Informed Design Concept

Prepared by Caleb Steele on 17-Nov-2022

Science & Technology Infusion Division
Western Region Headquarters
National Weather Service
National Oceanic & Atmospheric Administration

Contents

goal

Graphical communication that is **intentionally designed in service to our message**, maximizing our reach in fulfillment of our mission to "*Provide weather, water and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy.*"

We achieve this through the application of **messaging efficacy** and **graphic design** principles.

messaging efficacy:

what makes a message effective?

Perceived Susceptibility
[this can happen to ***me***]

Perceived Severity
[this is serious]

Self-efficacy
[I can do something about it]

Response efficacy
[what I do would make a difference]

[Chapman University: NWS Messaging (2021)]

Dr. Ann Gordon of Chapman University has done tremendous research on fear and it's role in disaster preparedness. A 2020 FEMA survey indicated that while 98% of respondents admitted that they are susceptible to at least one disaster where they live, only 68% have taken at least one of the three recommended preparation actions. Why the gap? It all comes down to fear and how we react to fear. Dr. Gordon's work reveals the keys to a successful response.

Perceived Susceptibility. People need to identify with and relate to the fear. If they don't believe that it can happen to them, they will see no need to take action, especially preventative action.

Perceived Severity. People need to relate to the seriousness of the situation. Extreme events happen all the time, but how has it impacted them? Weather can and does take lives and damage property; we need to make the severity clear and known.

Self-efficacy. Now that we have their attention through fear, the management of that fear is key to taking action. If people do not know what they can do to protect themselves, that fear is ignored. Action statements for individuals will help them manage fear and take action.

Response efficacy. Call-to-actions alone are not enough. They have to clearly relate to the induced fear in a way that makes it feel like doing something really will make a difference.

Any messaging we develop should strive to include these four principles.

2020 FEMA National Household Survey
https://fema-community-files.s3.amazonaws.com/2020-National-Household-Survey.pdf

98% acknowledge that the occurrence of at least one disaster type could impact where they live

47% believe that preparing can help in a disaster AND are confident in their abilities to prepare

graphical excellence:

what makes a graphic effective?

Clarity
[concise, legible, easy to understand]

Visual Hierarchy & Layout
[effective visual hierarchy, "information zones"]

Consistency
[look and feel - both external and internal consistency between elements like color, photos, icons]

Having our message down in text form is not enough. The best way to get that message from our brain to the brain of our partners and the public is through the use of visuals....weather graphics. For weather graphics that add to, and maximize our message, instead of competing with, there are three main areas in which to focus.

Clarity. Embracing clarity means our graphic is concise, especially if it is posted on social media. Another aspect of clarity is legibility. This includes making sure our font is easy to read, and our text high-contrast. Finally, we want our graphics to be easy to understand. This means limiting jargon and words of estimated probability and impact (WEPIs).

Layout. Layout design is a core tenant of graphic design, with some easy-to-grasp rules that harness the power of visual hierarchy and intentionally design information zones.

Consistency. Finally, much of the social science indicates that consistency plays a big role in building trust. Having a consistent look and feel, not only between graphics and offices, but consistency within a single graphic between elements like color and the use of photos and icons maximizes our message.

> ***"Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space."***
>
> - *Edward R. Tufte, The Visual Display of Quantitative Information*

