2015

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Original Publication Citation

Richards, D. (2015). Testing the waters: local users, sea level rise, and the productive usability of interactive geovisualizations. *Communication Design Quarterly, 3*(3), 20–24. doi:10.1145/2792989.2792992

Testing the Waters: Local Users, Sea Level Rise, and the Productive Usability of Interactive Geovisualizations

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ABSTRACT

This paper explores the potential for technical communicators to employ usability research with risk-based interactive geovisualization technologies as a method of cultivating "critical rhetorics of risk communication" for local communities. Through integrating theories from usability studies and risk communication, I offer some new directions for thinking about the productive usability of online, participatory technologies that promote citizen engagement in science. I argue that the key tenets of productive usability afford technical communicators the opportunity to build localized knowledge of risk in real, local users, which in turn improves the capacity for a community and its stakeholders to more effectively communicate risk.

Categories and Subject Descriptors

H.0 Information Systems: General

General Terms

Design, Human factors, Theory

Keywords

Sea level rise, risk, rhetoric, usability

"Old usability-testing methods need to be rethought, and old paradigms reconsidered." —Still and Albers, 2010, p. 190

INTRODUCTION

As members of what Ulrich Beck (1999) coins a "world risk society," we constantly face both real and manufactured threats to our well-being, livelihood, and existence. Public fears and anxieties about certain risks can be mitigated through effective, rhetorically prudent communication strategies (Danisch, 2010), but more often than not clear, detailed data from reliable sources (such as scientists) fail to assuage the totality of public concern and do not necessarily lead to effective, reasonable social or political action. A good number of researchers and practitioners in the multidisciplinary field of risk communication attribute this failure to the ubiquitous but problematic information-deficit model of risk communication (Bord, O'Conner, & Fisher, 2000; Kellstedt, Zahran, & Vedlitz, 2008), which begins from the premise that social inaction, disproportionate levels of fear, and political resistance stems from a sheer lack of information. Scholars in technical communication (Grabill & Simmons, 1998; Sauer, 2002) have helpfully contributed to the notion that effectively communicating risk requires more than just raw presentation of data to some passive, universal audience. Rather, a more democratic approach to communicating risks, through the inclusion of citizen experience (Chowdury, Haque, & Driedger, 2012) or appeal to values (Etkin & Ho, 2007), to a particular region or local populace has been shown to be more effective. This supports the constructivist argument put forward by Grabill and Simmons (1998) that "[p]eople's risk perceptions are determined by real and localized situations" (p. 419), rendering it problematic that many "approaches to risk communication [are] arhetorical—typically decontexualizing risks and failing to consider social factors that influence public perception of risk" (p. 416). If more effective risk communication stems from increased knowledge of localized perceptions and experiences, then how do technical communicators with a stake in risk assessment or communication analyze these real and localized situations? What strategies can be employed and where can expertise be best directed? Grabill and Simmons (1998) believe that one productive method is through usability research; this paper takes this approach one step further and focuses on risk based interactive geovisualizations as a potential site for usability data to inform local risk communication practices.

Before a community or region can move forward in addressing vulnerability or mitigating risk, especially with contemporary risks such as climate change, communicators and designers must first become familiar with the stories, values, beliefs, and concerns of a local community. Then, those with a stake in communicating risk can begin to address "framing," a popular Burkean concept in rhetoric and communication studies that advocates for a move away from a "one-size fits all" approach to communicating risks, particularly global ones such as climate change and sea level rise; this follows suit with Gross's (1991) "contextual model of science" (p. 19). As Matthew C. Nisbet (2009) writes, "messages need to be tailored to a specific medium and audience, using carefully researched metaphors, allusions, and examples that trigger a new way of thinking about the personal relevance of climate change" (p. 15). Effective, localized iterations of risk communication on global topics start from entering the minds and honoring the thoughts and existing value systems of the populations with which one is

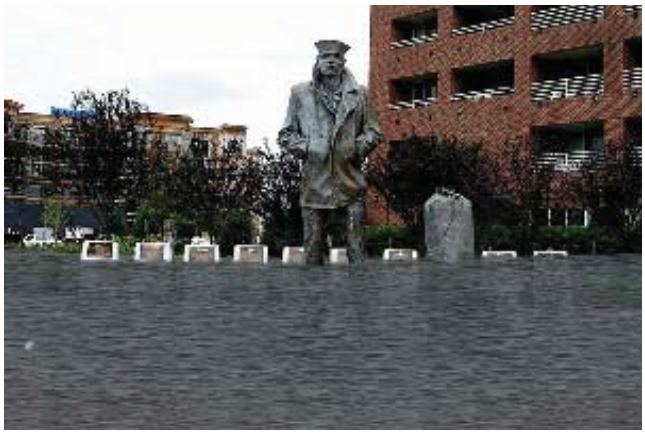
Symposium on Communicating Complex Information, February 23–24, 2015, Greenville NC, USA.

