, is an essential criterion of its success. Pictograms are the technical aids of choice for persons with intellectual disabilities. The coherence of the pictographic tool is essential to the user-friendliness of such aids. Pictogram-based solutions are not only useful for persons with intellectual disabilities. They can be used by all those who have difficulties reading, such as illiterate persons, tourists, senior citizens, children, refugees, asylum-seekers, etc. Taken together, they can represent up to 30% of the population.

Keywords
Pictograms; Autonomy; Accessibility; Intellectual disabilities; Technical aids

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1. Disabilities and rights

The United Nations Convention on the Rights of Persons with Disabilities (CRPD) was adopted in December 2006. 164 countries have signed it and it is being ratified by another 186. The purpose of this Convention is "to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity".[1]

Full and effective participation and inclusion in society is one of its general principles, the others being "respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons; non-discrimination; respect for difference and acceptance of persons with disabilities as part of human diversity and humanity; equality of opportunity; accessibility; equality between men and women; respect for the evolving capacities of children with disabilities and respect for the right of children with disabilities to preserve their identities".[2]

Several countries have passed legislative frameworks and regulations and have taken administrative and other measures. India, for example, set up the Rehabilitation Council of India (RCI) in 1986; it became a statutory body in 1993 following the enactment by parliament of the RCI Act (RCI, 2001). Its mandate was broadened in 2000 to give it the powers to regulate and monitor services given to person with disabilities. The Rights of Persons with Disabilities Act was passed in 2016 to fulfil the obligations of the CRPD, of which India is a signatory. It makes the appropriate governments responsible for taking effective measures to ensure that persons with disabilities enjoy their rights equally with others in terms of education, employment and access to resources.

Full and effective participation and the inclusion of persons with disabilities in mainstream society remains, however, a major challenge for all. Cognitive, physical, intellectual, communicational and emotional challenges constitute major hurdles for navigating the complex environments that persons with disabilities are faced with. The CRPD views disability as an evolving concept that results from the interaction between persons with disabilities, on one hand, and attitudinal and environmental barriers that hinders their full and effective participation in society, on the other.

The social model of disability that this is based on is a significant evolution from the earlier medical model. "The medical model views disability as a problem of the person, directly caused by disease, trauma or other health conditions, which requires medical care provided in the form of individual treatment by professionals". In such a context, becoming a functioning member of society requires medical care or rehabilitation. This is an extremely normative view as

[1] United Nations 2007 Convention on the Rights of Persons with Disabilities. Art. 1, p. 4. Retrieved from <https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-persons-disabilities>.

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it becomes incumbent on the person to adapt to society. Management of the disability is aimed at cure or the individual's adjustment and behaviour change.

> The social model of disability, on the other hand, sees the issue mainly as a socially created problem, and basically as a matter of the full integration of individuals into society. Disability is not an attribute of an individual, but rather a complex collection of conditions, many of which are created by the social environment. Hence, the management of the problem requires social action, and it is the collective responsibility of society at large to make the environmental modifications necessary for the full participation of people with disabilities in all areas of social life. (WHO 2001: 20)

Autonomy and accessibility consequently become key issues in achieving the full and equal participation and the social inclusion of persons with disabilities. Technical aids and measures to make key resources such as education, employment, transport, buildings, etc. accessible are necessary but not sufficient. Persons with disabilities themselves need to be prepared in their use, which involves learning.

2. Communicating with persons with intellectual disabilities

Social, academic and occupational learning, however, is a challenge for persons with intellectual disabilities. Learning is a complex process that involves various cognitive skills and abilities such as attention, memory, differentiation, prioritization and understanding. These abilities are essential for acquiring new knowledge, making connections between different concepts, and applying what has been learned in different situations. These skills are interdependent and often overlap, making learning a complex process (Clarke and Clarke 1965). In persons with intellectual disabilities, their cognitive skills and abilities which are essential for learning can be latent. Neither they nor their educators and caregivers are aware they exist and it is up to the latter to seek them out and identify them. Doing so would be of immense importance as it would allow the person to develop their inherent capacities and facilitate their social participation and inclusion (Deshpande 2005).