clarity

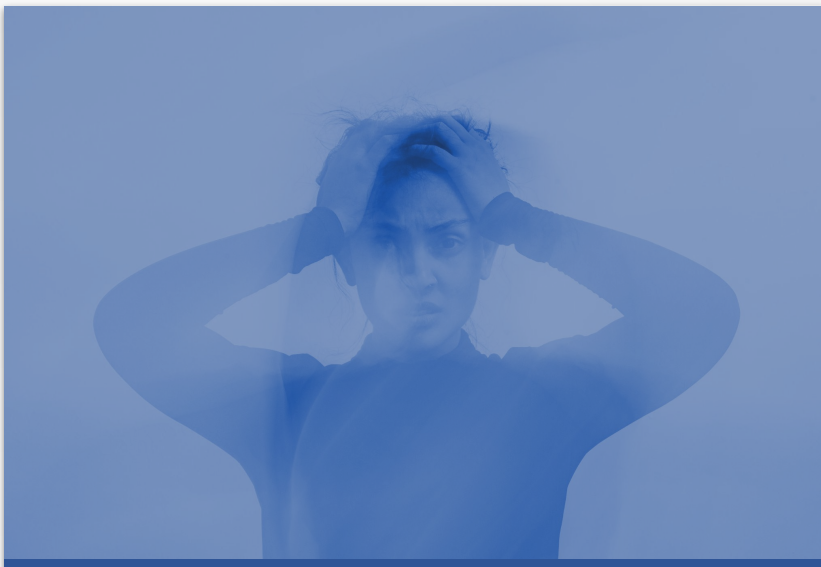
Tell it like it is. Oftentimes, our product/watch/warning/advisory names do not mean the same thing to the public as they do to meteorologists. The public often doesn't know what our criteria is. So, our "taglines" we use in messaging should focus on what we actually mean - use **plain language!** We can still use WWAs in our messaging, but we also need to describe them and make sure the message comes across even if the end user doesn't understand what the product means or what the threshold for that product is. Some examples are below.

Go from this...

- Wind advisory in effect for the area today
- Winter storm warning tonight

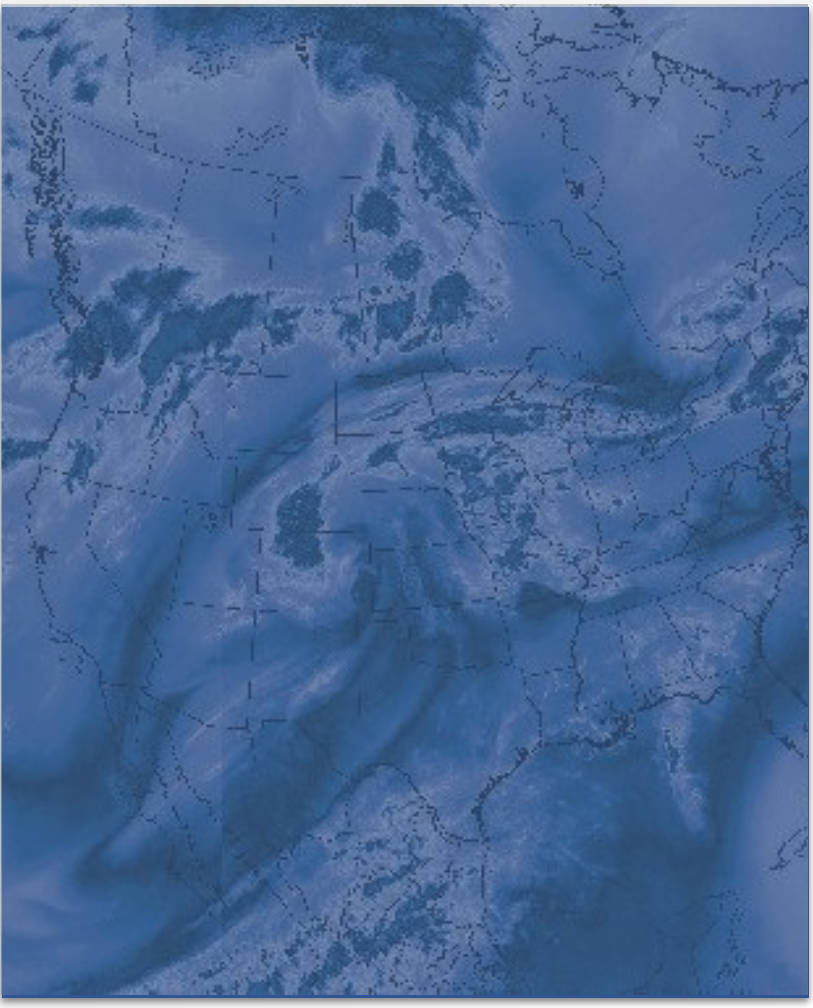
...to this!

- Strong winds (up to 40mph) will blow unsecured objects and cause difficulties with highway travel
- Heavy snow will cause reduced visibilities and rapid accumulation of snow, making travel very difficult to impossible



"Both prior social science research and NWS service assessments have demonstrated that many members of the public, and even some NWS partners, **do not understand** the distinctions among the terms used in the different WWA products or their intent."

NWS HazSimp Public Survey - Final Report, June 1st, 2018



This includes visuals too!

