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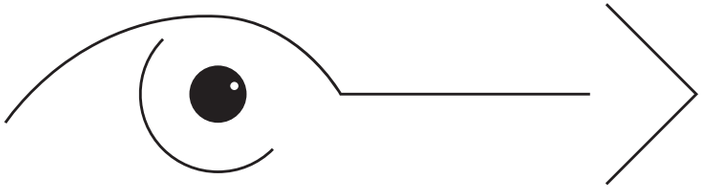

Before there was reading there was seeing. *Visible Language* has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that created visual form is an autonomous system of expression that must be defined and explored on its own terms. Today more than ever people navigate the world and probe life's meaning through visual language. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

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Contents

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Sometimes research creates breakthroughs that shatter paradigms. Sometimes research supports and affirms what's already known. Every journal hopes to publish a constant stream of breakthrough articles perhaps to the neglect of the necessary but less hair-raising articles that confirm, affirm, and probe what's thought to be known.

This issue presents three important articles that are closer to the latter than the former. Brian Switzer's nice study confirms the ways and means that design research contributes to complex problems in the mundane context of caring for the aging and dying. Hospice care called for help and Brian's designers brought their naive eyes and design research methods to bear and identified numerous possible interventions.

Rodrigo Ramírez's work affirms the usefulness of established comprehension testing protocols in the development of open-source icons for use in emergency situations. The nature of a crisis reinforces the need for designers to employ performance measures for supposedly "universal" icons.

Emma Fisher, Nicolette Lee, and Scott Thompson-Whiteside's study tests the assumption that design practitioners and design academics see research differently. Their conclusions confirm the original assumption in many ways while adding important nuance leading to proposals to advance collaborations between practicing designers and academic researchers.

Pino Torgu's challenge to conventional wisdom, that representational pictures of data enhance comprehension, probes Otto Neurath's Isotype and concludes that counting rows of pictograms is not as effective for reaching a total as reading an arabic number.

These studies confirm the usefulness of design research to practice and support their integration. The articles are another step away from glory in beautiful graphics alone to pleasure in the demonstrable integration of beautiful and useful work Paul Rand envisioned in his 1970 breakthrough *Thoughts on Design*.

One step, one study at a time, Design is passing from adolescence to adulthood.

Mike Zender

research proof

Reviewing Open-access Icons for Emergency:

a case study testing meaning performance in Guemil

Rodrigo Ramírez

Commonly called pictograms, symbols or icons, it is convened that these are normalized images designed to display a concrete meaning. As a system, icons function as a codified language to facilitate communication. These can also be efficient to manage messages on different media or information technologies. In the specific context of an emergency, different initiatives of icons have been developed, mainly considering context (i.e., a crisis) or specific actions (i.e., warning). Today, it is possible to find different icon collections, some presenting styling novelty, and open-access. However, usually, these are delivered as is, without any proof of their effectiveness. It these are designed for critical contexts such as emergency, evidence of performance might be provided. Evidence can be collected from testing, contributing to developing better tools for communication in crisis from local to global scale. This article presents definitions and a review of cases on icons for different types of emergency, selected by their open availability. Based in the literature review, a fundamental indicator to assess icons performance is Comprehension. As a case study, testing process and results conducted in the Guemil Project are explained. This is centered on 'Meaning' as a specific variable to measure performance. Finally, some reflections emphasize both open–access orientation and the importance of performance tests to establish effectiveness.

Keywords

emergency
open-access
icons
performance
meaning

Highlights

1. An emergency can be a complicated scenario with massive demands of information. Communities need accessible tools to manage.
2. Icon systems emerge as optimal graphic tools for multicultural communication in emergency = Open-access and implementable.
3. A visual language statement is not enough: Evidence about performance is needed to validate design effectiveness.
4. According to international practice, evidence of performance in icons is constructed mainly by asking about Comprehension.
5. Guemil Project includes a testing process on Meaning and Differences, a selection of results are presented.
6. New insights appear to be necessary, to collect interpretations from specific groups.
7. A collaborative approach is fundamental to transfer information into actions > safe decisions.

Introduction

Information design is a multidisciplinary practice oriented to develop information that is visible, understandable and usable for people, combining both art and science (Horn, 1999; idX, 2007). As a research area, Information Design contributes to articulate information needs, optimize communication, and measure the performance of messages. Figure [1] based on the framework presented in Allard, Briones, et al. (2014) shows, a fundamental virtuous cycle in Information Design is See > Understand > Use the content.

Information Design instruments such as graphic language, attempt to be natural ways to visualize, understand and perform in everyday life, constituting practical tools that can be eventually applied in different contexts. Fundamental tasks from communication design such as the presentation of information for action can be a different approach to construct reaction capabilities on emergency and facilitate resilience, and visual language can contribute to action (Frommberger & Waidynatha, 2017). Thus, graphic elements such as symbols and typography appear as ubiquitous, immediate solution to deliver vital information even for critical contexts. Different standards of symbols have been developed for diverse contexts such as transport, public spaces or safety at work, many of them aiming to reach universal interpretation.