The interventions designed to detect, develop and strengthen learning among persons with intellectual disabilities require effective communication media in order to succeed. An experimental study on the effectiveness of audio, video and print media (pictures) was conducted as a doctoral programme at a special education institution in Pune, India, to ascertain the relative effectiveness of media that are commonly available and used (Deshpande 2005). The study evaluated the impact of the three media on the following abilities:

- Memory.
- Ability of communication.
- Ability of association.
- Concept formation of colour, size, spatial relations.
- Ability of appreciation.
- Ability of prioritization.
- Ability of differentiation.

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- Attention.
- Ability of understanding.

The research revealed that print pictures were the most effective medium of the three for communicating with persons with intellectual disabilities. Although a very simple medium, technically speaking, with static picture frames, clear colours and figures, they scored highest in developing cognitive abilities like memory; concepts of space and colour; the ability to associate and to differentiate; and the abilities of prioritization and appreciation.

Pictures are a cheap medium and can be easily duplicated for reuse. They can be used in remote locations too, such as rural areas, an important criterion in the Indian context. The medium allows special education teachers to understand complex cognitive development and how lower-level skills can be built into higher-order thinking. It could assist educators in developing more effective teaching methods and tools to make the children with intellectual disabilities more self-supportive and autonomous (Deshpande 2005).

Special education teachers and carers often use images to communicate with their students and wards. The images are usually gleaned from magazines, catalogues, books, etc. The manner in which objects, actions or concepts are visually represented can thus vary from picture to picture. These variations can be personal, cultural, or geographic, for example. The images are useful as cues and for communicating simple messages, but it is difficult to base an efficient visual communication system on them, for a number of reasons:

- the diverse origins of the images result in a lack of coherence in the manner in which objects, and particularly the more immaterial items such as action verbs, professions, places, etc., are represented;
- it is difficult to describe tasks in detail using such images. They are useful as cues for action and as keyframes in a sequence, but one rarely finds the images required to create a task sheet that includes details of the subtasks;
- each teacher or carer has their own set of images and their own "grammar", if at all, for associating them to create messages. As a result, when students change groups they often need to unlearn one system to learn another. Besides, the images are collected as and when required, which makes for a resource that grows organically, and as it has often not been designed as a system, there is an absence of internal coherence;
- the situations in which visual communication can be used is constrained to those in which the required images are available;
- collecting images can be time-consuming and takes away from the primary task of caring for wards and teaching students.

3. Pictograms and intellectual disabilities

Pictograms are stylized figurative drawings used to convey information of an analogical or figurative nature directly, to indicate objects or to express ideas (Tijus et al. 2007). As visual communication tools, they are often used as alternatives to images. Ubiquitous in today's world, they are used in all sorts

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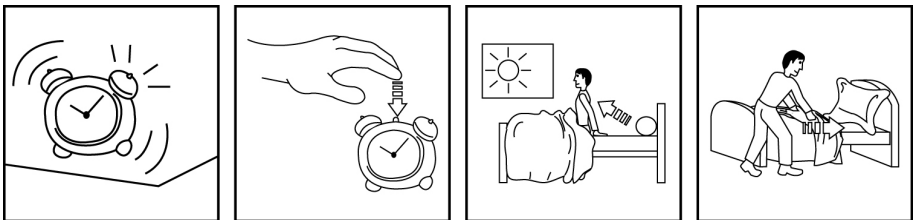
of situations, from road signage to laundry instructions, and infographics to modern technologies.

Although simpler than images, they are more effective as elements of a "visual language" than images are, and efficient ways of saying a lot with very little. Pictograms are useful tools when a message needs to be transmitted and understood independently of words, writing, language and culture. They are often instinctively learned and understood by natural means and are easily recognizable as they are stripped of details and the focus is thus solely on the bare message.

Many of the common pictograms transcend cultures to become international symbols, of which road signs are a vivid example. The international standard ISO 7001 (International Organization for Standardization) defined a pictogram set in the 1970's that has been in continual use since.

