

Inputs to optimize risk communication: testing preferences in icons for emergencies

*Contribuições para aperfeiçoar a comunicação de riscos:
teste de preferências em ícones para emergências*

Rodrigo Ramírez

risk management,
information design,
visual communication,
icon systems,
representations of risk

Disaster Risk Management (DRM) introduces a paradigm change from mitigating impacts to preparedness. Communication becomes fundamental for a safe experience. Designing information has a decisive role in optimizing the experience. Following their principles, messages can be optimized for emergencies. Everyday information tools appear to be less effective during and after an emergency. Icons constitute a paradigm of visual communication, however, usually these are not evidenced in their performance. This paper presents the testing process of an open-access icon set for emergencies, specifically the preferences test. 283 responses evidence how participants associate representations with given concepts. Communication based on icons contributes to establishing preferences, constituting a support for the communication of risk. Integrating communication to DRM contributes to an effective articulation of risks. Results are discussed as three insights: (1) Familiarity, (2) Performance, (3) Knowledge for reducing risks. Information design contributes to facilitating such a process.

*gestão de riscos,
design da informação,
comunicação visual,
sistemas de ícones,
representações de risco*

A Gestão de Riscos e Desastres (GRD) introduz uma mudança de paradigma da mitigação dos impactos para a preparação. A comunicação se torna fundamental para uma experiência segura. O design da informação tem um papel decisivo no aperfeiçoamento da experiência. Seguindo seus princípios, as mensagens podem ser aprimoradas para emergências. As ferramentas de informação cotidianas parecem ser menos eficazes durante e após uma emergência. Os ícones constituem um paradigma da comunicação visual, porém, geralmente eles não são evidenciados em seu desempenho. Este artigo apresenta o processo de teste de um conjunto de ícones de acesso aberto para emergências, especificamente o teste de preferências. 283 respostas evidenciam como os participantes associam representações a determinados conceitos. A comunicação baseada em ícones contribui para o estabelecimento de preferências, constituindo um suporte para a comunicação do risco. Integrar a comunicação ao GRD contribui para uma articulação eficaz dos riscos. Os resultados são discutidos como três insights: (1) Familiaridade, (2) Desempenho, (3) Conhecimento para reduzir riscos. O design da informação contribui para facilitar esse processo.

1 Introduction

An emergency can be considered a complex scenario with large demands for information. In the context of large-scale disasters, international organizations such as the United Nations Office for Disaster Risk Reduction (UNDRR, 2015, 2023) state that in a disruptive human experience, a situation can turn into a disaster when the impact surpasses the reactive capacity of individuals or communities. Principles such as Disaster Risk Reduction (DRR) and Disaster Risk Management (DRM) promote a multi-dimensional approach (Twigg, 2015; UNDRR, 2023), defining a cycle with stages – before, during, and after an event. DRM introduces a paradigm shift, from mitigating disaster impacts to articulating anticipatory experiences, a change where communication becomes fundamental.

This paper introduces Disaster Risk Management and information design principles, presents a case study on the design and testing of a set of symbols for emergencies, and discusses their reach so far. Tests consist of asking participants to choose preferences from concepts. Results present findings and insights to discuss approaches for communication, moving from mitigating disaster impacts to transforming the emergency experience through information.

2 Risks: from reaction to management

Organizations such as the World Economic Forum (WEF, 2022) state that risk management has emerged as one of the largest challenges for development. The United Nations Office for Disaster Risk Reduction, UNDRR (2015, 2023), promotes DRM as “the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses.” This is an evolution from an emphasis on reaction, mitigation, and relief, towards a reduction of disaster impacts, managing hazards, and preparedness. As Table 1 resumes, communication constitutes a fundamental instance for DRM definitions; critical definitions are presented.

Instruments such as the Sendai Framework (UNDRR, 2015) prioritize the organization and management of resources and responsibilities addressing particularly “preparedness, response and initial recovery steps.” Additionally, it provides definitions such as the need for communication and presents definitions. DRM resources can facilitate the identification of risks and contribute to learning how to deal with hazards, an opportunity to develop visible, understandable, and usable information.

Table 1 Disaster Risk Management definitions.

Before		During		After
Risk	Hazard	Response	Disaster	Recovery
The combination of the probability of an event and its negative consequences.	A potentially damaging event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.	Actions taken directly before, during or immediately after a disaster to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.	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.	The restoration or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society.

Based on Sendai Framework (UNDRR, 2015, 2023), Aitsi-Selmi et al. (2016), Robertson (2017).

3 Communicating risk: challenges

As Doyle et al. (2022) state, developing a shared understanding of the causes and effects of risk has been claimed as “crucial for individuals to collaboratively manage disaster consequences.” As Bui and Sebastian (2011) suggest, information constitutes a structural support to facilitate interactions in critical contexts such as an emergency. However, as Jaenichen (2011, 2019) states, processing information can be altered in critical conditions. In parallel, an effective understanding of risk in everyday life is an ongoing challenge, and observing contextual variables may require specific considerations (UNDRR, 2015, 2023).