Things like technical model or satellite imagery are visual jargon. As meteorologists, we look at these every day and can interpret them as soon as we see them! However, the general public does not. So, we have to think about a plain language concept when including images in our graphical communication as well! Our end-users, both our partners and the public, generally live at the surface and care about the surface. This means caution should be used when showing non-surface visuals, and careful explanations should be included when used!

Let's talk WEPIs!

Plain, clear language avoids **W**ords of **E**stimated **P**robability and **I**mpact. Words like ***possible***, ***expected, chance***, ***likely***, ***significant***, and ***notable*** mean almost everything under the sun to different people as the ridgeline chart from Lenhardt et al (2020) illustrates. As meteorologists, we would care if our forecast grid contained a 15% PoP and we thought it should be 75%. But using WEPIs create the same discrepancy - that is why they are easy to use and easy to agree upon! A clear message avoids these words or at least conditions them with an adjective. Resource: Precision in Language.

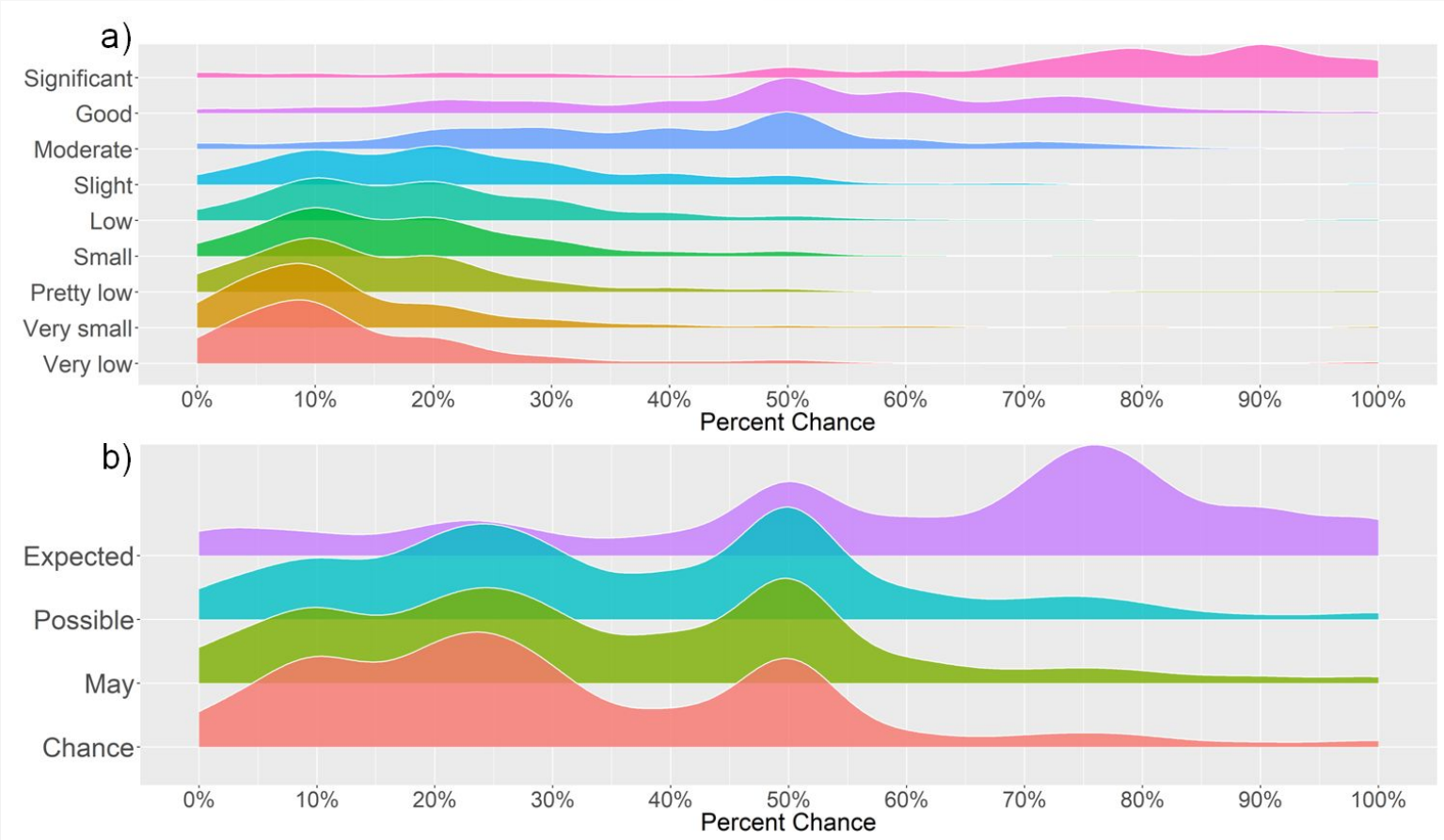
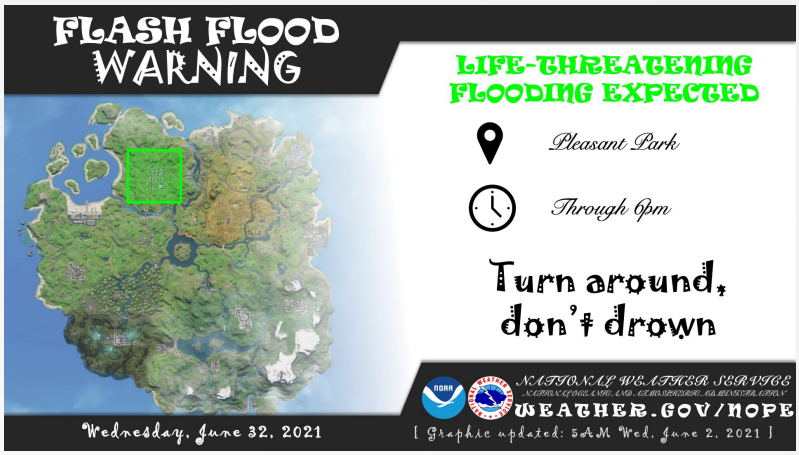