There is a difference, however, between pictograms as we commonly know them and their use as visual communication systems for persons with intellectual disabilities. In the real-life situations we are accustomed to, three pictograms placed side-by-side convey three separate and distinct messages.

In a visual communication system, pictograms placed side-by-side together constitute a message.



The sequential organisation of certain professional or daily activities can be an obstacle for people who have difficulty remembering their schedules or organising their time (Courbois and Paour 2007). However, learning is always possible, even if it takes time and requires adequate means. There are three main possibilities for professionals and parents to support the learning of persons with intellectual disabilities (Bussy 2014):

1. modifying the environment to suit the person's abilities (e.g. providing visual support if the person has difficulty processing verbal information);
2. using preserved cognitive functions (e.g. building on the person's strengths; using, for example, alternative and augmentative communication if the person has language difficulties);
3. re-educating or stimulating the dysfunctional cognitive function.

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Pictograms can be useful in each of these cases. They fulfil roles usually held by the care-giver: encouragement to adopt the behaviour or undertake the task; reminders of the order of the tasks to be carried out; and the means to self-evaluate the accuracy of the execution (Montreuil et al. 1991). However, the technical aid used must be adapted to the situation and the person.

For example, verbal memory disorders in Down's and Fragile X syndromes are obstacles to memorising verbally communicated information and, consequently, to following the instructions for carrying out tasks. Each piece of information given verbally should therefore be accompanied by its pictorial representation (for example, pictograms). The dual modality (visual and verbal) improves the memory trace and thus makes it easier to retrieve this information (Bussy 2014).

4. Pictograms and "visual languages"

A pictogram-based visual communication system is an artificial construct and can thus be designed to be as efficient as possible. For the system to be effectively efficient, the design needs to focus on the three primary structures of a "visual language": the modality of the representation, pictograms in this case; the "grammatical structures" used to organise them; and meaning, which must be as comprehensible and unambiguous as possible. The "grammatical structures" apply as much to the construction of the units (pictograms) as to that of the sequence (message) (Cohn 2020).

Pictograms and images can be associated either as sequential images which are juxtaposed images bound by meaningful connections, designed for instruction manuals and signage; or visual narratives which are a type of sequential images, often drawn, which convey a continuous event sequence, typically to tell a story, as in comics and picture stories (Cohn 2020). Pictograms, as used for persons with intellectual disabilities, would fall into the category of sequential images, though it would make the communication richer if it were also to include visual narratives.

It is however important to understand that in associating images to construct messages or narratives, we enter the realm of "visual languages" that use codes and conventions for those messages to be coherent and understood. However, although images, photographs, pictures or pictograms have long been used to communicate with persons with intellectual disabilities, this aspect isn't often taken into account. One of the reasons is the widespread "Visual Ease Assumption" that rests on the premise that visual narratives, given their non-linguistic nature, may alleviate processing difficulties in populations that struggle with language (Coderre 2020).

Visual information correctly presented is effectively easier for persons with intellectual disabilities to process than oral or written information, as images are concrete representations that directly reflect the real world. For example, unless the association is learned, nothing about the sound "dog" or the word "dog" directly evokes the animal. A picture of a dog, however, looks like one and can be directly linked to its semantic representation.

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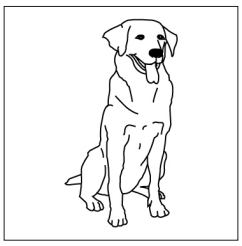

As a result, the visual stimulus (picture "dog") is more easily processed than the more abstract stimuli, whether acoustical (sound "dog") or graphical (word "dog").

The information to be communicated here is simple. In the case of a visual communication system, however, the kind of information to be conveyed can be more complex and representing it requires the use of a "visual grammar" to create the corresponding pictograms and messages. "The messages are thus no longer simplistic and universally transparent and require a certain proficiency that is acquired through exposure to the visual language" (Cohn 2020).