FIGURE 1

In a broad context, this paper presents a review of icon systems that address emergency scenarios. It describes four cases selected by their open-source access, and opens a discussion from their visual statement but fundamentally from their performance as visual tools to accomplish communication objectives. A review of testing methods is presented, and performance measuring is exemplified taking five cases from the Guemil icons. Finally, reflections are delivered to remark the importance of visual information integrating risk management cycle with the user experience, using performance indicators and promoting collaboration.

1. Icons as normalized messages

Symbolic language persisted from ancient times, as a graphic instrument to represent actions and convene meanings (Aicher & Krampen, 1979). Today, Pictograms or Icons are part of normal processing of information by visual ways. Icons are normalized images that share a codified message, condensing a precise meaning, intending to present a common language. According to Jardí (2011), these are 'pictorial representations with an informative character that are generally part of wider systems, sharing attributes such as graphic style.' In theory, these are conceptualized as a universal language, and they would be functional to reduce linguistic barriers (2011, 23). Usually, iconic language pretends to be universal, applying to daily tasks, work and activities (Abdullah & Hubner, 2009; Frascara, 2011, Boersema & Adams, 2017).

Today, icons are part of systems that cover different functions and categorized according to their use (Abdullah & Hubner 2009). In recent history, different approaches had progressively become standards. Probably the best known are the AIGA/DOT (1979) for public information, ANSI z353 (2011) for safety, or the visual standardization for digital interfaces (Mijksenaar & Zwaga, 1990). Everyday contact with these particular elements of information should help to explain why icons are so ubiquitous, as Zender & Mejía (2013) demonstrate. From the interpreter side, Frascara (2011) defines two types of users for icons: (1) Professional and (2) General public: He considers that professional use of information must be clearly distinguishable and highly memorable. On the other hand, the general public needs an obvious meaning, ideally with no learning required. However, despite these statements, icons systems are not always being measured about their

System Name	Year	Context of application	Source	Open source	Promoted by
AIGA/DOT	1979	Public information	aiga.org	✓	AIGA
Health and Safety	1996	Safety signs /Health	hse.gov.uk	✓	UK Gov
ISO 7001:2003	2003	Safety signs / work	iso.org	x	ISO
ISO 7010:2011	2011	Public information		x	ISO
ANSIz545.3	2011	Safety signs / work	ansi.org	x	ANSI
ANSI - INCITS 415	2006	Safety signs / work		x	ANSI + INCITS
UN / OCHA	2012	Humanitarian Information	Reliefweb.net	✓	UN OCHA
Hablamos Juntos	2010	Emergency / Health	segd.org	✓	SEGD
ADA	2009	Public information	graphicartistsguild.org	✓	GAG
IIID Safety	2004	Safety signs / work	?	?	IIID (?)
SERNATUR	2012	Public information / Tourism	sernatur.cl	?	Sernatur, Chile (?)
First Aid	2015	Humanitarian Information	buerobauer.com	✓	Other
Guemil	2016	Risk & Emergency	guemil.info	✓	Other

TABLE 1

An –in-progress– compilation of icon systems for public information, safety, and emergency

performance or effectiveness on communication. As Wogalter et al. (1999) explain, this can be critical in contexts such as safety and emergency. To illustrate, Table 1 shows different icons systems available worldwide.

Contextualizing risk and emergency

Due to human nature and global reach, risk and emergency management emerge as one of the most significant challenges for development (WEF, 2017). Aiming to complete emergency as a context, some concepts from the UNISDR 2015 document 'Sendai Framework for Disaster Risk Reduction 2015 – 2030' –commonly known as 'The Sendai Framework'– are presented here. The idea of a framework is oriented to consider the 'organization and management of resources and responsibilities for addressing […] in particular preparedness, response and initial recovery steps'. Additionally, the Sendai Framework states definitions such as risk management or the need for communication, delivering relevant terminology for discussion. A potential role of information is part of every definition:

- Risk, defined as 'the combination of the probability of an event and its negative consequences.' Here information can be applied to identify, or used to facilitate learning about risk scenarios, and prioritize its reduction.
- Hazard, defined in the Hyogo Framework for Action (2005–2015) as a 'potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.' Information here should help to identify and learn from identified hazards, facilitating preparation and eventual reaction.
- Emergency, a disruptive situation that affects both individuals and/or a whole community. Here information is a key to aware, to prepare, to react and to recover, among other stages.
- Disaster, defined as a 'serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.' Here also, information is relevant because such disruptive scenarios usually imply limited access to information, confusion, and lack of understanding, probably one of the most challenging contexts for safety or recovery.

In parallel, the discipline known as Emergency Management involves 'all plans and arrangements to engage and guide multiple actors in their efforts coordinating responses to emergency needs.' (UNISDR, 2015). They state that effective information 'can avoid the escalation of an event into a disaster.' Also, it is important to note that from a human-centered focus, this concept usually involves humanitarian crises.

In everyday life, visual tools can also play a fundamental role in experiencing an emergency. As Harries (2008) states 'there is a growing realization that people's understandings of hazards are the result of a process of social construction and not simply of perception and information.' As a lingua franca of the information age, icon systems should be able to present and evoke precise meanings. As Kremer (2016) remarks, providing 'unambiguous iconography can make a difference in communication for disaster.' Oriented to perform indeed in critical situations, previously users need to learn information.