As stated by Twigg (2015) and Robinson (2017), tools for effective communication and advances in information technologies appear to be efficient and have dramatically improved scientific risk information. However, the same tools usually appear to be less effective during a critical scenario. Twigg (2015) suggests that communication for Disaster Risk Reduction (DRR) “should aim to shift the balance of power towards communities by enabling people to investigate, define and explain their own problems.” Robinson (2017) states “People face different risks, access information differently and take action on different issues.” She suggests the importance of social interactions arguing that effective communication is “critical for people to understand the different types of risk they face, discuss what can be done and take action to manage those risks.”

Observations from Aitsi-Selmi et al. (2016) analyzing the role of science in Disaster Risk Management (DRM), pose challenging ideas for the communication of emergencies:

- Once an event has started, human responses become mainly instinctive (i.e., run away), not rational, as communication models suggest.
- Large events such as earthquakes might be focused on preparedness, hazard identification, and mitigation actions.
- Learning is a primary and fundamental action for preparedness. This can be optimized by integrating instructional information (i.e., procedures, do's, don'ts).
- Interaction may involve sharing knowledge; this is an opportunity to foster participatory practice and settle common approaches.

Information embraces a key role in conducting the experience of risk and emergency, for example presenting appropriate messages to identify hazards or integrate preparedness. Figure 1 presents a conceptual diagram as a sequence (before, during, and after an event), connecting the experience with information.

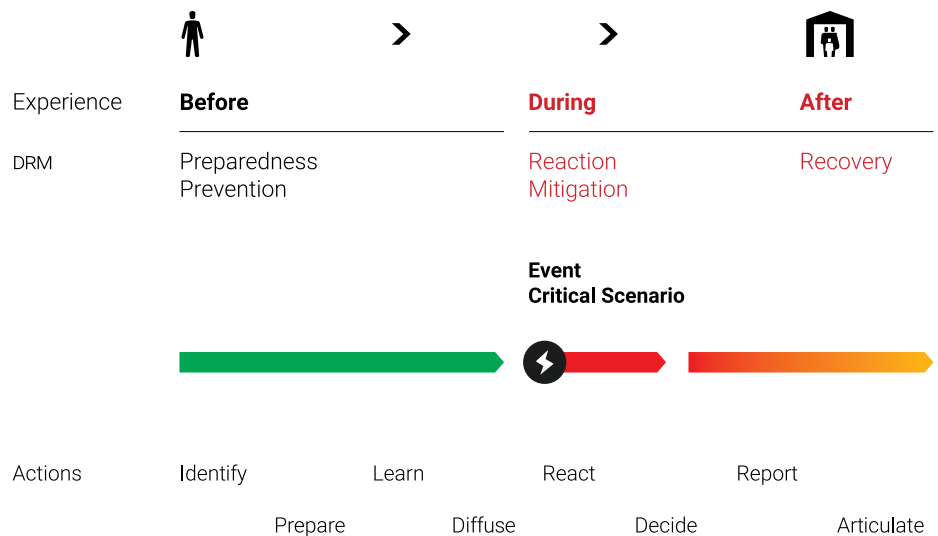


Figure 1 A synthesis of risk and emergency: Experience + DRM + Actions.
Source: Author.

Figure 1 also suggests that the right moment to present and process information becomes crucial (Doyle et al., 2022). Exploring appropriate information and multiple supports to operate along DRM stages (before–during–after), becomes necessary to optimize the emergency experience. For example, before an event information may help to identify or create awareness of already known threats, or facilitate learning from unknown hazards. During an emergency, timely information is key to responding or decision-making, reducing the impacts. After a critical event, information may aid in articulating recovery steps. Integrating user needs and emergency variables is a large challenge to conduct experience. Specifically, comprehensive information on all dimensions

of disaster risk, including hazards, exposure, or vulnerability is a focus of risk management. Such focus may consider the identification of contents, typologies, moments, and originators of information, making visible, for example, who (i.e., originator), what (i.e., actions – options), or how (i.e., procedures). Communication is an articulator to manage the experience, facilitating, for example preparing, preventing, and transferring messages into actions. For effective communication, it is necessary also to integrate context (where) and the nature of users (who), presenting “meaningful information that leads into specific action” (Robinson, 2017); which is discussed in the next section.

