INFORMATION DESIGN FOR THE EXPERIENCE OF EMERGENCY: TESTING GUEMIL ICONS AS A CASE

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In a critical human experience such as emergency, having clear and opportune information is a key for reduce uncertainty. A well-designed information should enhance preparedness, may contribute to decision making and support resilience. Specifically, icons are ubiquitous graphic tools for the representation of multiple scenarios or actions. This paper focuses on design and testing of icons as a language for emergency.

1. Introduction

Human experience is a focus of design, transferrable to scenarios such as risk communication. An emergency experience radically affects the interaction with information, transforming this in a structural support for action in critical contexts. Information Design is defined as a combination of art and science to present information to be used efficiently and effectively by humans (Horn, 1999). An optimal designed information allows people to see, understand messages and it facilitates decisions. In everyday, standardized symbols –or icons, constitute a typical solution, as they simplify contents allowing to deal with access barriers.

Commonly called symbols, pictograms or icons, these are normalized images designed to display concrete meanings (Abdullah and Hubner, 2006; Jardí, 2011). In everyday life, icons are a codified language integrated with communication systems displaying consistent information on multiple supports. However, can this principle be applied to an emergency scenario? From a perspective of information design, this proposal presents definitions crossing user experience and cycle of risk. In this intersection, icons constitute a visual tool oriented to support critical scenarios by information. In specific context of emergency, different initiatives are being developed, considering context (i.e. a crisis) or specific actions (i.e. evacuate). Such critical context suggests that icons need to be verified in their effectiveness, and

different tests have been developed. As literature review shows (Brugger, 1999, Frascara, 2001 ISO, 2007), a fundamental indicator to assess icons performance is comprehension. As a case study, testing process conducted in the Guemil project is explained. 'Meaning' has been considered as a variable to measure performance and test results reveal challenging insights to discuss. Reflections are oriented to emphasize the importance of consistent visual language for disruptive future scenarios, and the application of performance instruments to define effectiveness on multi-cultural communication, from local to global scale.

1.1. Information Design

Information design is a multi-disciplinary practice oriented to develop information visible, understandable and usable for people, combining both art and science (Horn, 1999; idX, 2007). This discipline contributes to articulate information needs, optimize communication, and measure performance of messages using multiple instruments such as perceptual or cognitive (Frascara, 2011).

Information design draws on resources such as typography, images or infographics, as a way to visualize, understand and perform information in everyday life, systematically operating in different supports. Based on the framework presented in Allard, Briones, et al (2014), a fundamental cycle in Information Design is See > Understand > Apply contents, as figure [1] shows:

See

Design to make
visible

Understand

Design to make
comprehensible

Apply

Design to take
action / decisions

Fig [1] See > Understand > Apply information cycle.

Among the multiple elements that articulate graphic information for universal interpretation, icons are commonly used elements constituting a *lingua franca* for everyday communication (Boersema & Adams, 2017). For emergency context some definitions (UNISDR, 2015, 2017) and initiatives have been developed (UNOCHA, 2012, Ramírez, 2016), contributing to define a 'language for emergency'.

Centered in specific aspects of the discipline known as Disaster Risk Management (DRM), this paper establishes a relationship with user experience and specifically their need of information in different moments of an emergency. As an international example of design for emergency, it introduces to the project called Guemil icons for emergency (www.guemil.info). This is an initiative oriented to conceptually represent the cycle Before > During > After an Emergency. The set of icons is applicable to the whole cycle of DRM.

Oriented to know about effectiveness of such a language supposedly universal, a key aim is to collect user's interpretation from their visual design. To measure its performance, systematic tests were developed and applied internationally. From evidence, specific aspects are reviewed, analyzing cases that exhibits their performance. This step contributes to establish notions about comprehension of information in emergency. It concludes reflecting about future opportunities, focused on preparedness and learning.

1.2. Disaster Risk Management and User Experience

The disaster risk is a potential loss or total - partial destruction of life or resources that can happen to a system, society or community in a specific period of time (UNISDR, 2015). This can be determined by the combination of factors associated to 1) Hazard; 2) Exposition; 3) Vulnerability.

This is a continuous process defined by UNISDR (2017) as a plan that defines “goals, specific objectives and actions in order to reduce disaster risk”. It considers activities for coordination, resources and development, promoted by the document known as “The Sendai Framework, 2015-2030”. This planned management it contributes to that communities can recognize their hazards vulnerability and face eventual disasters with a focus in preparedness. In this sequential process, two parts are fundamental: (1) Preparedness, previous to an emergency or disaster situation, and (2) Recovery, after the disaster disruption. Also, it recognizes that recovery is developing continuously in the cycle of risk.