As a result, internal coherence is an essential criterion of an efficient system. The "grammar", whether for the pictograms or their sequence, needs to be formalised and used in all the instances in which it is applicable. It thus becomes useful to understand the mechanisms and principles underlying the process of visualization.

5. Formal Aspects of Visualization

Visualization refers to the encoding and decoding of information into a graphical/visual/spatial form, whether inside the human imagination, as a mental image, or outside it, as images such as pictograms, diagrams, cinema, photographs, sculpture, and painting. This definition suggests that information varies in its suitability for being visualized.

Some information appears well suited to textual representation but is difficult to represent visually (e.g., a national constitution), some is well suited to visualization but is difficult to represent textually (e.g., Michelangelo's David), some may be equally suited to either (e.g., the plots of action novels that later appear as successful movies), and, finally, some may be suited to neither (e.g., Beethoven's Ninth Symphony).

Visualization (and images) can be approached from different angles: the formal aspects of the image itself; the cognitive, perceptual and mnemonic underpinnings; or the interpretive function. Although the applications and the areas mentioned below may not correspond to the experiences or the lives of persons with intellectual disabilities, their conceptual bases provide a foundation for building an effective visual communication system at two levels:

1. The design of the visual communication system itself
2. The creation of user-friendly resources using the system.

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The formal aspects of images include (Davis, 2009):

1. Appearance: The recognizable attributes of images (color, shape, edges, contrast, opacity, texture, etc.).
2. Measurement: The scale of images (how large or small something is in relation to something else).
3. Dimension: The temporal constructs embedded in images (showing process with video, time lapse, slow motion, high-cam moving or still images that capture metamorphic processes, temporal axes in graphs).
4. Perspective: The perspectival aspects of an image according to the relative position of the viewer (Vantage point, 1, 2 & 3-point perspective, multiple perspectives).

Taking into account the cognitive inclinations, strengths, and limitations of the human mind in visual matters, provides a way to think about the match between the formal aspects of an image and its effectiveness. These include (Davis 1988):

1. The beneficial effects of external and internal images on memory, and which visual attributes enhance this mnemonic effect.
2. The use of "memory theaters" - mapping images on top of complex visual forms as with the figures of astrology and astronomy, and associating images with words; distinctions between cued and uncued recall and recognition.
3. The automatic interpretive and perceptual processes that help us parse visual input; their implications about images that are likely to be easy or difficult to read; the types of information in an image that we are likely to uncover most quickly.
4. Some exploration of why optical illusions and movies work; seeing the world through the eyes of a fly, spider, or frog; stereo vision, color opposition, capacity limits, and laws of good form applied to the evolution of visual presentation (Davis, Hodges, & Sasnett 1989).
5. Our ability to internally manipulate images through zooms, pans, rotations, transpositions, and juxtapositions and how these maps onto successful visual conventions (Davis 1989).
6. Our ability to make imagistic models as an aid to understanding, reasoning, and design.

6. Pictomedia: an example of a pictogram-based visual communication system

The Pictomedia system was designed for persons with intellectual disabilities who were able to master simple tasks but had problems performing more complex ones. Their memory problems would not allow them to remember all the subtasks of the main task, their sequence, or both. And as their reading skills were extremely limited or absent, they could not use written instructions. Pictograms allowed the tasks to be converted into "comic strips" that they only needed to follow to execute them.

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The nature of the relationships between a sign, or a signifier, on one hand and an object or concept, the signified, on the other, leads to distinguishing three types of signs: icons, indices, and symbols (Jakobson 1965). Pictograms can be all three.

The aim is to have pictograms that are iconic, as far as possible. The icon acts chiefly by similarity or resemblance between the signifier and the signified; the picture "tree" that evokes the object "tree", clearly and unambiguously. However, not everything can be represented as icons; action verbs, professions and comparisons are some examples.