4 Designing information

As mentioned, visual information is a central part of everyday experiences and can facilitate interactions in critical scenarios. Information design, a multidisciplinary field, has been defined as a practice focused on preparing content that is visible, understandable, and usable for people, combining both art and science (Horn, 1999). According to Frascara (2011, 2015), information design draws on visual outcomes such as legible typography, meaningful symbols, normalized images and sequential instructions, among other supports, aimed at being a natural way to visualize requirements and allow them to be understood and interacted with. It consists of applied tools that can be systematically managed in multiple and even simultaneous supports and contexts in everyday life. Applying information design as a step-based method might contribute to articulating needs, optimizing communication, and measuring the performance of messages using multiple instruments such as perceptual or cognitive instruments. For the International Institute for Information Design (IIDD), one core competency is “[...] testing of use and usability, evaluate the test results and refine the information accordingly.” (idX Group, 2007). Graphic elements such as symbols and typography appear as ubiquitous solutions that deliver visible and legible information, and in critical contexts, such resources might be a simple, effective approach to visualizing content.

Robinson (2017) poses critical questions addressing to reflect on the importance of developing communication tools for emergencies: How to develop visible and understandable information, facilitating seeing, understanding, and taking action. To communicate in emergencies it is fundamental to detect factors that optimize information for being visible, understandable, and able to be transferred into action. Therefore, managing the experience of an emergency is an opportunity to implement effective messages, by integrating information design principles. Specifically, visual tools can aid in the understanding of risk and hazardous scenarios, from identification, prevention and preparation (Before) to reaction (During) and active recovery (After) (Ramírez, 2022). The case study introduces icons as functional, measurable units of information.

5 Case study: icons for emergencies

Based on definitions from Abdullah and Hubner (2006), pictograms, symbols or icons constitute normalized images designed to condense a concrete meaning (i.e., a subject or action), functional tools that reduce linguistic barriers, usually conceptualized as a “universal” language.

Icons are components of the everyday processing of visual information, displaying messages to be conveyed via different media or information technologies (Easterby & Zwaga, 1984; Boersema & Adams, 2017). As graphic tools, constitute seemingly optimal instruments for conveying efficient messages and handling barriers in communication (i.e., accessibility, multi-modal displaying). As a visual system, icons share attributes in order to present messages in a consistent manner. As different authors mention (Easterby & Zwaga, 1984; Dewar, 1999; Frascara, 2011; Boersema & Adams, 2017), different symbol systems have been developed for various contexts such as tourism (WTO), public spaces (AIGA) or work safety (ANSI), aimed at serving as functional communication tools. As Frascara (2015) states, an icon development project involves a cycle of interviews, meetings and tests, with a considerable amount of time spent on consultation and refinement of their visual design. The general public needs to recognize an evident meaning, ideally with no learning required.

Different icon sets are available under an open-access policy (i.e., Material Design). Also, being easily implementable in multiple platforms, icon sets are also available specifically for emergencies (i.e., UNOCHA), to represent context (i.e., tsunami hazard), messages (i.e., shelter available), or actions (i.e., evacuation), among others. In a comparison of different emergency symbols for vulnerable users, Frommberger and Waidynatha (2017) concluded that “visual language can decisively contribute to action.” Icons are normalized images that operate as codified messages that condense conventional meanings articulated in a familiar language, can be flexibly implemented on different supports, and are considered a lingua franca of the information age. However, usually driven by collaborative efforts, these sets are offered for open use with no evidence of their performance. Beyond the visual design statement, for critical applications (i.e., warnings) it is necessary to know what people see and what they interpret in a representation (Marom & Goldschmidt, 2011).

Guemil is an open-access icon set for emergencies. Conceptually, it aims to integrate the DRM phases before > during > after an event, constituting both a design and a research initiative (www.guemil.info). The design part integrates multiple representations such as risks, hazards or actions, combining analogical, anthropomorphic, or symbolic elements. In parallel, iterated icon versions were introduced (2018, v10, 2020, v15). the latter included COVID19 icons and improvements from previous processes (Ramírez, 2022). As shown in Figure 2, the current version includes 86 symbols.



Figure 2 Case study: Guemil Icons Set (www.guemil.info).

Planned as a communication resource to display messages in critical contexts, the case study goes beyond visual styling, to present performance indicators. The second part of the project is a research platform, integrated to test and evaluate the icons. Details are presented in the next section.

6 Integrating performance indicators

Icons epitomize elementary principles of information design: graphic tools to be seen and understood, and to activate decisions. According to literature review (Brugger, 1999; Olygay, 2003; Frascara, 2011; Boersema & Adams, 2017; Brick & Freeman, 2021) and international practice (ANSI, 2011; ISO, 2018), evidence of icon performance is constructed by collecting qualitative data (open responses) to evaluate comprehension, usually through quantitative indicators (i.e., percentage of responses).

Representations generate interpretations, allowing a determination of whether they convey meaningful information. However, often icon systems do not evidence performance indicators. References to good practices such as the “Hablamos Juntos” project (2010, 2012) demonstrate how this evaluation process can create a more inclusive and effective implementation. Following such practice, performance is defined through choices and interpretations given by participants, as shown in the next sections.