The model known as the 'Disaster Risk Management Cycle' (DRMC), as the developed by TorqAid (2016) it presents this process as a time sequence of events: Before, during and after an emergency as figure [2] shows.

The Disaster Risk Management Cycle, DRMC

Fig [2] The DRMC cycle. Adapted from TorqAid (2016).

1.3. Contextualizing risk and emergency

Due to human nature and its global reach, risk and emergency management emerge as one of the “largest challenges for development” (WEF, 2017). Aiming to complete risk (hazards) and emergency (disaster) as a context, some concepts from the UNISDR 2015 document “Sendai Framework for Disaster Risk Reduction 2015 – 2030” are presented.

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, such instrument states definitions such as risk management or the need for communication, delivering relevant terminology for discussion. A potential role of information is part of their definitions:

- **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 known 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, DRM 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, communication 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. Oriented to perform indeed in critical situations, previously users need to learn what is intended to communicate.

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.

1.4. Emergency as a scenario for design

The International Standards Organization, ISO (2009) defines User Experience as “a person's perceptions and responses that result from the use or anticipated use of a product, system or service”. They add these involve emotions, beliefs, preferences, perceptions, physical and psychological responses, their behaviors and results that might occur before, during and after. In parallel, a first requirement for an exemplary experience, is to know “exactly the needs from users” (Nielsen & Norman, 2017). Individuals are usually labelled as 'users' at the moment of using a product or service. Thus, terms are extended as “user studies” or “usability”.

In parallel, an effective information “can avoid the escalation of an event into a disaster”. (UNISDR, 2015). Additionally, the Sendai Framework states on definitions, delivering relevant terminology to precise further discussion: i.e. Risk, Hazard, Emergency, Disaster. Also, it appears to be relevant to note that this concept usually involves humanitarian crises. Therefore, from a human–centered focus there is an opportunity to think and apply design products and strategies to transform this scenario. Here, the main case is Guemil icons for emergency (www.guemil.info). This is presented, compared and analyzed as a visual tool for emergency contexts. See figure [3].

Fig [3] DRM + UX to Visualize, Understand and Apply information. Source: author.

Before

During

After

Figure [3] Guemil Icons, v10. See guemil.info

1.5. Guemil Icons for Emergency

Guemil is an open source pictogram initiative for risk and emergency situations. The design concept behind such icons is to represent information for different stages of the cycle of risk (before – during – after an emergency). As an open source project, icons are available from a web platform. See figure [4].

Also, Guemil is a design project that combines design and research, integrating in one hand a set of icons that conceptually covers the risk cycle with a strategy to make the set of icons accessible (open source). In the other hand, a research based on a process of testing in order to measure what meaning and which differences people can interpret from icons, as evidence about the role of information for emergency.

1.6. Measuring performance

In communication for disaster, as Kremer (2016) remarks, providing “unambiguous iconography can make a difference [...]”. After visual design stage, the implementation of public symbols is commonly assumed as is. Thus, considering only a visual

language statement from originators seems not be enough: Evidence about performance is fundamental to demonstrate their effectiveness through a combination of perception and reasoning. In other words, visual tools should provide cognitive evidence about what is understood (precise meaning), and what is potentially generating multiple interpretations (or confusion) in emergency contexts.

As a discipline centered in human beings and behaviors, exercises such as empathy, observing human interactions are natural for design. After design, an aim is to collect what a specific icon does mean to a specific user in an emergency context. This is achieved by testing: During 2016-2017 Guemil project conducted an international process asking users from all around the world about their statement of 'Meaning' and 'Differences'. Here, a general background on icons testing and a specific development from the case of Guemil are provided.

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).

Figure [4] Samples from Guemil tests forms (pdf), Meaning section.

Concepts usually mentioned in international standardized protocols (ISO 9186:2011, ISO 9186-1:2014, ANSI z535) are **Appropriateness**, referring to recognition, and specifically **Comprehension** (Brugger 1999; Olygay, 2003; Hablamos Juntos, 2009; Frascara 2011; ISO 2011). Therefore, according to international practice, evidence of performance in icons is defined by a quantitative index and constructed by testing. From results, it should be possible to evaluate and/or compare different options.

International standards usually define a rate of 66% 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).