Therefore, presenting critical information through visual tools can help to understand risk and disaster scenarios, from identification and preparation –Before–, to reaction –During– towards active recovery –After– (Ramírez, 2017). Merging this with a user–experience approach, this framework constitutes another focus to deal with emergency centered on human needs. Starting from identifying hazards or understanding vulnerability, to action and reaction in a disruptive situation, towards a relief, assembly or procedures for recovery, in a continuum that resembles experience and it can be learned by users, articulating needs and actions by information.

Icons for emergency

Different types of graphics are recognizable resources of information for multiple contexts. In the unexpected and potentially dangerous scenario of emergency these are commonly deployed in applications such as signage or on multi-platforms, usually articulated by text (typography), images (icons)

Prohibition Warning Mandatory Emergency escape

FIGURE 2

Free Safety Sign examples combining icons + colour + shapes, according to Safety signs and signals, HSE-UK (2015), see www.hse.gov.uk

and color (codes). Its correct application can provide meaning and certainty to facilitate decisions. The effectiveness for critical contexts such as warning messages and the use of clear signs are discussed in Wogalter et al. (1999), Zender & Mejía (2013) and Frommberger & Waidyanatha, (2017).

Beyond the widely recognized public symbols evidenced in everyday use, there are others explicitly oriented to safety or emergency. International organizations such as ISO (7010:2011), define a safety sign as graphic support, that delivers a general safety message, obtained by a combination of a color and geometric shape and which, by the addition of a graphical symbol, evokes a particular safety message'. These are conditions that require action and visual information can constitute a difference, as Figure 2 exemplifies. ISO norm such as 7010:2011 prescribes safety signs oriented to industrial safety in a general context, for accident prevention, fire protection, health hazard information and emergency evacuation.

ISO (2011) states that 'There is a need to standardize a system of giving safety information that relies as little as possible on the use of words to achieve understanding.' Marom–Tock & Goldschmidt (2011) remarked about the need for visual symbols in signs, especially where 'text cannot be trusted as a communication channel […]'. As occur with everyday use of visual information on multiple devices (i.e., interfaces, signage or instructions), it is essential to consider the context as an experiential framework. A systematic application of such images would become progressively familiar in its recognition, but also ideally in comprehension and use.

A recognizable representation can make a difference in critical contexts, and this constant and implicit learning by visual tools can have a global projection. However, beyond their form proposal –usually assumed as universal– can graphic elements such as icons be tested from the interpretations that people construct? Can this visual language be pre-learned to perform better during or after an emergency?

2. Four open–access cases

Icons can be ubiquitous elements constituting a tool to enhance communication in critical contexts such as an emergency. Four cases are briefly described here to examine different applications. The focus is defined under two main variables: (1) A broad context of emergency (i.e., health, humanitarian crises, disaster) and (2) their open–access. References are showed in Table 2.

TABLE 2

Icon cases oriented to Emergency as international open-access references

Case	Application	Access
1 Hablemos Juntos, 2010	Humanitarian access to information in clinical context	Free (downloadable)
2 UN OCHA icons, 2012	Humanitarian crises, risk and emergency	Free (downloadable)
3 First Aid, 2015	Humanitarian crises, displaced population	By request
4 Guemil Project, 2016	Risk and Emergency	Free (downloadable)

1 Hablamos Juntos (2010)

FIGURE 3

Examples from Hablamos Juntos Icons

Hablamos Juntos (Spanish for 'We speak together') is a US-based project funded by the Robert Wood Johnson Foundation, administered by the UCSF School of Medicine, and promoted today to be adopted by different organizations. This symbol system was launched to contribute to reduce language barriers and improve the quality of health care for people in an eventual clinical emergency. Oriented to humanitarian focus on clinical situations in a context of migrants living in the US –non-familiarized with English as the first language, also known as Limited English Proficiency (LEP).

'Hablamos Juntos' is a remarkable case of a system combining aesthetic and practical issues, in an icon set developed by a collaborative approach. The symbols are the result of a process involving both design and testing, from different stakeholders who endorse the outcome. Among these organizations, the Society of Environmental Graphic Designers (SEGD) has published further documentation, such as 'Developing a Symbols-Based Wayfinding System: Implementation Guidebook.' Today, the project and their extensive testing program can be fully accessed at the SEGD website, see Note 1.

With extensive documentation such as the 'Symbol Design Research Report' (2009), it is possible to observe how the icons are not only proposed, but also tested and then promoted for adoption by health organizations. The collaborative process in this project shows how the final set of 50 symbols was not only constructed but also validated by evidence. Briefly explained, this involved first a research and design task inside 4 Design Schools. Secondly, a testing and evaluation stage, and finally a refinement conducted by professional consultants. Figure 3 illustrates the outcome.

Note 1, icons and documentation are accessible at: https://segd.org/hablamos-juntos-0

2 UN OCHA Icons (2012)

FIGURE 4

Examples from the UN OCHA Icons

The Humanitarian and Country Icons is a symbol initiative to present emergency and crisis-related mainly for humanitarian information, originated in 2012 by the United Nations (UN) Office for the Coordination of Humanitarian Affairs (OCHA). This collection includes a massive set with near 500 icons covering different aspects of humanitarian representations such as food, shelter, or medical assistance. It is oriented to relief workers and has been optimized and hosted for use mainly on maps. These are available in a pixel format (.png), applicable on screen-based and digital platforms, in open and well–known platforms such as Google Maps.