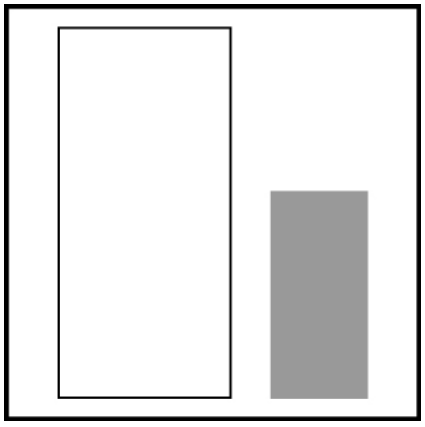
An index can be useful in such cases. It acts on the basis of association by contiguity. Indices establish connections between the signifier and the signified. Smoke is an index of fire, and the footprint an index of human presence. However, in a pictographic system, these relationships must be coherent and consistent. All instances of a category must be represented in the same way to facilitate understanding and to lessen the cognitive load of deciphering the images. Semantic rules play that part in the Pictomedia system.

And finally, symbols act chiefly by learned associations between the signifier and the signified with no similarity or contiguity required between the two. It is merely based on a decision to interpret the sign in that manner. Traffic signs are a good example of symbols. This makes symbols hard to understand and difficult to remember for persons having cognitive and memory issues. As such, they should be avoided in a pictographic system. However, they are impossible to ignore as they are so much part of our everyday lives. If necessary, icons and indices can be used to explain them. "The internal coherence of the Pictomedia system is ensured by a set of visual, semantic, and syntactic rules" (Muzumdar 2009).

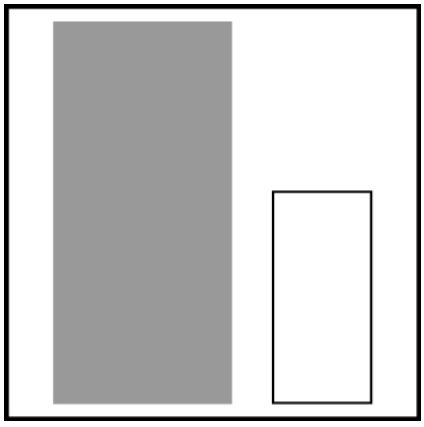
The visual rules give the pictograms a similar look and feel, allowing them to be recognised as belonging to the same set of images.

The semantic rules define the manner in which a concept (action verb, colour, profession, etc.) is represented visually. All instances of a given category must be represented in the same manner.

Examples of semantic rules:



Big



Small

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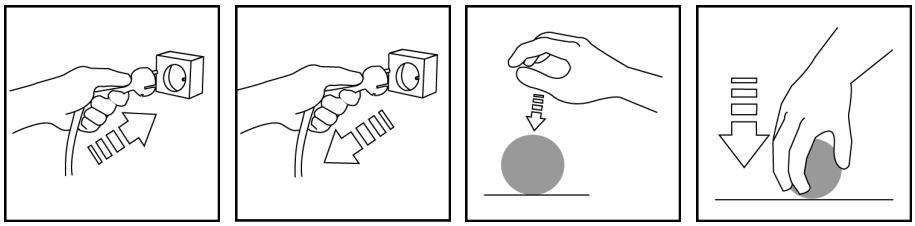
Rule: The information to be communicated is in black, the grey provides context.



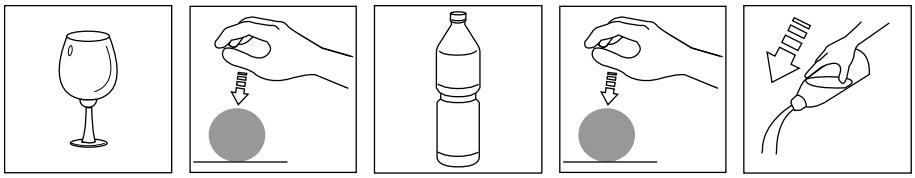
Plug in *Unplug* *Take* *Put down*

Rule for Action verbs: the part of the body involved in the action, associated objects if any, and an arrow to show the direction of the movement.

Rule: "Take" and "put down" are generic pictograms that are associated with the objects that the action is applied to (see example below).