6.1 Methodology: testing meaning and preferences

As mentioned, the case study process integrates both design and testing. Interpretations from icons become fundamental to research about the communication of emergencies. Tests explore how every representation is visualized and deciphered by individuals, making associations and using their own words.

Hypothesis: If symbols are designed for risks and emergencies, evaluating their interpretations and preferences will reveal if those are visualized and understood, contributing to the management of risks.

The testing method involves a validation experiment in three sequential steps: (1) Define tests; (2) Collect and categorize; and (3) Establish performance. Two different tests were developed: (1) Meaning and (2) Preferences, both implemented through interactive surveys, oriented to collect at least 200 anonymous responses per item. For both tests, bilingual forms were designed using Google Forms and Typeform to be completed by individual participants in 10 minutes. To ensure accessibility, printed tests were also available by demand. An onboarding dialog task provided information consent, instructions facilitated the characterization process and interaction with participants. Also, they were able to provide comments after responding. Figure 3 summarizes the methodology applied in both tests.

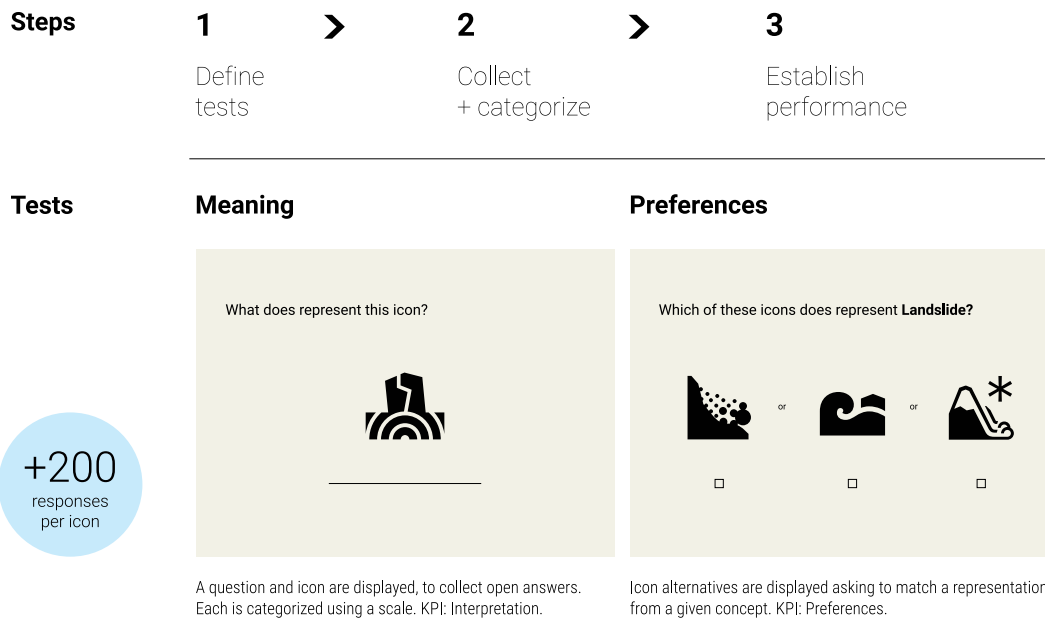


Figure 3 Icon testing methodology: meaning and preferences.

In this paper, the detail of the results are taken from the Preferences test (2). Visualizations of both tests are available on the project website; for further discussion on open-access icon systems and detailed responses considering the meaning test, see Ramírez (2018).

6.1.1 Meaning test

This test displays an isolated icon and the question: ‘What does this icon represent?’ asking participants to provide open responses. Each answer is matched with a list of possible denominations, categorizing the response