Original icons provided can be accessed at their website, see note 2. Here they state: 'Anyone making maps for disaster response or other humanitarian purposes is encouraged to use these icons for their digital maps and is welcome to link to them directly on this server.' Therefore, this is an effort to visually embrace everything originated by collaboration that includes website platforms such as The Noun Project. Some icons are shown in Figure 4.

UN OCHA icons constitute an interesting humanitarian initiative from a global–scope organization, with a massive outcome set. However, despite being a collaborative initiative, some professional icon design principles (i.e., visual consistency and recognition in small sizes) appear to have been neglected and could limit its application as an effective tool for communication. In this case, a testing process is not known to have conducted.

3 First Aid, Icon Based Communication Kit (2015)

FIGURE 5

Example of First Aid Icons and kit samples

The First Aid Kit is originated in Austria, and it is oriented to refugees moving from West Asia to Central and North Europe, representing a context of

Note 2, icons are accessible at http://reliefweb.int/map/world/world-humanitarian-and-country-icons-2012

different cultures and their future communication needs with an emphasis on ethnic differences, packed in a visual outcome. More than being solely an icon set for an emergency such as forced displacement, First Aid is a set of visual tools to display multiple information using normalized components such as A4 format, designed to facilitate its B/W printing and distribution in various supports such as instructional material, boards, maps or implementation in further developments such as campaigns.

Collaborating with different organizations such as the Red Cross, First Aid is an open source information case, available on their website as a kit oriented to action, see note 3. Moreover, following the apparent clarity of graphic style and simplicity of its implementation, this initiative is continuously incorporating improvements after feedback provided by users and organizations. The current kit is 2.0, expanded to facilitate health interaction. The team states that they are open to help and advice 'considering comprehensibility and diversification' and hereafter they are constantly 'evaluating, improving and expanding' the icons and applications after suggestions, to produce visual tools to assist in a current humanitarian crisis, such as the displaced population. However, the project does not disclose any formal testing procedure to examine. Figure 5 illustrates examples from the kit.

4. Guemil icons for emergency (2016)

FIGURE 6

Example of icons from Guemil Project

This is an initiative of icons to represent risk and emergency contexts associated mainly to natural disasters. It is conducted as a design + research project by the author of this article. Guemil makes available an icon set to represent information in a stage–based concept: Before, During and After an emergency, constituting a resource for the deployment of graphic information for critical contexts. A key visual characteristic of Guemil icons is its simplicity and boldness.

As a collaborative project in development, icons are packed into an open source typeface. This can be installed as a multiple format font for computers, web servers or mobile apps. A pre-release version is available, its accessibility in a web platform and adaptability of such symbols make them easy to use for diverse contexts: Guemil icons can be implemented in multicultural communication using physical–analogic and/or digital supports. In parallel to design, the project includes a testing process to collect informa-

Note 3, icons are accessible at http://buerobauer.com/first-aid-download/en.php

Note 4, icons are accessible at www.guemil.info

tion about the performance of icons, specifically in Meaning and Differences. This is detailed in the next section.

Discussion from cases

For the human experience, an emergency can represent a complex context with massive needs of information. Here, concrete visual elements such as icons are usually presented to optimize communication. However, as the team from Hablamos Juntos (2009) project states 'Symbols are not the panacea for a poor signage system, nor will they solve wayfinding issues. But they can be part of a viable and dynamic system that can assist all people, regardless of their reading skill level, to feel more comfortable and confident […]'.

Platforms such as those on the web can facilitate their accessibility and public sharing. Thus, downloading and adopting open-access icons systems contribute to expanding their application as a normalized instrument to recognize, prepare or react in a disruptive situation. This can facilitate information demands from individual users, organizations or even communities, promoting its eventual adoption as a graphic language to commonly refer to emergency contexts.

However, such direct accessibility would also require to provide evidence about performance. As Frascara (2011) states, a pictogram development project involves a cycle with Interviews + meetings + tests, with a considerable amount of time spent on consultation, and refining its visual design. Being open source initiatives, it seems to be important to make available ways to validate if this graphic language is effective for the intended purpose. In some of the cases presented, graphic principles such as visual style, consistency, or small-scale reproduction raise questions about their feasibility as tools for communication. It these are designed for critical contexts such as risk or humanitarian crises, a responsibility to provide evidence of effectiveness emerges.

If icons are designed to present information to be visible and understandable in a critical context, ideally this requires collecting the most of data about their functioning. Therefore, asking what they can interpret is fundamental to observe what is objectively comprehended, and what could be misinterpreted. As noted, although they claim to be collaborative not all initiatives presented have been confronted with feedback, and beyond an originators' statement, this appears to be a key part of the process. In parallel, other challenges appear here, related to processing information in a real scenario of emergency and opportunities related to creative commons practice. Analyzing such topics need a more direct discussion and exceed the focus of the research presented.

All in all, as it occurs with Design methods iteration can be made by testing in different scales or contexts being used to improve tools for communication in an emergency. This constitutes an opportunity to explore if the so-called 'universal' visual language can facilitate recognition. Even more, systematically applied this iterative process can be an efficient approach to integrate the risk cycle with the user experience (before–during–after an emergency). Thus, beyond statements on style, concepts and form, can be considered 'Meaning' from users as a critical response for effectiveness using icons to represent emergency? Such a hypothetical idea is developed in the next section.