communicating. (It is imperative that individual cognitive-based perceptions are not orphaned from the social and cultural contexts within which individuals live.). In following Grabill and Simmons's (1998) call for cultivating more critical rhetorics for risk, I contend that one way technical communicators can conduct the type of localized research Nisbet (2009) and others call for is by analyzing and observing how residents within a given community are currently using the risk communication tools and technologies available to them. I believe that if technical communicators pay closer attention to how typical residents (e.g., non-scientists, non-city planners) are currently using the communicative and decision-making tools already in existence they will be able to contribute even more meaningfully to scholarship and practice of effectively communicating risk. Observing residents' uses of such technologies gives potential for gaining insight into the perceptual and behavioral aspects of a local community. While Grabill and Simmons (1998) have provided the theoretical space necessary for positioning usability—broadly defined—as a viable method for obtaining such knowledge, their work does not provide any concrete models for what such a usability approach might look like. This paper speculates and outlines just that: I explore how technical communicators might approach such a study designed for transferring knowledge about use of a tool to risk communication practices.

PREVALENCE OF SEA-LEVEL RISE GEOVISUALIZATIONS

So, then, what kinds of communicative and decision-making tools might technical communicators turn to? Well, it depends on the topic and community chosen. As a researcher located in Norfolk, Virginia, a near-coastal city surrounded by water and second to New Orleans in terms of increased flood risk due to sea level rise, the choice was clear: study the construction of messages, perception of risk, and social attitudes of the area's population as they relate to flooding and sea level rise brought about by climate change. Even if climate change is isolated as a variable, the people of Norfolk still regularly experience flooding from tides, storm surges, and rainfall. Mitigation efforts have already begun and new and old homeowners alike rely on flood maps to gain a better understanding of the parts of the city most likely to flood. Inundation risk is very much a part of every day life for the people of Norfolk and its surrounding cities

In terms of the risk of coastal inundation, an increasingly popular technology is online, interactive geovisualizations that use large scale data sets on ocean levels, tide gauges, and elevation to visually depict at-risk regions in terms of storm surge and other causes of floods. While local GIS workers create geovisualizations with flood zone data for their specific communities (e.g., norfolkair.norfolk.gov), and while FEMA (msc.fema.gov) uses its geovisualization tool to assist homeowners and renters to identify flood zones for insurance purposes, federal agency NOAA (coast.noaa.gov/digitalcoast/tools/slr) and nonprofit group Climate Central (sealevel.climatecentral.org) have developed geovisualization tools that combine the above data sets with others, such as social vulnerability, property value, and the relative vulnerability of specific hospitals, schools, historical landmarks, and more. While NOAA's tool has a neat CanVis feature allowing users to visualize certain spots in, for example, 6 feet of sea level rise (Picture 1), Climate Central's Risk Finder tool combines the most amount of data sets with particular emphasis not only on mapping but on comparisons and projections. I wish to discuss Climate Central's geovisualization tool specifically here not only because I have an established relationship with the organization, but also because the wide array of tools and data sets provide the most opportunities for users to explore.

