Usability and Visual Communication for Southern California Tsunami Evacuation Information

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Introduction

Abstract

Evacuation behavior, including participation and response, is rarely an individual and isolated process and the outcomes are usually systemic. Ineffective evacuation information can easily attribute to delayed evacuation response. Delays increase demands on already-extended emergency personnel, increase the likelihood of traffic congestion, and can cause harm to self and property. From an information design perspective, addressing issues in cognitive recall and emergency psychology, this case study examines evacuation messaging including written, audio, and visual presentation of information, and describes the application of design principles and role of visual communication for Southern California tsunami evacuation outreach. The niche of this project is the inclusion of cognitive processing as the driving influence when making formal design decisions and measurable data from a 4-year cognitive recall study to support the solution.

WHAT IS INFORMATION DESIGN?

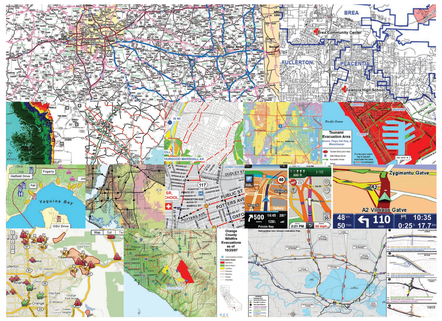
Visual communication has proven a successful approach in simplifying information so that messages are memorable and comprehensible to a variety of demographics. Semiotics and the principles of information design contribute a critical role in mass communication. Information design has been established as its own discipline since the 1960s in Europe and Asia, but is a relatively new discipline in the United States. The objective of information design is promoting clear communication between government and its communities, as well as agencies and the people they serve. Information design adheres to fundamentals that include participatory design methods, empirical and diagnostic benchmarks, and quantitative measured outcomes. I analyze, order and test symbology, iconography, graphic density and the length and levels of visual variables to ensure relevant and appropriate meaning to a specified community.

WHAT IS EMERGENCY MANAGEMENT?

Emergency management departments in the United States distribute informational and instructional messaging to its residents and communities before an evacuation is required in hopes to make the population "information aware" and therefore more prepared (FEMA 2014). Emergency management is a public authoritative agency interconnected with agencies responsible for the safety, response, recovery, and preparedness of "any unplanned event that can cause deaths or significant injuries to students, employees, customers or the public; or that can disrupt operations, cause physical or environmental damage, or threaten the facility's financial standing or public image" (Oregon State Office of Emergency Management). The specific focus of evacuation information centers in its systemic and capacious variables.

Assessment

SEMIOTICS AND WAYFINDING FOR DISASTER PLANNING

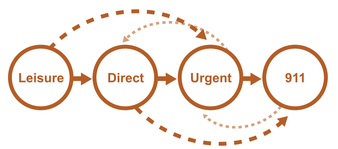


EXAMPLES OF EVACUATION WAYSHOWING USED IN THE UNITED STATES BY CITY AND COUNTY EMERGENCY MANAGEMENT DEPARTMENTS.

There are currently no guidelines, regulations, or methodology that include stake-holders in the process of developing and evaluating these maps and their messages. Nor is there data to support that the materials are being understood, are memorable, or useful. A problem in conveying evacuation information using a "map" as the main visual infrastructure is assuming the skill set necessary in map reading. An individual will need the following skill set in basic map reading and comprehension; 1) how to use a legend or key; 2) how to determine orientation of the map to physical space; 3) understand meanings of color, texture, and symbols; and 4) how to determine self location to destination in order to create a route. Maps can be confusing to read and dense with information. They can also be authoritative and can imply that the user must understand the map instead of the map being developed to understand the user's needs.

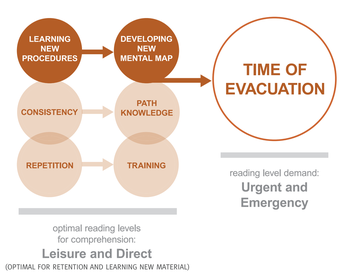
COGNITIVE RECALL AND DISASTER PSYCHOLOGY

Ineffective evacuation information can easily attribute to delayed evacuation response and communities not evacuating at all. Evacuation behavior and decision-making is rarely an individual and isolated process and responses become systemic. Ineffectual behaviors increase demands on an already-extended emergency personnel, increase the likelihood of traffic congestion, and harm to self and property. Evacuation materials need to be developed with the inclusion of emergency cognition and disaster psychology. The ability to problem-solve, make rational decisions and recall information becomes vulnerable when confronted by urgent situations. Processing information during high levels of stress contribute to information overload, tunnel vision, temporary cognitive paralysis, and forms of denial. Tunnel vision is associated with extreme stress and exhaustion in which primitive tasks become central to cognitive processing and problem-solving capabilities are limited. Temporary cognitive paralysis, such as when people "freeze", is also associated with people experiencing dramatic shifts in cognitive demands as a result of an abrupt change in the environment. Even though panic is not a likely response in evacuation behavior, these cognitive phenomena effect how a person receives and retains information. Variables that contribute to cognitive paralysis include: limitation of reaction time, perception of danger to self, and previous training or experience. This is especially true if people do not receive instructions and evacuation information until the time of evacuation is required. Findings from the 2012 FEMA National Survey found that 92% of respondents received their information from the media with the top three sources from local television, national television, and radio at the time of the emergency. Media sources are problematic for two main reasons; 1) they are audio reliant, which data from our study demonstrated was the lowest performing outcome in information recall; and 2) information is usually distributed or accessed at the time of impact providing new information on a population already in distress.