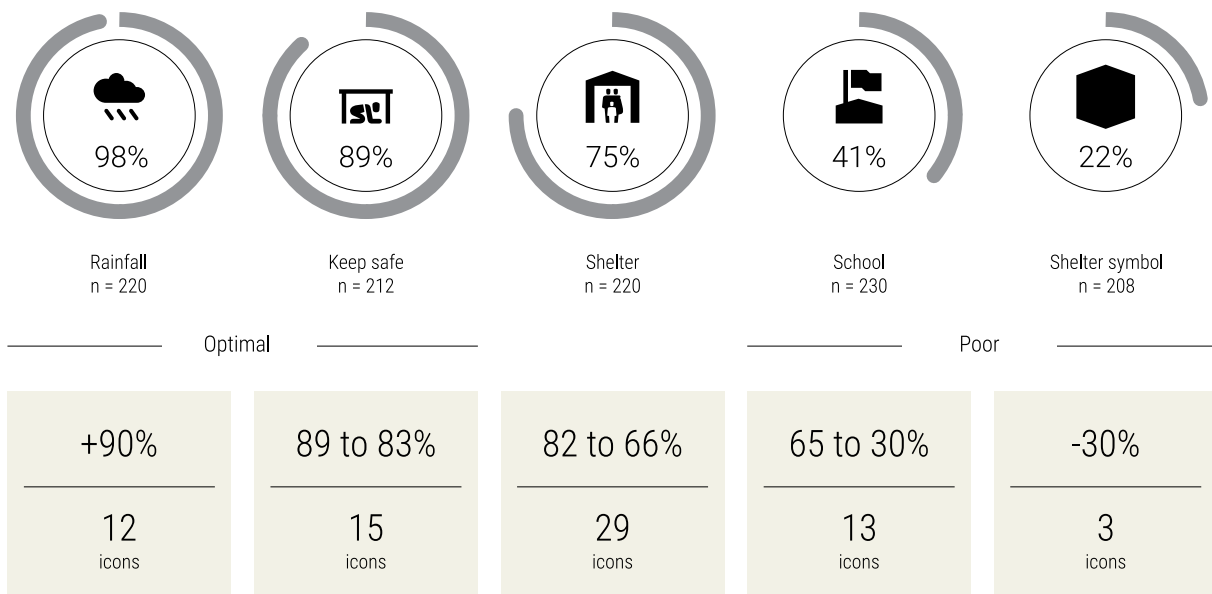
according to a 6-grade scale. Such scale was based on the work of Brugger (1999), Olygay (2003), and Frascara (2011), considering an approval of 83%. Labeling was not incorporated as a variable. Table 2 presents the categorization scale.

In the Meaning test, results define a quantitative index per each icon, contributing to evidence performance. From left to right, Figure 4 illustrates a sequence of examples for icons considered optimal, to neutral or poor performance icons from their interpretations.

Table 2 Meaning tests categorization.

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	Understanding is opposite as is intended	No answer or any answer is given

Based on the work of Brugger (1999), Olygay (2003), and Frascara (2011).



72 icons tested

Figure 4 Meaning tests performance (examples 2018–2022).

6.1.2 Preferences test

15 concepts were included in this test, oriented to collect associations related to a concept provided, depicting a particular element (i.e., icon) or integrating a whole composition (i.e., a sign). Here, the question was “Which of these icons does represent [...]?”, in order to identify which

representation participants can connect with a given concept, called a Preference. The purpose of this test was to explore particularities among concepts and representations that could share formal attributes or mark a difference. Therefore, unlike the previous test, the preferences test was not aimed at obtaining correct meanings nor a definitory index, but rather at identifying associations or relations, suggesting trends from the preferences marked. Also, sample icons from other systems are included as options (i.e., UNOCHA icons).

According to the categorization of usability testing by Chisnell and Rubin (2008), this test is considered an exploratory evaluation, where participants were asked to select from a series of representations to indicate which of them matched a defined concept or message. However, as the participant had to choose a representation from given alternatives, this test might be also considered a multiple-choice evaluation. Figure 5 introduces the concepts included.
















Emergency Exit	Assembly Point	Tsunami Alarm
		
Evacuation Way	Tsunami Hazard	Shelter
		
Landslide	Charging	Vertical Evacuation Area
		
Volcanic Eruption	Safe Location	Connectivity
		
Warning	Go to Shelter	Flooding
		

Figure 5 Preferences testing | Concepts and icons.

Test participants were recruited by open callings (social networks, email) and during activities (workshops). 283 answers were then collected and processed for analysis ($N = 283$), distributed in Females ($n = 181$), Males ($n = 94$) and not responding ($n = 8$). Test participants were mostly in the undergraduate level of education ($n = 140$) and the largest age range group was 16–25 years ($n = 76$). Geographically, the main group came from Chile ($n = 242$), then Japan ($n = 17$) and Argentina ($n = 9$). Few came from Colombia, Cuba, Peru, Spain, and New Zealand, among others, accounting for eleven countries in total.

In the preferences test, the dimensions are open to discover more associations than specific interpretations and may constitute all ‘correct’ choices. Thus, choosing more than one option was allowed, and results may reflect more than one preference per concept (marked as [...] in results). Results are visualized in Figure 6.

7 Discussion and insights

In general terms, results from the preferences test reveal clear associations between a given concept and its graphic representation, for example in “Warning” (206 preferences in 283 responses). Other associated with common visual references or well-known icons tend to be most preferred, for example, “Tsunami hazard” (199 preferences). On the other hand, icon cases depicting less-known significant references, show clear preferences, for example in “Vertical Evacuation Area”, where one option doubles the other (182 vs 86 preferences).

On the other hand, no critical differences were observed across the characterization of participants and dimensions observed: the majority of concepts indicate clearly one option chosen. Following findings such as those from Brick and Freeman (2021), most preferred representations combined iconic representations with indications such as descriptive shapes, for example, “Landslide” (162 preferences), or color, for example, “Evacuation Way” (148 preferences). Nevertheless, results remark on the importance of context and familiarity in achieving accurate interpretations (i.e., representations of hazards such as “Landslide” or “Volcanic Eruption”). So far, visualizing the results challenge prevalent ideas pre-assigned to icons, such as “universal” language on the representation of emergencies, for example, familiarity with risks, iconic vs symbolic representation, and implementation.