3. Testing Icons:

What is considered

Icons are visual resources to deliver information on multiple scenarios and even in disruptive contexts, being appropriate for multicultural communication and across supports. However, as Foster (2001) states 'Verbal description is not equal to graphical implementation (and then to comprehension)'. A graphic style proposal might suggest multiple interpretations from users, becoming necessary to collect functional evidence: This is specifically what is the icon depicting. In specific, what does an icon represent?

After the design process, an aim from the testing procedure is to collect what a specific icon does mean to a specific user inside the topic of emergency. Then from results, it should be possible to evaluate and/or compare different options. Here is provided general background on icons testing and then a specific development from the case of Guemil.

In order to test the so-called 'Public Symbols', different testing procedures have been developed, pursuing a common aim to collect responses from the public, asking them to provide an open answer or choose among options (Brugger, 1999; Olygay, 2003; Frascara, 2011; Boersema & Adams, 2017). Concepts usually mentioned in international standardized protocols (ISO 9186:2011, ISO 9186-1:2014, ANSI z535) are Appropriateness, referring to recognition, and specifically Comprehension (Hablamos Juntos, 2009), as a merging concept on understandability.

For an emergency application, asking users what they suppose each icon represents is probably one of the most simple but important actions to define if this is effective or not. Then, evaluation scales and grades weighs are developed to quantify the effectiveness of each icon. Two main topics asked for evaluation are (1) Meaning and (2) Differences:

(1) **Meaning**: Interpreting a defined image (significance): what does an icon represent (depict),

(2) **Differences**: Recognizing particular elements from the icon, or among its components to distinguish characteristics.

International standards usually define a rate of 67% minimal comprehension to define an acceptance index on when an icon is effective or not (i.e., AIGA/DOT). Even more, in safety, emergency or risk related fields a rate of 83 to 85% is required to accept every icon (i.e., ISO, ANSI).

About the number of answers, some testing procedures recommend a relatively low number of responses (ANSI: 50 responses). Others such as Hablamos Juntos (2009) mentions 231 respondents from their comprehensibility survey, distributed in three US locations. Finally, ISO supports extensive testing, ideally covering at least five countries, with 400 responses each, in a total coverage of 2000 participants. In this scale, some additional material is also required (i.e., approved references, context symbols).

Additionally, some testing protocols define to provide a concept or name to recognize meaning, or just ask for open answers (Frascara, 2011). This is defined in procedures such as Comprehensibility Judgment Test (also known as 'Judgment test'), where users are shown the variants for a particular referent (meaning given). (2) Comprehension test, where users are asked to interpret a specific icon (depiction), sometimes with clues or alternatives to their meaning and/or context of application, sometimes without any information.

For the analysis of data, it can be important to consider how testing groups are segmented: Age range, Location, Education or any specific group for relevance. For example, with coverage inside the US, Hablamos Juntos (2009), established four language groups: English, Spanish, any Asian language, and other Indo-European languages. In the case of Guemil with an international coverage intended, tests are provided in English and Spanish, then users can define their segmentation marking age-range, location and even their familiarity with an emergency.

Tests can present variations, being adapted to different requirements. However, a primary objective in testing is to determine how effectively icons communicate an intended meaning. Basically, this can be collected from open answers to choosing options from a given meaning. Then, identify or analyze differences from responses or chosen options. In the case of Guemil that is detailed in next section, more than following a provided systematic methodology, the process has been an adaptive process with different practices, mainly learning by doing.

Study case: Testing 'Meaning' on Guemil icons

Methods for testing icons mainly involve measures of their Comprehension. Therefore, dimensions such as Meaning and Differences can be considered as key variables to establish a functional performance index. This is the case of the process followed to measure Guemil, where icons are being tested in a global scope.

Methodology guidelines applied are explained here according to considerations presented, and this is considered as a task to validate the effectiveness of the project. However, the purpose of testing icons was not to develop a methodology but to provide a feasible means of design by adopting diverse international practices available.

As mentioned, Guemil tests results shown here are centered on 'Meaning' as a specific variable. Thus, a first objective was to collect 200 answers per icon. An iterative method involving prototypes and evaluation was applied for the forms, designed to present icons and get open answers. For the procedure three main tasks were included:

(1) Define the Test: Five forms with questions were packed in interactive PDF (English and Spanish), considering a response timing of 10 min per form. The number of icons included in the test was 72 (for comparison ISO 7001: 78 symbols). These were randomly distributed in five forms. In a typical test page, this displayed three icons with the question: What does mean each icon? Every answer corresponds to an open interpretation from a specific user, considering even an empty or no response (*see figure 7*).