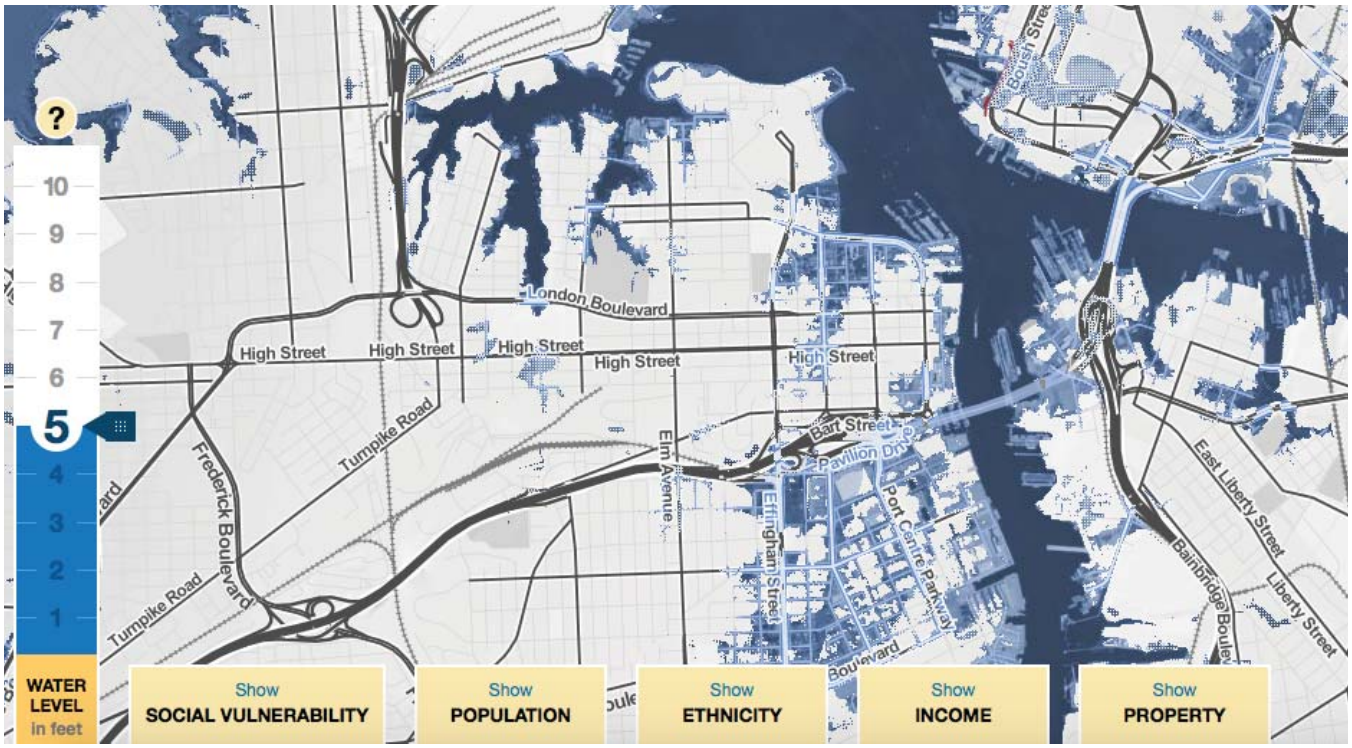


Picture 1.

As geovisualizations of data, the tools described above occupy an exciting if not underdeveloped space within risk communication, risk visualization, which is "the systematic effort of using images to augment the quality of risk communication along the entire risk management cycle" (Eppler & Aeschimann, 2009). While basic visuals such as pictographs and bar graphs enhance memorability and aid in more effectively presenting probability and uncertainty (Lundgren & McMakin, 2013, p. 177), such visuals are static. In their handbook Risk Communication published through IEEE Press, Lundgren and McMakin (2013) devote only two paragraphs to the topic of "static versus interactive visuals," and while not sharing any research on the effectiveness of interactive visuals, do suggest that communicating risk in online, interactive environments might be viable. It follows that such environments, such as the ones listed above, would be viable in effectively communicating risks because they are designed in a way that actually moves beyond the information-deficit model of communication and towards interactivity, user-defined goals, and customizable data sets.

Risk Finder as a Communication Design Product

When the nonprofit climate communication and research group Climate Central released its Risk Finder tool in 2013, they aimed: (a) to communicate on sea level rise and coastal flooding in a way that connects data to people and (b) to raise the profile of the issue of sea level rise and how it is connected to storm surge risk. As a publicly-accessible interactive GIS, Risk Finder uses standard mapping technology but overlays numerous federal, state, and even some local data sets on current and forecasted sea levels, tide lines/gauges, LIDAR elevation data, levee locations, social variables (e.g., ethnicity), and property values. Risk Finder, like the Surging Seas tool released a year earlier, was designed for the general public, city planners, and floodplain managers as a first cut screening level analysis tool. While generally useful in providing an overview of the vulnerable and at-risk areas of a city or county, the Risk Finder tool is also a communications tool that provides the planners and stakeholders of a given community with a reference point for crafting claims and making decisions related to current and future projects. The key, unique feature of the Risk Finder tool is the "slider" (Picture 2), which allows users to visualize areas



Picture 2.

vulnerable to flooding, 1-10 feet above the local high tide line, from combined sea level rise. storm surge, and tides—or to permanent submergence by long-term sea level rise. The map includes layers for social vulnerability, population, ethnicity, income, and property value, and is based primarily on LIDAR elevation data supplied by NOAA.