A MODEL OF READING SITUATIONS THAT DO NOT ALWAYS ACT OR RESPOND IN A SEQUENCE. CHANGE IN DEMAND TRIGGER CHANGES IN COGNITIVE PROCESSING.

OLD MODEL: DISTRIBUTION OF INFORMATION IS CURRENTLY GIVEN AT TIME OF EVACUATION.



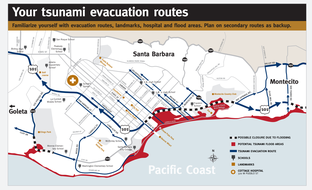
NEW MODEL: PROPOSAL FOR AN INFORMATION CAMPAIGN PRIOR TO EVACUATION.

Pilot

DEVELOPING VISUAL STANDARDS FOR EVACUATION WAYSHOWING

The U.S. Geological Survey (USGS) and the California Geological Survey (CGS) provide geologic and seismic expertise to local and government offices that include inundation maps for the purpose of emergency planning. These maps are for "local governmental agencies [to] use these new maximum tsunami inundation lines to assist in the development of their evacuation routes and emergency response plans". Yet, I found a number of these maps were used in their original format, or slightly altered, for public outreach. The presentation of these maps have serious issues in readability, scale, labeling, and graphic density for a person who does not have, or should have, experience in topology or geographical map reading. When we tested one of these maps provided on a public outreach brochure in Santa Barbara, comprehension and cognitive recall failed by 100% early in the study and was excluded from further testing.

MAP WAS DEVELOPED BY CGS FOR EMERGENCY PLANNING—THE SAME MAP PREVIOUSLY GIVEN TO RESIDENTS FOR EVACUATION WAYFINDING IN SANTA BARBARA COUNTY, CALIFORNIA.



REVISED DIAGRAMMATIC MAP, INSPIRED BY PUBLIC TRANSPORT, AND BASED ON COGNITIVE RECALL STUDY, SEMIOTIC STANDARDS, LENGTH OF COMPONENTS, AND LEVEL OF ORGANIZATION.

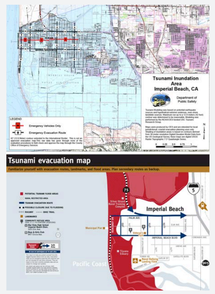
DESIGN PRINCIPLES AND WAYSHOWING

We revised the map by simplifying it down to only relevant layers of information. We formulated length and levels of components (e.g. compositional space and hierarchy) and use of visual variables. This approach was particularly critical for the continuity and application of other tsunami evacuation campaigns to be used in other coastal cities. The redesign prioritized a distinct clarification between foreground and background information driven by "wayshowing" principles. We changed the main visual infrastructure from a geological, topology, or road map to assimilating the more commonly recognized diagrammatic public transportation map. Maps are static forms of communication relying on the reader to decode the information, finding out where they are on the map, navigating the space, and determining which routes are relevant. By approaching the map from the perspective of the user, information takes an active role indicating directions for movement and instructions.

A disciplined typographic approach was established into 5 levels of hierarchy. The following list of information was given a consistent type size, use of caps, and color in every map we have produced. The order is from the most prominent, foreground information, to lower level, background information:

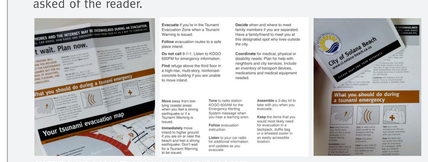
1) Identification of the city represented.
2) Identification of neighboring cities and major highways for spatial orientation.
3) Names of landmarks, including train stations, hospitals, parks, tourist sites, and in some cases, well known residential areas known to the people who live in the city.
4) Street names and highways of evacuation routes
5) Other smaller, but relevant, street names needed in order to connect to the major evacuation routes

We used Meta, a humanist sans serif typeface designed by Erik Spiekermann and released in 1991, because of its cleanliness and legibility. In some cases, the typeface had to be legible at 7 points and Meta's subtle inclusion of serifs helped shape words the same way serif typefaces do. Editing the amount of information was also a significant and successful negotiation in reducing text when applied to the content of brochures mailed out to residents and businesses in the inundation areas. We re-stylized the writing using direct conversational (e.g. using "you", "your", etc.) throughout the material to be more specific and direct in instruction and what was being asked of the reader.



TYPOGRAPHY. THE FIRST MAP USED BY IMPERIAL BEACH WAS DENSE AND FULL OF COMPETING VISUAL NOISE. THE SECOND MAP DEMONSTRATES HOW OUR REVISIONS IMPROVED LEGIBILITY REVEALING USABLE AND RELEVANT INFORMATION INTENDED FOR THE PUBLIC TO USE.