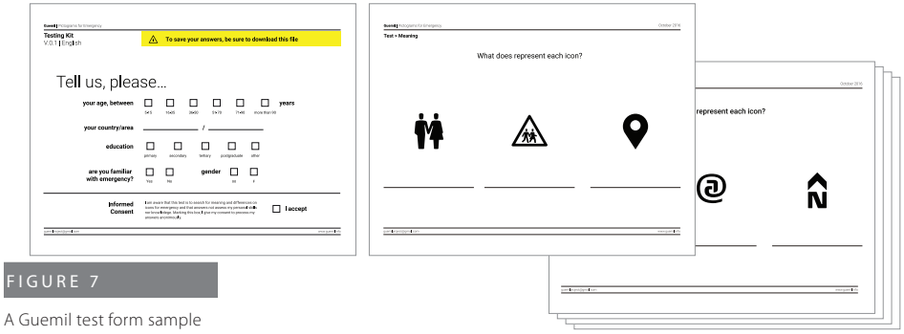


FIGURE 7

A Guemil test form sample

(2) Collection and weigh of responses: Open answers are collected into a database and marked using a 6–grades scale, adapted from work developed for public symbols such as ISO and IIID, and published by Brugger (1999), Olygay (2003) and Frascara (2011). All responses have been collected and processed anonymously (*see Table 3*).

TABLE 3

Answer categories for the evaluation of the comprehension test; based on Brugger (1999), Olygay (2003) and Frascara (2011)

1 **Correct**	2 **Almost correct**	3 **Doubtful**	4 **Incorrect**	5 **Opposite meaning**	6 **No answer**
Correct understanding of the icon is certain	Correct understanding of the icon is likely	Correct understanding of the icon is marginally likely	The response is wrong to the intended meaning	Meaning is opposite as is intended	Any answer is given

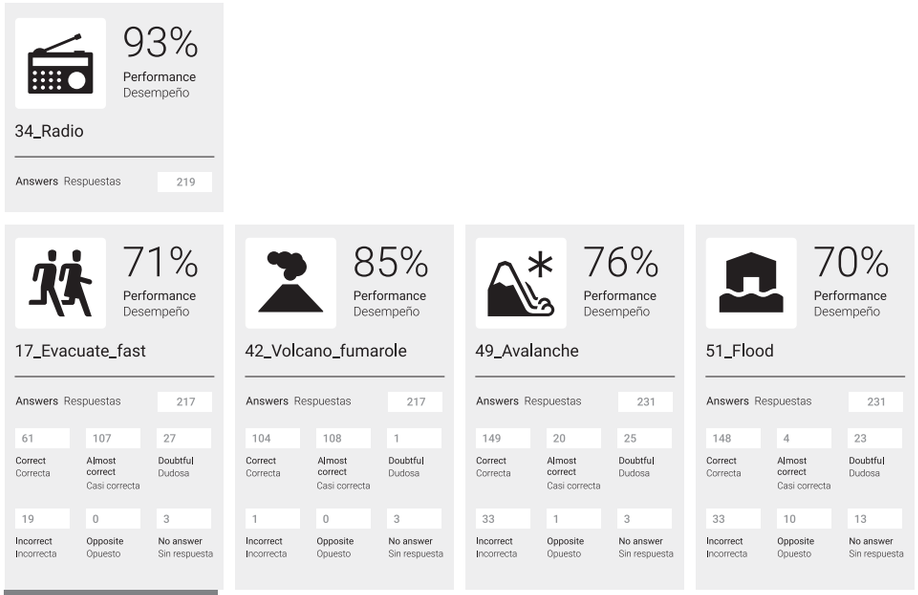


FIGURE 8

An example of visualization from Guemil tests web platform, with their performance index after testing.

(3) Establish performance: A quantitative index is calculated from weighed responses, to present the performance for each icon by percentage (+83%: Accepted). Taken from international practice for emergency or safety context, it has been adopted than up to 5% in 'Opposite meaning' (5) answers requires one to discard the icon from the system. Examples of this index are shown in Figure 8.

Additionally, other questions with multiple choice answers were included to test differences (i.e., options from given alternatives), associative meanings (i.e., colors), or performance (i.e., these icons can be applied…), to collect further information from visual language used for emergency. Although 'Differences' is the second important variable in tests, this is not presented here. Informed consent is presented on the first page noticing responders about the purpose of tests, informing them that is not a test about their skills or knowledge. In the last page or each form, users had the option to include a short comment or reflection.

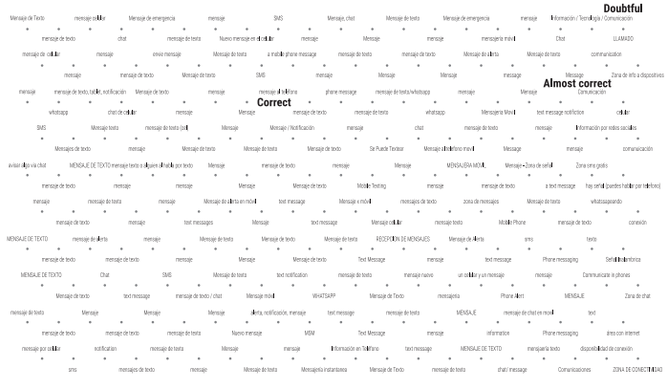
Considering the international scope intended and as a pattern in construction, tests responses reveal a bias in age range: mainly 19–35 years, and from geographical location: Mainly Chile, Colombia and other South American countries. Then the West coast of the US, mainly from California. In Europe, answers come mainly from the UK. In Asia, from Hong Kong and Mainland China. This is explainable because these are specific locations where participants were asked to participate.