Observations become important for identifying what is working, along with what might be misinterpreted, contributing to iterating the visual communication of emergencies. However, interpretation and preferences are just two dimensions in a complex experience for participants, and variables such as context, the complexity of emergencies and local practices may affect associations, for example in “Safe location” (160 preferences). Another focus is the frequency of combined or non-given responses marked as [...], which appears distributed along the concepts.

N=283

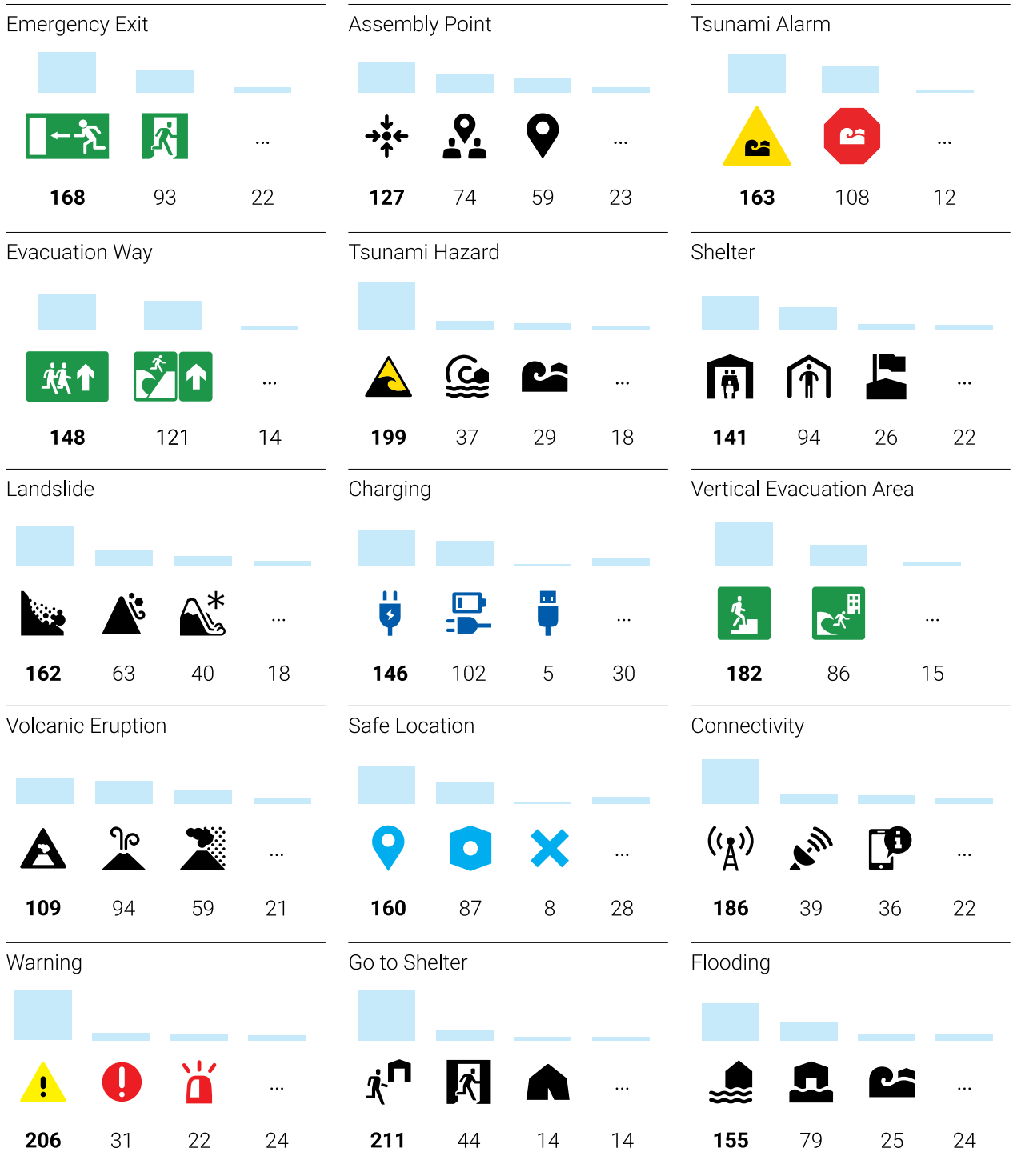


Figure 6 Visualization of results, preferences test.