COLOR. THE CALIFORNIA DEPARTMENT OF TRANSPORTATION OFFICIALLY BRANDED THE COLOR BLUE BY IMPLEMENTING TSUNAMI EVACUATION ROUTE AND EVACUATION SITE IDENTIFICATION SIGNAGE THROUGHOUT COASTAL CITIES. WE ALSO RELIED ON CONVENTIONAL MEANING OF RED FOR THE INUNDATION AREA—ASSOCIATED WITH MEANINGS SUCH AS EMERGENCY EXIT SIGNS, FIRE TRUCKS, EXTINGUISHERS, EMERGENCY STOP BUTTONS, AND THE AMERICAN RED CROSS. A THIRD COLOR, GOLD, WAS USED FOR LANDMARKS (USEFUL FOR SPATIAL ORIENTATION) AND HOSPITAL LOCATIONS. THE REMAINING NEUTRAL COLOR PALETTE WAS USED TO SUPPORT THE USE OF COLOR. WE ENSURED THAT THE COLOR PALETTE HAD CLEARLY DEFINED HIERARCHY, INTENSION, AND PRIORITY OF INFORMATION.



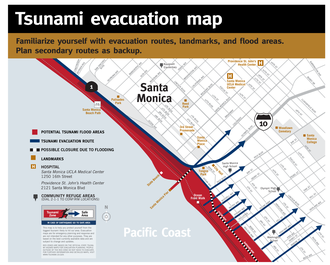
CONTENT. EXAMPLE OF MASTHEADS AND LANGUAGE USING DIRECT CONVERSATIONAL STYLE IN BROCHURE THAT WAS MAILED TO RESIDENTS

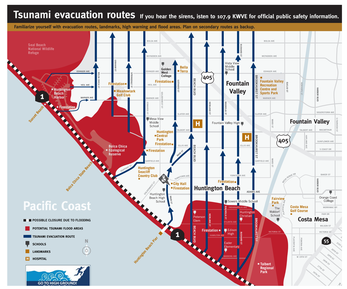
TEXTURE. THE FIRST MAP USES TEXTURE INTENTIONALLY TO BRING ATTENTION TO AREAS OF IMPORTANCE. THE SECOND MAP SHOWS WHEN TOO MUCH TEXTURE IS USED, THERE IS NO PLACE FOR THE EYE TO SETTLE.

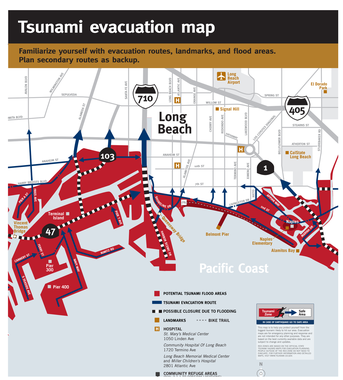
Final Outcomes

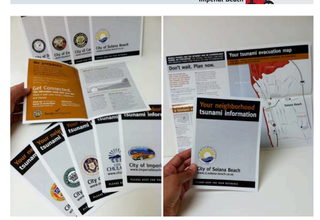
COGNITIVE RECALL STUDY

Teaming up with Dr. Steve Schandler, Director of Chapman University's Cognitive Psychophysiology Laboratories, we conducted a cognitive recall study. To date, we have data from over 300 participants recruited from both a control group and communities. We tested 3 different presentations of information; written, audio, and visual (e.g. map). Participants served individually in one study session, followed 24-hours later with a phone call interview. One third of the subjects were given the visual redesign evacuation map; one third received a written description of the same movement routes; and one third was presented with a digital audio recording describing the same movement routes. Across all groups and both review periods, the visual (map) presentation of information produced better retention (less forgetting) of information from Day One to Day Two. In summary, the written presentation of evacuation information resulted in the greatest immediate recall for both groups. However, visual presentation produced the most stable recall across the 24-hour retention period. This is particularly significant in trying to initiate a preparedness campaign prior to a disaster event so at the time an event occurs, experience with the information would have already made a cognitive imprint reducing the amount of learning new information under stress.









FINAL MAPS. TO DATE, WE HAVE COMPLETED WORK FOR 12 COASTAL CITIES IN CALIFORNIA INCLUDING SANTA BARBARA, HUNTINGTON BEACH, CARLSBAD, CITY OF SAN DIEGO, CORONADO, CHULA VISTA, DEL MAR, ENCINITAS, IMPERIAL BEACH, NATIONAL CITY, OCEANSIDE, AND SOLANA BEACH. WE ARE UNDER PRODUCTION WITH THE COUNTY AND CITY OF LOS ANGELES AND COMPLETING WORK FOR VENICE, MARINA DEL REY, HARBOR CITY, LONG BEACH, SANTA MONICA, TORRANCE, MALIBU, EL SEGUNDO, RANCHO PALOS VERDES, HERMOSA BEACH, AND MANHATTAN BEACH.

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