95%

200 Responses Map > **Mobile Message**

FIGURE 9

Optimal Performance

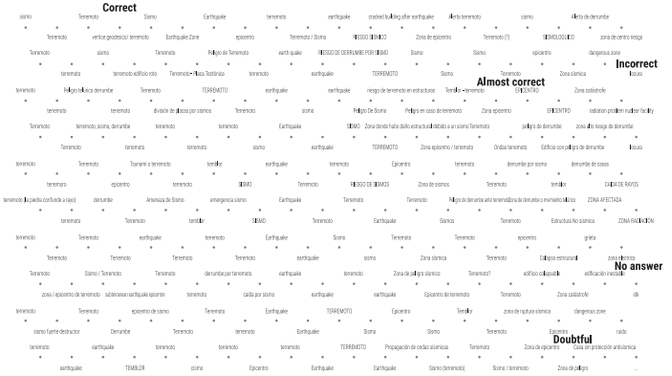


86%

200 Responses Map > **Earthquake**

FIGURE 10

Accepted Performance



Visualizing Meaning performance

Specific results from Meaning part in Guemil tests are presented here in figures 9 to 13. For all cases, the question was: What does represent each icon? Responses correspond to Open Answers. In a wide spectrum to see and compare, a diagram allows to map 200 responses according to evaluation scale (*see Table 3*). These have been arranged from optimal to poor performance.

Figure 9 Mobile message [96%]:

This a case of an icon presenting a direct interpretation, with precise recognition. It can be observed that is a combination of an analogical image (more descriptive than symbolic), with a relatively familiar action (usually

seen in everyday communication media). No single response was considered as Incorrect because all are close to depiction (Mobile + Messaging + sms). Of 72 icons tested, 15 can be included in this group (over 90%).

Figure 10 Earthquake [86%]:

A precise meaning provided, in this case with a more symbolic representation. It is interesting to observe that is possible to recognize a consistent pattern of answers using different words ('Terremoto,''Sismo' or 'Temblor' are Spanish for 'Earthquake'). Of 72 icons tested, 20 can be included in this group (between 83% and 89%).

Consistent with statements made by Hablamos Juntos (2009) in their analysis after testing, most of icons that are in categories such as iconic or narrative are observed to perform better (83 to 96%), supporting their observation about form simplicity and boldness.

Figure 11 Authority Instruction [78%]:

In this case it is possible to observe that most of the responses fall into 'almost correct' category. This means that many responses are describing the literal icon and pointing to 'Police Officer' ('Policía' or 'Carabinero' in Spanish) although not delivering a precise description or emphasis in the action of 'Instruction.' Linking this with analysis from Hablamos Juntos (2009) although the icon part is recognized (Police), what appears to lack is the narrative component. Also, this could be explained because there was no context when the tests were conducted. Of 72 icons tested, 25 can be included in this group (between 66% and 82%).

Figure 12 Network [43%]:

This is case where abstraction (a representation relying on a symbol), can create different interpretations from users. Although some responses can be related with the intended depiction ('Break of Connection' or 'Support network') suggesting almost correct meanings, some others are revealing a confusing ambiguity: 'Electrical circuit''Connectivity''Broken route.' Providing more visual clues and detail eventually with elements that link clearly to objects, people or context could help to improve recognition. This icon is considered to be reviewed, focusing on a more explicit action (loss of connection) than a generic concept (network). Of 72 icons tested, 11 can be included in this group after tests (between 20% and 65%).

Figure 13 Girl [7%]:

The specific case of this icon evidences a complete failure of meaning. However, it also offers a great lesson about precision for visual communication. It is a case about how wrong emphasis in representation (hair bun + dress intended) can create disparate interpretations, making it difficult even to identify a pattern in responses (probably most repeated is 'Elder,' that actually can be considered as Opposite meaning). Another reflection from this case –and others related with human depictions is about the number of icons necessary to precisely represent actions (it can be observed for example that a 'couple walking' representation creates interpretative emphasis on couple behavior more than evacuation). Of 72 icons tested, just this icon can be included in this group (below 20%).

All 72 icons responses on Meaning can be visualized in detail in the project website: www.test.guemil.info.