Results reveal significant associations on how to integrate visual resources into DRM. Additionally to the testing evidence presented, three insights allow to open discussion on the importance of the role of visual information and considering preconceptions as “universal language” for emergencies, towards the articulation of the experience:

1. **Familiarity:** Responses tend to validate interpretations based in analogical representations, or those that participants frequently interact, suggesting that previous experience and knowledge of hazards play a role associating concepts and representations (i.e., Emergency Exit and Warning). On the other hand, symbolic or abstract representations tend to distribute preferences (i.e., Shelter).
2. **Performance indicators:** Beyond a statement assuming that an icon would be comprehended just because of a defined style, it is important to provide functional evidence regarding what is naturally associated, define visible differences, present messages to bring clarity and reduce uncertainty, or matching concepts with their representations as effective information for emergencies (i.e., Volcanic Eruption). Icons can be highly interpretative, it is important to follow up their performance on a continuous basis, to evaluate if representations can improve their associations (i.e., Assembly Point). Testing is also an opportunity to collect local interpretations and recognize cultural associations to compare performance indicators.
3. **Knowledge for reducing risks:** As a participatory experience conducted by visual information, test results may constitute an appropriate moment to dialog on what is defined as significant information for specific groups, and what is relevant to enhance emergency management. This could activate dialogs on how to optimize the communication of risk driven by social awareness and participatory knowledge.

As the results evidence, visual information establishes preferences and generates valuable insights for designing appropriate, usable information for emergencies. Also, findings spark questions: As participants could guess, what are the differences to choose? Are labeling determining a bias in choices? What if collecting more interpretations allows visual meanings to be refined, toward a common language for emergencies? And, moreover, what other cultural or educational variables might affect specific, local interpretations of hazards or risks? A key is updated information available, via open-access media, and multi-disciplinary integration. Nowadays, tests are continuously being applied, updating results on the project website.

7.1 Limitations

Being part of an ongoing research process, tests can contribute to validating visual tools but also pose limitations. It is necessary to continuously improve testing in the following phases: The first aims to clarify interpretation and integrate resources such as text labels. So far, testing has been designed as a form-filling task, conducted in an “ideal” situation, not amid a real disruptive scenario nor in a simulation context, with a potential bias in the collected responses. A critical observation to improve the process is to attend moments that eventually may represent an emotional or cognitive barrier to new information, such as during or after an event. With data analysis, it becomes evident the convenience of expanding instruments, for example using statistical content analysis.

8 Conclusions

Emergency scenarios constitute complex experiences with large requirements for information. Such disruptive scenarios usually entail limited access to information or lack of certainty, probably one of the most difficult challenges for DRM. Integrating communication to DRM contributes to an effective articulation of risks. Clear, familiar information can make a difference in visualizing, understanding and applying communication. The management of emergencies can be optimized by delivering timely information that brings certainty and prevents an escalation to a disaster. Icons can be considered an effective resource to communicate emergencies. However, as icons may change their interpretations it is important to evaluate on a continuous basis.

Projecting in the long term, an opportunity to create common bodies of knowledge can integrate local and global platforms. This is an example of “small change” to facilitate larger transformations, contributing to enhancing DRM through the application of open access and validated visual tools. Moreover, collaborative design is an opportunity to integrate local or multicultural participants, in order to create participatory information tools. Finally, this research informs multidisciplinary approaches and is open to collaboration.

Acknowledgment

The author wants to acknowledge the collaboration of different teams in this design + research initiative: The Design Network for Emergency Management, Design 4 Emergency group. A committed group of design students from the School of Design, Pontificia Universidad Católica de Chile, and the National Research Center for Integrated Disaster Management, CIGIDEN FONDAP, Chile).