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 considered in Guemil tests were:

(1) **Meaning:** Interpreting a defined image: what does an icon represent (depiction). Users provide their own interpretation. See figure [4].

(2) **Differences:** From a given concept, users are asked to match this with different and look-alike icons. Responses are then compared.

3. Collecting responses

Transcending from industrial society paradigms for design, today a capacity to combine research + practice, constitute a disciplinary knowledge *corpus*, transferrable to other fields such as science, management, or technology (Cross, 2001), contributing to that is generically denominated as “Human Factors”. In user-centered design processes, a fundamental starting point is to raise information from what people do, live, or aspire to reach their needs, developing then creative and technically feasible products, experiences or combinations. As Norman (2004) states, a human factor such as emotion is central to understand what we as an individual do prefer or refuse. In his words, “those products [or experiences] that are a joy to have [or live]”. On the other hand, a poorly solved design is an avoidable experience; “visceral” approaches that shapes then “reflective” behavior and decisions (Norman, 2004).

Thus, results from Meaning and Differences tests, open discussion on multiple topics as the predominance of local associations or the effectiveness of icons as information tools. It suggests interesting insights to share in an interdisciplinary context, the necessity of presenting evidence, and collaboration opportunities. Guemil experience is being complemented with practical exercises such as hands-on workshop in locations such as USA, Hong Kong and along Chile, sparking discussion about the role of design for learning, familiarization but fundamentally for an informed preparedness based on information.

Defining characteristics from design, Wasson (2000) considers a “successful” product that is adopted [by users]. Therefore, if design connects at an emotional level, it satisfies context needs and optimize available resources. Thus, it has largest possibilities to be naturally incorporated into everyday practices. This can be applied also to the emergency experience: Human emotions are priority spaces where Human-centered Design have to work.

Here, elements such as visual information might constitute a key to reduce uncertainty, facilitating decision making and optimize the experience. Methodologically, tests were designed following international practice (Brugger, 1999, Frascara 2011) to be applied in a global reach. Both Meaning and Differences indicators generate a performance index from users’ interpretation. After collecting answers from tests covering 27 countries and more than 200 answers for each of 72 icons tested, a massive dataset is the base for a series of visualizations to reveal performance.

As mentioned, icons deliver information on multiple scenarios and even in disruptive contexts, being appropriate for multi-cultural communication and across supports. Such public solutions have been recently revised and expanded in places such as Japan (METI, 2017). However, as Foster (2001) states “Verbal description is not equal to graphical implementation (and then to comprehension)”. Graphic styles might suggest multiple interpretations from users, becoming necessary to collect functional evidence: Specifically, what is the icon depicting, and what is interpreted from users. From a dataset obtained, this was prepared for visualizing results and relationships as a study case.

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). (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.

From the data analysis, it is important to consider how testing groups are segmented: Age range, location, education or any specific group for relevance. For example, for 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, the process has been an adaptive process with different practices, mainly learning by doing.

As an information design initiative, Guemil shows how is possible to innovate in an intersection of disaster management cycle and the user experience, developing visual elements of communication for risk and emergency. Asking users in an international, multi-cultural context, testing evidences meaning performance. Such validation allows to deliver indicators of effectiveness, but also reveals further insights connecting to variables such as location, age or language of responses. However, as Harries (2008) suggests, “[...] people’s understandings of hazards are the result of a process of social construction and not simply of perception and information”. Therefore, beyond the visual design problem, analyzing responses collected from evaluations might reveal new relations from users’ interpretations.

After preliminary analysis, results also challenge prevalent notions such as ‘universal’ language traditionally pre-assigned to icons role. However, results and connections are going to be presented and open to discuss from multiple perspectives. See figure [5] with process, and figure [6] with the visualization web platform.

Figure [5] Process after tests: from database to the visualization of results, see test.guemil.info.

4. Discussion: Visual information, performance, experience

Information is a structural support for all stages of DRM. Visual tools such as icons appear as ubiquitous units of information, efficient to manage and flexible to implement on different supports. Also, icons are simple resources for public adoption and contribute to optimizing messages.

Different analyses can be projected from the data collected. Although a first phase collecting 200 answers per icon was completed in 2017, further project activities stimulates a continuous process. It is important to have a visual, common language that represent precise meanings for action, displaying simple and consistent instructional information.

Icons and their testing constitute an applied design + research project with a potential impact in the development of visual tools. the web platform makes available a base resource for information and discussion. However, there is a large room for future improvements, specifically integrating new ways to enhance engagement.