figure from Lenhardt et al (2020)

Brevity is the soul of wit.

Shakespeare's Hamlet character, Polonius, said it best. Sometimes less is more. Our graphical communication should be brief and concise. A single weather graphic will never be able to tell the whole story - the objective should be to present the least amount of information required to invoke interest and inspire additional action - such as clicking through to get more information. Weather graphics are essentially...ads.



What's easy is easy.

Weather graphics are first and foremost communication pieces. Especially if there is dangerous weather that requires action to protect life and property. While it is totally okay to explore them as art during the sunny and 70 days, when action is required, we need to make the information as easiest to absorb as possible, which means using legible, clear fonts that are easy on the eyes.. Hopefully the completely fictitious example in the upper-right illustrates this point well.

Relatable impacts, not hazards.

An inch of snow is a meteorological hazard, not an impact. Do impacts linearly increase with snow amount, or do more factors play a role? Ask yourself "So what?" to refine down to a relatable message. Take the once again completely fictitious conversation below. While we could say something like "Winter Weather Advisory" or even "1-2 inches of snow expected" this doesn't really get at what the impact will be - making it not the most relatable.

Yo, what's the weather gunna be like?

1 to 2 inches of snow expected

That sounds like nothing, so what?

It will fall in a very short time around rush hour

Okay? So what?

The commute is going to get messy

Ohhhhh. Thanks fam. I'll wfh today.

visual hierarchy & layout

If everything is important, nothing is. In weather graphics, we can use **visual hierarchy** to set importance and direct attention. Some bite-sized training on how we can apply this principle for weather graphics can be found on the Western Region STID Visual Science Site. Not just graphic design principles, the tenants of visual hierarchy are very much supported by behavioral/cognitive science as ways to maximize comprehension of our communications.

If you already took a look at the STID Visual Science Site, you will notice a visual hierarchy module that lays out concepts like **position**, **size**, **color**, **direction**, and **number**. An equally important aspect of layout design is the use of negative/white/**blank space**. These are all variations of the themes of the **Gestalt principles** - which describe how humans interpret objects.

There are natural paths our eyes will follow across objects. Absent any other guides, our eyes will generally flow on some variation from the upper left to lower right (for cultures that read text from left to right). So, position on the graphic is a key component we can intentionally design. This means we should generally put the most pertinent information (like a title, or bottom-line-up-front) in the upper-left corner of a graphic. Size and color follow suit to draw attention (different colors, different sizes) attract our attention off this default path.