References

- Abdullah, R., & Hübner, R. (2006). *Pictograms, icons, and signs*. Thames & Hudson, London.
- Aitsi-Selmi A., Blanchard, K., & Murray, V. (2016). Ensuring science is useful, usable and used in global DRR and sustainable development: A view through the Sendai framework lens. *Palgrave Communications*, 2, 16016. <https://doi.org/10.1057/palcomms.2016.16>
- American National Standards Institute, Inc. (2011). *Criteria for Safety Symbols*. <https://www.nema.org/Standards/ComplimentaryDocuments/Z535-3-Contents-and-Scope2-2.pdf>
- Boersema, T., & Adams, A. S. (2017). Does my symbol work? International standards for designing and testing graphical symbols. In A. Black, P. Luna, O. Lund, & S. Walker (Eds.), *Information Design: Research and practice* (pp. 303–314). New York: Routledge.
- Brick, C., & Freeman, A. (2021). Communicating evidence in icons and summary formats for policymakers: What works? *Behavioural Public Policy*, 1–29. <https://doi.org/10.1017/bpp.2020.54>
- Bui, T., & Sebastian, I. (2011). Beyond rationality: Information design for supporting emergent groups in emergency response. In F. Burstein, P. Brézillon, A. Zaslavsky (Eds.), *Supporting real time decision-making* (pp. 159–179). New York: Springer.
- Brugger, C. (1999). Public Information symbols: A comparison of ISO testing procedures. In H. Zwaga, T. Boersema, H. Hoonhut (Eds.), *Visual Information for everyday use*. London: Taylor & Francis.
- Chisnell, J., & Rubin, D. (2008). *Handbook of usability testing: How to plan, design, and conduct effective tests* (2nd ed.). Indianapolis: Wiley.
- Doyle, E. E. H., Harrison, S. E., Hill, S. R., Williams, M., Paton, D., & Bostrom, A. (2022). Eliciting mental models of science and risk for disaster communication: A scoping review of methodologies. *International Journal of Disaster Risk Reduction*, 77, 103084. <https://doi.org/10.1016/j.ijdrr.2022.103084>
- Easterby, R. S., & Zwaga, H. J. G. (1984). *Information design: The design and evaluation of signs and printed material*. London: Wiley.
- Frascara, J. (2011). *¿Qué es el diseño de información?* Buenos Aires: Ed. Infinito.
- Frascara, J. (2015). *Information design as principled action: Making information accessible, relevant, understandable, and usable*. Champaign, IL: Common Ground Research Networks.
- Frommberger, L., & Waidyanatha, N. (2017). *Pictographs in disaster communication for linguistically challenged populations*. Los Angeles: Sahana Software Foundation.
- Guemil Project website. (n.d.). www.guemil.info
- Hablamos Juntos Symbols. (2008, 2012). <https://segd.org/hablamos-juntos-0>
- Horn, R. (1999). Information design: Emergence of a new profession. In R. Jacobson (Ed.), *Information design* (pp. 15–33). Cambridge: MIT Press.
- International Institute for Information Design. (2007). idX Core Competencies. *What information designers know and can do*. <http://www.iiid.net/>
- ISO Symbols. (n.d.). <http://www.graphical-symbols.info/>

- ISO Graphical Symbols. *Test methods – Part 1: Method for testing comprehensibility*. <https://www.iso.org/standard/59226.html>
- ISO 9241-210 (2018). *Ergonomics of human-system interaction*. <https://www.iso.org/standard/52075.html>
- Jaenichen, C. (2011). Design for evacuation: Improving city evacuation instructions. *Parsons Journal for Information Mapping*, NY.
- Jaenichen, C., van Manen, S., Lin, T., Kremer, K., & Ramírez, R. (2019). *Design for emergency management*. DNEM
- Material Icons Guide. <http://google.github.io/material-design-icons/>
- Marom-Tock, Y., & Goldschmidt, G. (2011). *Design for safety: Symbol genre in safety signs*.
- Olygay, N. (2003). Building on test results to design safety symbols. *Proceedings of the International Ergonomics Association*. Seoul.
- Olygay, N. (2001). Developments & testing of the IIDD Safety Symbols System. *Information Design Journal*, 10(2), 107–114.
- Ramírez, R. (2018). Reviewing open-access icons for emergency: A case study testing meaning performance in Guemil. *Visible Language*, 52(2), 32–55.
- Ramírez, R. (2020). *Diseñar la información de emergencia: Experiencias para gestionar el riesgo y educar la resiliencia*. Serie Policy Papers, CIGIDEN.
- Ramírez, R. (2022). *Co-creating visual dialogs for crises and emergencies: Climate scenarios as opportunities*. Detroit: Cumulus Detroit Design for Adaptation.
- Robinson, L. (2017). Words into action guidelines: National Disaster Risk Assessment. Special Topics. A. *Public Communication for Disaster Risk Reduction*. UNDRR. https://www.undrr.org/files/52828_specialtopics%5B1%5D.pdf
- TorqAid Disaster Risk Management Diagrammatic Framework. (2016). <http://www.torqaid.com/resources/>
- Twigg, J. (2015). *Disaster risk reduction*. London: Overseas Development Institute. <https://goodpracticereview.org/wp-content/uploads/2015/10/GPR-9-web-string-1.pdf>
- United Nations Office for Disaster Risk Reduction. (2023). Global assessment report. Special report 2023. *Mapping resilience for the sustainable development goals*. <http://www.undrr.org/gar2023sr>
- United Nations Office for Disaster Risk Reduction. (2015). *Sendai framework for disaster risk reduction 2015–2030*. http://www.wcdrr.org/uploads/Sendai_Framework_for_Disaster_Risk_Reduction_2015-2030.pdf
- United Nations Office for Disaster Risk Reduction. (2016). *Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*. https://www.preventionweb.net/files/50683_oiewgreportenglish.pdf
- Humanitarian Icons v.02. (n.d.). <https://brand.unocha.org/d/xEPyTAUjC3sH/icons>

About the author

Rodrigo Ramírez

rramireo@uc.cl

Pontificia Universidad Católica de Chile

Chile

Submission date/*Artigo recebido em*: 1/8/2023

Approval date/*Artigo aprovado em*: 15/8/2023