Syntactic rules: the fundamental choice made for syntax in the Pictomedia system was to sequence the pictograms to follow the progression of the task and not the order of the words in the instruction.

The sequence of the pictograms for the instruction, "Pour water in the glass" will thus be, "Take the glass, take the bottle, pour", which is how the action is generally performed. Having the pictograms in this sequence makes it easier for the person with intellectual disabilities to execute the task as they just have to follow the pictures. It also makes the pictographic instruction language independent as the pictograms are in the order of the task and not that of the language of the instruction itself.



7. An example of a pictographic solution: Pictomedia Access

The aim of the Pictomedia system is to provide solutions to compensate for the incapacities of the person in all the areas of their life in order to facilitate their social inclusion.

Pictomedia Access is one such solution and is a pictogram-based mobility tool. It was designed for persons who have difficulties in finding their way around geographical spaces and have little or no reading skills, which makes the use of written itineraries difficult or impossible. The basic concept consists in translating the person's route into pictographic itineraries that include photographs of existing geographical landmarks. The landmarks indicate points at which actions need to be taken, such as "turn", "cross the road", etc. This allows the person to move around using the pictographic document alone, with no modifications required to the physical environment.

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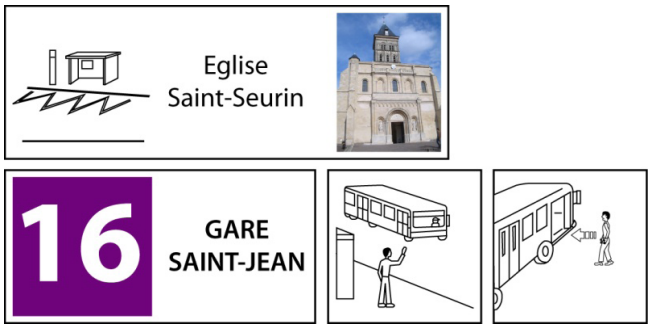
As a result, Pictomedia Access goes beyond the notion of accessible transport and makes the whole city accessible: buildings, large sites, urban spaces and public transport.

Pictographic itinerary extracts:



At the "St. Seurin" bus-stop, take bus number 16 going to "Gare St. Jean"

Get off at the "Victoire" bus-stop.

The safety of the person is ensured by a mobile phone with the number of a care-giver or a parent on fast-dial.

New functions and technologies can be added to the basic solution, such as smartphones, tablets, GPS, augmented reality, etc. As for remote assistance, it can evolve technologically, with the use of smartphones or tablets, using localisation and video calls, for example, or in organisational terms, going from individual assistance to collective assistance, such as a call centre. As long as the basic concept remains unchanged, these different versions remain compatible with each other.

8. Adapting pictograms to users' needs

For pictograms to be efficient autonomy tools they need to be adapted to the user and their needs, which could involve adapting them:

- to the form of intellectual disability;
- to the individual; or
- to the cultural context.

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The form of disability has not been taken into consideration in the design of the Pictomedia system, there being insufficient data available on the relationship between the form and the person's comprehension of a visual language. However, the manner in which the latter is used can be adapted to the type of disability.

Children with Down's and X-Fragile syndromes, for example, have impaired verbal memory, and information given to them orally should be accompanied by its pictorial representation (e.g. pictograms). The dual visual and verbal modality augments the memory trace, making it easier for them to retrieve information. In addition, the use of timetables helps them keep track of time and reduces the anxiety associated with change (Bussy and Kientz 2012).

Children with Williams-Beuren syndrome, however, have difficulties reading and understanding timetables in the form of double-entry tables (Thibault and Fayasse 2009). It is therefore preferable to use verbalization with them, as they do not present the same verbal memory disorders as the two other syndromes.

The other issue is in how far one needs to go in adapting the pictograms to the individual, as the more they are adapted to a single user, the less universal they become.

The question here is the role attributed to the pictograms. Are they "crutches" or communication tools?

If crutches, they can be designed specifically for a given user and their needs, independently of others, thus making them easier to use.