The mapping portion of the geovisualization tool was designed for all audiences, while the other forecast and analysis modules were designed for more specialized audiences such as planners and floodplain managers. Climate Central has found that many users of the mapping portion of the web tool are public residents. What sort of data can technical communicators collect from observing residents using this geovisualization tool aimed at communicating risk? What sorts of problems are these residents seeking to solve? What information are they after? How do people of different social groups and contexts interact with the tool differently, and what might this say about the landscape of risk in the region? How are their perceptions of risk changing when using the tool, if at all? The very nature of the Risk Finder tool resides at the intersection of cultural usability (Salvo, 2001) and risk communication; assessing the quality and usefulness of risk based interactive geovisualizations brings about the opportunity for technical communicators to do "coordinating work" (Johnson, Salvo, & Zoetewey, 2007) not only with the participatory design of the tool itself at this key moment for Climate Central developers with a new citizen-based user population, but moreover with the extant expert/nonexpert and assessment/communication divides that plague rhetorics of risk. Usability testing can help inform risk communication practices because communicative design tools do not exist in a vacuum: "Culture is always present, so any study of users, even if scientific at its core, must grasp the influence of the cultural factors at play in shaping a user, a product, and a product's use…This integration requires, therefore, a sufficient theoretical and practical bridge that connects science and culture" (Still & Albers, 2010, p. 189). A resident's use of a geovisualization of inundation risk will necessarily reflect that user's values, beliefs, and risk perceptions of their community. An appropriate method for gathering relevant data, then, will necessarily focus on what the self-guided goals are of users interacting with these risk-based geovisualizations.

BUILDING NEW KNOWLEDGE THROUGH PRODUCTIVE USABILITY

While the relationship between technical communication and usability studies is a topic in and of itself worthy of exploration (see Still &Albers, 2010; Redish & Barnum, 2011; Sullivan, 1989), technical communication's close allegiance with rhetoric has consistently ensured that usability studies be open to a wider range of "contingent" (Johnson, Salvo, & Zoetewey, 2008), "contextual" (Lund, 2006), and "cultural" (Sun, 2006) factors involved in the use of products, tools, interfaces, and online sites. Usability studies that do not fully account for the real contexts of use ultimately delimit the bounds of knowledge and data obtained about a tool. When Wong-Parodi, Fischoff, and Strauss (2014) conducted usability testing on the Risk Finder tool using 149 United States adults recruited through Amazon's Mechanical Turk (MTurk), they found Risk Finder to be a user-friendly decision-aid tool, testing primarily for knowledge comprehension, consistency of preferences, and active mastery of material. The study operated according to predetermined uses of the Risk Finder tool, but, as many usability experts know, general audiences may have uses for these type of geovisualization technologies that researchers and designers have not anticipated and that would provide insight. While extremely useful in the continued development of ensuring the functionality of the Risk Finder tool, Wong-Parodi, et al.'s (2014) study, in using anonymous volunteer users from across the country, did not investigate what Lund (2006) might call the deep "contexts of use"

and how a combination of other factors might influence the use of the decision-making tool. As a robust risk communication tool, interactive geovisualizations of inundation like Risk Finder provide technical communicators the opportunity to use unconventional usability methods to "acquire knowledge from user experience areas that [have been] neglected" (Lund, 2006, p. 4). I contend that one of these user experience areas that have been neglected thus far with risk-based geovisualizations is the cultivation of rhetorics of specific, localized cultures of risk..

One approach to usability that facilitates this cultivation is "productive usability" (Mirel, 2003; Simmons & Zoetewey, 2012) an approach to usability geared specifically to attending to how users are trying to solve real problems—essentially the tool's usefulness (Rubin & Chisnell, 2008). In their usability testing done on civic Web sites, Simmons and Zoetewey (2012) pushed beyond the conventions of traditional usability—functional literacy—and instead sought to evaluate the usefulness of the Web sites based upon the myriad kinds of work local citizens wished to do using information on the site. As they write, a "focus on usefulness rather than traditional usability prompted [the users] to negotiate the goals of the Web sites to emphasize the functions that support citizen knowledge work" (p. 260). Further, "[b]y asking citizens for what purpose they would use a site and listening to their stories of use, we were able to better understand what usefulness meant for them" (p. 262). By evaluating a web tool for its ability to assist users in their desire to obtain the necessary information for subsequent civic action, Simmons and Zoetewey (2012) reframe usability as one process of learning about the thoughts, problem-solving concerns, and desired paths of action of residents as it relates to environmental civic action. Productive usability is an apt theoretical framework for assessing risk-based geovisualization tools because it affords space for individual problem solving and an opportunity to listen to users' "stories of use." This approach allows technical communicators to draw meaningful connections between the use of a tool and a users' risk perceptions and literacy in terms of complex environmental problems; this opens up pathways for users to openly discuss their problem-solving processes and voice their concerns about risk in their specific locale. My argument here is a theoretical one: that usability testing with risk-mapping tools such as Climate Central's Risk Finder offers technical communicators a unique opportunity to develop localized models for risk communication in the context of information design by seeing how local users actually use tools pertinent to risk. The practical considerations of my argument are discussed below.