Beyond, a challenge articulating actions for DRM is how to promote efficient actions: As a part of design process, knowing what information is required by communities and prototype preparedness scenarios, can contribute to learning based on what to do –and what not–.

4.1. Next steps

Summarizing the experience so far, four points are remarked for following development and collaboration:

1. More local research: Data collected from specific communities, age range or education level, may allow to observe specific comparisons or patterns. Local interpretations contribute to observe particular depictions or cultural interpretation, or what is already considered as meaning from media.
2. Familiarity: A research challenge that emerges is understand meaning problems on misinterpretation crossed with language aspects (verbal–visual), familiarity with specific scenarios or the lack of actions. See Frommberger & Waidyanatha (2017).
3. Creative common practice: An open–access approach is a contribution to share meanings and facilitating learning by visual tools is a key.
4. Variables to add: Additional topics to explore performance in visual language for emergency and the perception of risk, testing other variables: Associations (e.g., Color) or performance tasks (e.g., Decisions).

Figure [6] Guemil website, with meaning tests performance visualizations, see test.guemil.info

Performance visualizations constitute an open data platform on information design for emergency, see figure [6]. Such indicators allowed to improve the visual language of icons, and a new version was launched on mid-2018 (v10). From this point, future testing versions can integrate platforms and practical challenges for new user needs and perceptions. Furthermore, user testing may contribute to refine interactions adapted to local interpretations or integrate interactive instances, for example working on application supports from inside real scenarios, and transferring information into action observing potential errors. Following section concludes reflecting on such extensions.

5. Conclusion: An opportunity for a common language

Emergency is a complex human experience with global implications. As a context with significant needs, different initiatives to optimize information are available. To develop effective messages seems to be necessary combining both Experience (UX) and Management (DRM) approaches.

Merging this concept with a user-experience approach, an innovative focus to deal with emergency centered on human needs emerges: 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 should be learned by users, articulating needs and actions by information. Moreover, oriented to perform certainly in critical situations, previously users need to visualize and learn what specific information is being depicted.

Visualizing and understanding how to enhance information appear as a challenging field for interaction design. Design can be a connective discipline to observe, understand and work at this intersection. Experience from the project activities suggests integrating risk and emergency from a user experience scope and promoting collaborative practice. Here, visual tools can be considered as a key resource to activate communication and promote action.

Guemil testing presents an ongoing design + research experience. Testing reveals interesting insights, showing how evidence about performance is a necessary step to validate notions pre-assigned to 'universal' tools such as icons. However, questions on the real experience of emergency or the application as information tools are open to further research.

Graphic tools 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 statement assuming that an icon system would be universal just because their visual style, it is important to provide functional evidence. See Ramírez (2018). As a simple solution, icons can help to present understandable graphic depiction. However, more debate on the role of language for emergency, from individual to collective experience (users + communities) is a permanent task in order to construct precise meanings.

Such an international research is an opportunity to identify perceptions and interpretations from emergency, for example revealing what constitutes a familiar representation for local communities. Considering that project is an active process, more results are new possible insights. Reflections are intended to be developed in next versions:

- Other emergency scenarios reveals urgent demands to continue global initiatives for accessible and functional communication tools (i.e., climate change, migrations, adaptive living).
- Reliable information, presenting performance indicators could help to reveal comprehension problems to focus on emergency interpretation.
- Open design initiatives add new dimensions in project-based research. Therefore, promoting these might contribute to their adoption and stimulate global connections, with a bottom-up approach, relying on collaboration. Inter-discipline is fundamental to explore common challenges.
- 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.
- Testing appears to be necessary to validate language and transcend to a dimension of understandable and usable messages. Also, to observe how the recognition and interpretation complete communication, ideally from a real experience of emergency.

Guemil project constitutes a research platform for constructing visual knowledge on emergency, demonstrating how if the design outcome assesses meaningful factors, it reveals performance. As a system, such graphic components can play a fundamental role visualizing opportune information for critical decisions. Hopefully, these can articulate communication design for disruptive scenarios.

However, such research experience provides direct insights by people and preview patterns for emergency. Projected in multi-disciplinary or multi-cultural contexts, insights will continue revealing stimulating next actions. The case is also an open invitation to collaborate.

As an ongoing process, Guemil makes available a concrete graphic tool, applying consistent resources, a “Language for Emergency” for visual information in critical contexts. Research constitutes a starting point, presenting symbols but also optimizing common tools and activating approaches on designing the experience of emergency.

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