However, these pictograms will probably not be easily understood by others, nor theirs by the person, making it difficult to develop common resources.

Designing pictograms as a communication tool alone, on the other hand, can make for a highly efficient visual language, albeit with a steep learning curve.

The Pictomedia system has used a bottom-up approach to strike a balance between the two options. New pictograms are designed in response to the needs of a particular person and situation. The design process, however, takes into account the larger context and population, applying semantic rules if they exist or creating new ones if necessary. The aim is to arrive at and maintain a system, the coherence of which makes it easier to understand. We believe a common "visual language" is essential for the social inclusion of persons with intellectual disabilities.

Evaluating the appropriateness of the visual representation of an object or a concept presents its own problems:

- The absence of context: as in an oral language, context plays a role in the understanding of an individual word/pictogram, though its importance should be less in the case of pictograms.
- The role of learning: when pictograms are taught, learning makes up for intuitive understanding, as in the case of road signs for the larger population. The visual representations in teacher-built pictographic tools are quite varied, but once taught, they are understood by the students. Learning also plays a role in the use of pictographic systems, notably in the understanding of the semantic rules.

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– The abilities of the subject: pictograms are evaluated by asking the subject to name the object or concept that's represented by the pictogram. In some cases, the subject can have understood the pictogram without being able to express themselves.

Pictomedia takes a more pragmatic approach, which could be improved. The instructions of a task are repeated while showing the pictographic version, but without explaining individual pictograms. If difficulties encountered in understanding appear to be related to certain pictograms, their design is reviewed. When the person can describe the complete task with the help of the pictograms, it is assumed that they have been understood.

9. The Kamayani research project: a cultural challenge

The adaptation of pictograms to a cultural context was an important element in the Kamayani project.

The Kamayani Prashikshan and Sanshodhan Society (Kamayani Institute of Training and Research) was established in 1964 in Pune, India. It currently runs 2 special-education schools, 2 sheltered workshops and a farm-based training centre near Pune for around 450 students.

Kamayani established its own research wing in 1989 to develop a corpus of knowledge on intellectual disabilities in the Indian socio-cultural context. It has since developed its own instruments and methodologies for the education and development of intellectually disabled persons.

Since 1989, Kamayani has been recognised as a Scientific & Industrial Research Organization (SIRO) by the Ministry of Scientific and Industrial Research. It has also been an affiliated research institute of the University of Pune since 1996.

The aim of the ongoing research project is to study the impact of pictograms on the autonomy of Kamayani students.

A group of 11 teachers underwent training in the use of pictograms and the design of pictographic resources and task sheets. Each teacher chose a task to test, and together they represent an interesting mix of tasks, including brushing teeth, washing one's face, braiding hair, tying shoe-laces, folding shirts, making a cucumber salad, making dough, and making paper bags.

The tasks will be carried out by two groups of two students each, one group using pictographic task sheets and the other oral guidance, the current pedagogical approach. This will also allow the two approaches to be compared, as pedagogical tools for teaching the task on the one hand, and as memory aids in its execution on the other.

The generalisation of the use of pictograms in both Kamayani schools is planned in the next phase, the current group of teachers providing training and assistance to their colleagues.

Pictomedia pictograms were primarily used in the creation of the task sheets. They were however designed, tested and used in France and reflect the specificities of a French context.

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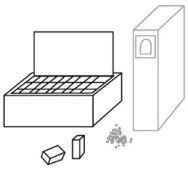
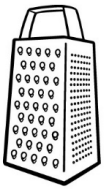
The cultural context at Kamayani, significantly different from that of France, created some interesting situations related to the design of the pictograms required for the task sheets. The pictograms fall into four categories:

1. The existing pictograms are understood by the students at Kamayani; this was the case for most of the pictograms.
2. The objects to be represented are found in both contexts but require their representations to be adapted.

	French pictogram	*Kamayani version*
Sugar The French pictogram shows sugar cubes, the use of which is not widespread in India. The Kamayani version represents sugar as being what is put in beverages.		
Grater The grater the Kamayani students are accustomed to is the box-type grater.		