DESIGNING A STUDY: CONSIDERATIONS FOR RISK AND USABILITY

In order to observe what neglected knowledge citizen users have and harness that knowledge for reshaping risk communication strategies, technical communicators conducting usability tests must—echoing Patricia Sullivan's (2014) recent sentiments—fight against ethics of control, indeed resist the urge to control users. In designing usability protocols and scripts for interactive geovisualizations, users should be allowed, after they are informed about the tool, to choose their own pathways for solving problems or gaining information important to them. What are the things people want to use this tool for? Are there things they want to do but cannot? What are the concerns of a local populace? How do their backgrounds (time spent in the area, political affiliations, age) inform these decisions? What are their perceived levels of risk? If, as Grabill and Simmons (1998) claim, "risk perceptions are determined by real and localized situations" (p. 419), and too often information-deficit approaches to communicating risk are arhetorical, "decontexualizing risks and failing to consider social factors that influence public perception of risk" (p. 416), then usability research attempting to address these concerns should be infused with the known factors of effective risk communication and try and extract just what the real, localized situations and the social factors at play are. Testers of risk-based interactive geovisualizations might consider the following areas of exploration, with particular attention paid to the specific locale or community where the research will be conducted. I rely on my own place in Norfolk, VA below.

Previous experience with inundation

For Climate Central, the Risk Finder tool provides interactive data on how rising sea levels brought about by climate change increase the risk of coastal inundation. While there is far from consensus on the topic, research has shown that people who have had direct experience with flooding are more likely to reveal concern over climate change and view the issue in more certain terms (Spence, Poortinga, Butler, & Pidgeon, 2011; Whitmarsh, 2008). Norfolk, a city that is quite familiar with flooding, has a large population of residents who have experienced flooding to some extent, whether through tides, storm surges, or rainfall. Are there any observable differences in the ways in which users who have direct experience with flooding use the tool? What role does direct experience play in use of the interactive risk-based geovisualizations?

Place attachment

Home to the largest navy base in the world, a significant portion of the population of Norfolk is military personnel and are thus quite transient in their living arrangements. What role does a user's sense of "place" play in their use of the tool? Researchers at the University of Victoria (Canada) have found that "place attachment" is a unique predictor of climate change engagement (Scannell & Gifford, 2013). How might close attention paid to the amount of time spent and sense of place attachment in users impact their use of the tool?

Changes in perception

This one is of great interest and potential: does the actual act of visualizing one's neighborhood inundated change the perception or risk of sea level rise in a person's mind? A representative at Climate Central, who has found that over 80% of their users focus on the mapping (as opposed to comparison, analysis, forecast) feature of the Risk Finder tool, stated that the visualizations of the web tool were designed to communicate risk (D. Rizza, personal communication, December 6, 2014). Does user interaction with the tool itself, indeed the process of personalization, change any perceptions of risk? beliefs? attitudes? What might that indicate about the receptivity and power of risk visualizations in the strategic messages being communicated to coastal southeast Virginia?

Exploration of emotions

Cognitive psychology plays an instrumental role in understanding risk perception and for explaining the lack of urgency in "distant" global environmental concerns, but emotion or the "normative ethical dimension" (Roeser, 2012)—which drives human decision making—typically plays a minimal role in risk communication and policy making. What emotions are driving a given population to use a tool? What is their emotional state while using the tool?

CONCLUSIONS

These are not an exhaustive group of considerations when designing a usability study for interactive risk-based geovisualizations. There are many other factors, such as political affiliation, gender, and age, that would provide some insight in the continued development of critical rhetorics of risk. Regardless, I contend that a productive usability approach to risk-based interactive geovisualization tools not only improves the product for the designer but also provides key insights for technical communicators interested in risk communication by identifying key decision-making processes, visual risk literacy skills, and even risk perceptions from a local population—all of which can play an instrumental role in more effectively communicating risk to a specific community..

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