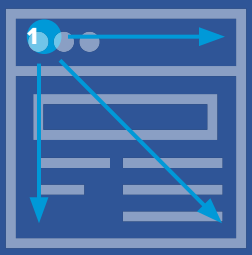
Color is a powerful tool when used intentionally and appropriately. It can be used to direct attention, as well as order (think severity scale). But overused, quickly loses its utility and instead distracts and adds confusion.

For weather graphics especially, negative space (or blank space) is also an important aspect of our graphic design. Filling every square inch with content hurts our visual flow (our eyes don't know where to go), and looks cluttered. Adding information to the point where it hurts comprehension goes against our reason for creating the graphic in the first place!

Visual Hierarchy & Layout Principles for Weather Graphics

Position

In left-to-right reading cultures, we generally perceive the upper-left corner first, and generally follow some path to the bottom right.



Size

Size guides interpretation of importance. Generally the bigger, the more important, although simply a change in size can command attention.

Color

Color, when used appropriately, can guide attention and indicate severity. When misused, it loses clarity.

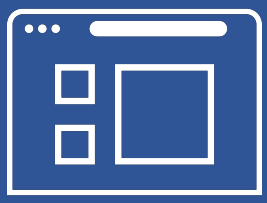
Color to draw attention:

Color to order:

Too much color:

Negative Space

Negative, or blank space, allows content to "breathe" and keeps a sense of organization, and helps your eyes to "flow" across the visual.



Taking these principles into account, we can also combine a few of these concepts into the idea of an "information zone". That is, a place intentionally designed to house our pertinent information, which will lead us nicely into our next topic, consistency. Intentionally designed and placed information zones unlock our ability for consistency, and enable us to take advantage of recognition-over-recall. The recognition-over-recall principle is a common theme in UI design and can be put another way; it is probably far easier for you to know where to look for information than trying to remember that information itself, right? Designing in a way that takes advantage of how our brain processes information leads to better comprehension and flow of information from the brain of the expert to the brain of the user.

Above is a graphic from the Chapman University study of NWS weather graphics, labeling where important pieces of information are placed in each graphic and how they vary.

Recognition vs Recall

Seeing a friend:

"Hey I recognize you!"

Trying to remember their name:

"But what is your name?"

We can easily recognize that something is familiar, but more specific details, like names are harder to remember. However, having a cue, like a face in front of you, can help "jog your memory". We can take advantage of this way we store and process information by designing a consistent look and feel through information zones.

consistency

Consistency is one of the most important building blocks of branding and is necessary for fostering trust and building recognition. Why is it important that our communication is recognizable? Social media is rife of information, especially weather information (240-hour deterministic forecast maps). Building a consistent brand increases trust, and if the information source is more trustworthy, action is more likely to be taken when necessary and suggested.

One of the silver linings of the COVID-19 pandemic is that it offered numerous opportunities to study risk messaging (albeit health risk, not weather risk). We can take some of the lessons we have learned and apply them to our own messaging. Two such studies are linked within the Informed Design Google Site, and also below.

Source Credibility, Expertise, and Trust in Health and Risk Messaging

Qualitative analysis of visual risk communication on twitter during the Covid-19 pandemic

In the previous section, the concept of recognition vs recall was covered, which relates directly to the idea of consistency. If users can instantly identify the source, level of trust, and where the pertinent information is, they are more likely to get what they need in the brief time they view our communication, or become engaged enough to also follow any links we include.

This consistency not only applies to the look and feel of graphic-to-graphic from shift to shift, but also office to office, and even to the exact verbiage we use. While tailoring our communication to each unique event is desired, applying all the principles of messaging efficacy can be challenging. Rather than having to reinvent the wheel every time, having vetted call-to-action statements to choose from will not only increase our messaging efficacy, it enables quicker and easier generation of our graphical communication!

Pictorial consistency: Which photo is most compatible with the stated message?

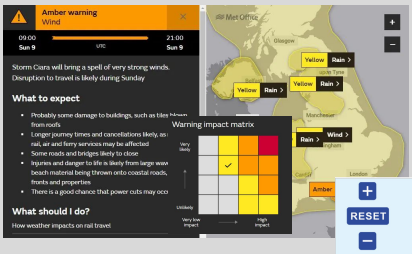
Consistency does not only just apply within an office (shift-to-shift) or among a region or agency. Consistency is also important within a graphic. The inclusion of photographs in weather graphics is very popular. The Pictorial Superiority Effect supports the use of photographs, and even one of the previously linked studies on risk communication during the COVID-19 pandemic would suggest the use of them. But not all pictures are equal.