3. The objects to be represented do not exist in the French context.

Chapati Indian flat-bread cooked on a smooth, slightly curved griddle.	
Sari Traditional Indian dress for women.	

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4. Customs that are different in the two contexts.

	Kamayani
Sitting down to eat Food is generally eaten seated on the floor in traditional and rural settings in India.	
Greeting The traditional greeting is the namaste, palms joined at chest level, fingers pointed upwards.	

The use of the pictograms and the task sheets were also adapted to the students at Kamayani. Some of the students have multiple disabilities: speech pathologies, muscular problems, visual deficiencies, etc. The pictograms were thus displayed in a larger size and the task sheets were wall-mounted to make them more visible and to avoid the need to turn pages.

It must be noted that we are referring to a very specific context here, that of a special-ed school in Pune, in the state of Maharashtra. The language spoken there is predominantly Marathi, though many other languages are also spoken, particularly in the cities, like Pune.

We cannot generalise our experience to an "Indian" context. Multiple contexts co-exist within the country, whether western-influenced, national, or regional in nature. We have not, at this stage, aimed at designing a communication system that takes them all into account. Managing such a system would require a computer application, along the lines of a word-processor where one could choose the context in much the same way as one chooses languages. This would allow the appropriate variants of the pictograms to be displayed and used.

10. Social impact

Pictogram-based solutions are generally designed to compensate for users' cognitive incapacities, their limited or absent reading skills, or both. Persons with intellectual disabilities are not, however, the only beneficiaries. Indeed, many people face such challenges, and for a variety of reasons. Pictograms can be useful to them, too. So in addition to persons with intellectual disabilities, the mobility solution, for example, could also be useful to people who have difficulties reading: illiterate persons, immigrants, refugees, tourists, etc.; elderly persons; children; and people who have difficulty finding their way around public transport networks. Based on the figures of the Bordeaux metropolitan area, together they represent up to 30% of the population of the territory.

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11. Perspectives and scope for additional research

There are multiple avenues for developing the efficiency of a pictographic visual communication system and its applications.

Improvements could be made to the systems themselves in improving the visual quality of the pictograms; the morphological rules for designing the pictograms; and the syntactic rules for constructing messages. The better the "visual grammar", the more efficient the system.

A better understanding of the visualization processes would make for pictograms that are better and more easily understood. This would include the higher level interpretive and comprehension processes which help explain recognition, interpretation, connotative effects, and powerful symbolisms.

In the field of information technology, pictograms could contribute to the development of text-free interfaces, with visual representations that are located halfway between pictograms and icons, already ubiquitous in user interfaces.

The advent of artificial intelligence (AI) agents also presents new opportunities for pictographic development and accessibility. Pictolab has recently collaborated with the Harvard Visualization Research Laboratory at Harvard University. MidJourney, an AI art generator, has begun to be tested for the production of pictograms from text inputs, such as asking MidJourney to create images for simple yet complex activities like "How to brush your teeth" or "How to braid your hair". ChatGPT was also used to generate task lists for other activities. In the context of the research project currently being conducted in India, Google translator could then be used to translate from English into various Indian languages. Combining the use of different AI tools could allow significant progress to be made in the applications and the manner in which pictograms could be used.

12. Conclusion

An efficient pictogram-based "visual language" can make a significant positive impact on the social inclusion of persons with intellectual disabilities. It could also benefit a much larger population. The current social model of disabilities, in placing the disability in the relationship between a person's incapacity and a maladapted environment blurs the notion of "person with disabilities".

On the one hand, if a person with disabilities is in an environment adapted to their incapacities, they are no longer considered to be disabled; on the other hand, every person is confronted by situations where their "incapacities" limit their ability to engage in an activity and consequently limits their participation. By the current definition of disability as a restriction of social participation, this would make them "disabled".

This should be taken as an opportunity to have a more holistic approach to disabilities along the lines of universal design so products and services are designed, as far as possible, to be accessible to all, whatever their incapacity, and consequently improve the quality of life for all.

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