FIGURE 11

Below Acceptance

200 Responses Map > **Authority Instruction**

78%

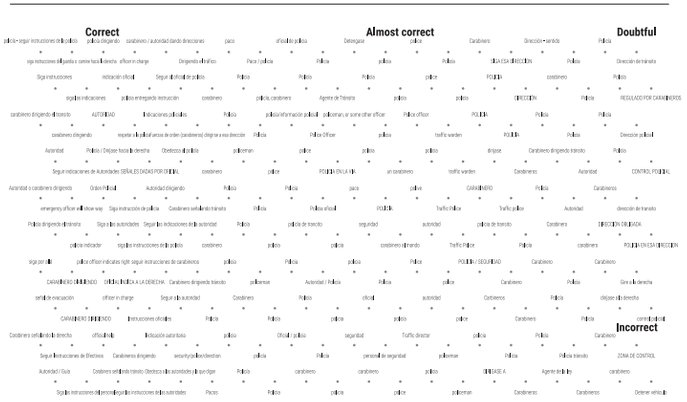


FIGURE 12

Below Acceptance

200 Responses Map > **Network**

43%

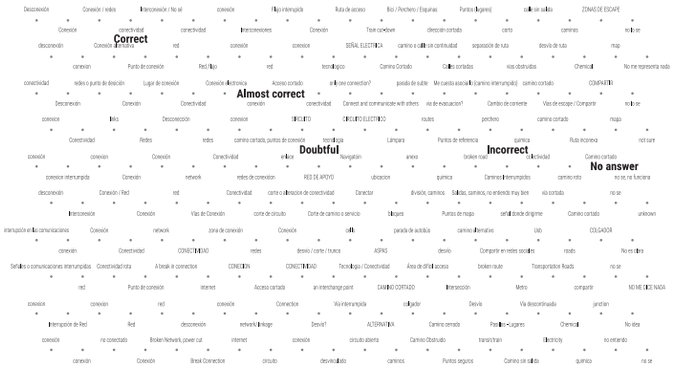
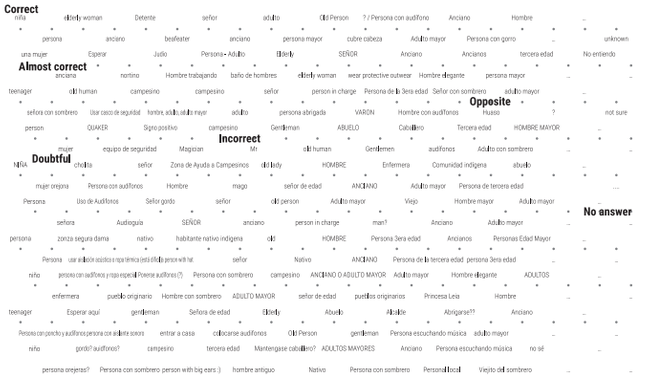


FIGURE 13

Poor Performance

200 Responses Map > **Girl**

7%



Next steps

The dataset collected should allow constructing different analyses. Although the task of collecting 200 answers per icon is finished (2017), further actions for the project suggests a continuous process to improve performance. Three steps are here suggested for further development and as open possibilities to collaborate.

1. Conduct further local testing: This could be linked to data collected such as geographical locations, age range or education level, allowing specific comparisons or evidencing patterns. Local research contributes to observe particular depictions or cultural interpretation, or what is already learned as meaning from media. This point is stressed after insights obtained by Frommberger & Waidyanatha (2017) working with linguistically challenged communities in Asia.
2. A research challenge that emerges is understand meaning problems on misinterpretation crossed with language aspects (verbal–visual) or familiarity with specific scenarios.
3. For next iterations, it is considered to construct additional ways to visualize performance in visual language for emergency, testing other variables: Associations (e.g., Color), Differences or Performance tasks (e.g., Decisions).

Other questions about the real experience of emergency or the effective role of graphic tools are open to further research. The following section will conclude with reflections to promote open-access, performance and collaboration.

4. Conclusion

Emergency is a complex human experience with global implications. Visualizing and understanding emergency appears as a challenging field for communication design. Being a context with significant needs, different initiatives to optimize information are available. To develop effective messages seems to be necessary to combine both User Experience and Risk Management approaches. It is recommendable to integrate risk, safety, and emergency from a user experience scope, promoting collaborative practices. An open–access approach is a contribution to share meanings.

From a design perspective, visual tools such as icons are ubiquitous units of information, efficient to manage and flexible to implement on different supports. Icons are simple resources for public adoption and contribute to optimizing messages. These can enhance learning and decisively impact in all stages of risk cycle: covering from vulnerability identification and preparedness Before, to action and reaction During, towards recovery and resilience After, in a continuum covering different aspects of experience. However, beyond a formal statement assuming that an icon system would be universal just because their visual style, it is important to provide functional evidence.

From a research perspective, testing is necessary to validate design and transcend to a dimension of understandable and usable communication. It is necessary to observe how the recognition and interpretation of graphic tools complete communication. Reliable information presenting performance indicators and based on creative commons practice could help to reveal comprehension problems to tackle and focus on meanings. Tracking interpretation by people, the Guemil project is a platform for constructing visual knowledge on emergency, demonstrating how if the design outcome assesses meaningful factors, it reveals performance. The experience is useful to provide direct insights by people and preview patterns.

The case is also an invitation to collaborate, exploring other needs. If the community can adopt open initiatives, is more feasible to build a common language for the cycle of risk, aiming to preparedness, reaction or resilience supported by consistent information. Therefore, such initiatives are just a starting point. Hopefully, these can articulate the design of information for optimal, ideally safe decisions. Communication based on icons is a contribution, but also an opportunity to understand constraints and problems emerging on emergency scenarios. Thus, a definitive conclusion cannot be established here, because it will continue transforming.

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Awards

Guemil Project has been awarded as 'Shortlist' in IIIDawards 2017, in Emergency Category (iiidaward.net).

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Hablamos Juntos Symbols. https://segd.org/hablamos-juntos-0

UN OCHA Icons. http://reliefweb.int/report/world/world-humanitarian-and-country-icons-2012

http://mw1.google.com/crisisresponse/icons/un-ocha/index.html

UN OCHA Icons are also available via Google http://mw1.google.com/crisisresponse/icons/un-ocha/index.html

First Aid Kit. http://buerobauer.com/projekte/first-aid-kit/

Guemil icons for emergency. http://www.guemil.info/

ISO symbols. http://www.graphical-symbols.info/

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