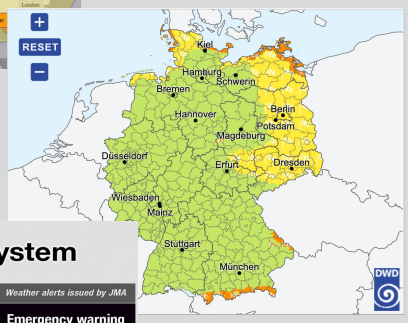
A picture is worth a thousand words, right? So, our guide for using pictures should be, “are those words the same words as our message?” At the top of the page are two images with the heart of a message overlaid. Does the stock photo of a model posing in snowfall convey danger? Or does the picture of snow-covered highway with low visibility? To get our message through, we need to refrain from “nice” pictures, and instead show pictures of the actual impacts we expect. Although controversial, if we intend to save lives (and property) by inspiring action, this should be worth it, especially if we reserve the use of such photos for eminent forecast graphics vs purely educational graphics. This idea of consistency would also apply to other visual elements used like icons (i.e. using icons of similar style/from the same collection).

The power of color was previously but briefly demonstrated, but we also need to include color as we talk about consistency. Using consistent colors, and ensuring individual colors carry the same meaning across a graphic greatly aids in interpretation.

Consistency: global color

Risk colors that span from green to red or purple are about as universal of color palette as you can find, as evidenced by the weather communication examples from around the world shown below (UK, Germany, Japan)





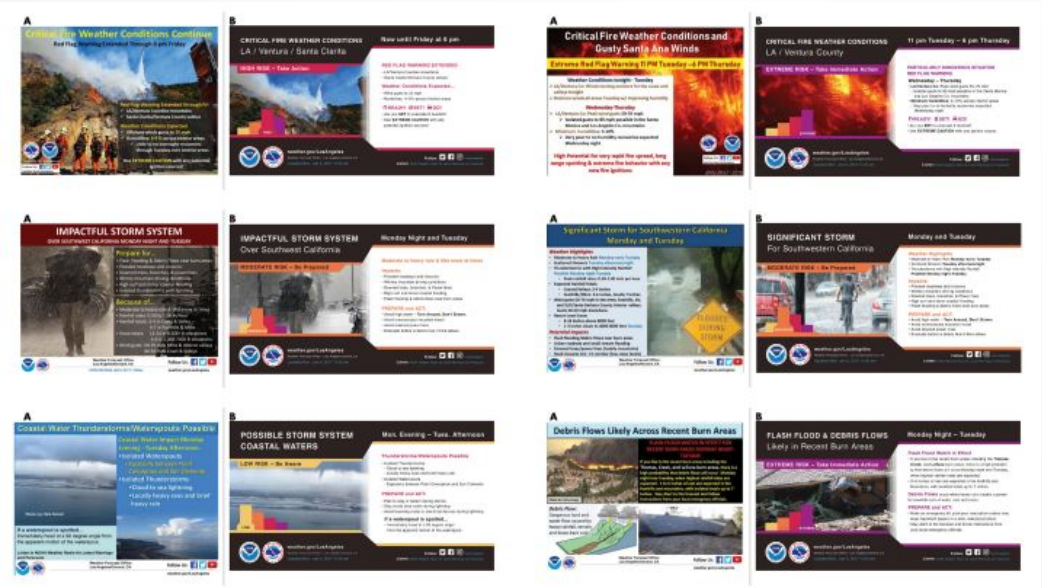
5-Level Warning System

Warning Level	Action to take	Information provided by local government	Weather alerts issued by JMA
5	Must take measures to protect lives	Disaster information	Emergency warning
4	Must evacuate	Evacuation order / advisory	Landslide alert info. etc.
3	Elderly people must evacuate	Evacuation preparation information	Rain / flood / storm surge warnings etc.
2	Should check evacuation procedures	—	Rain / flood / storm surge advisories etc.
1	Should be on alert for disasters	—	—

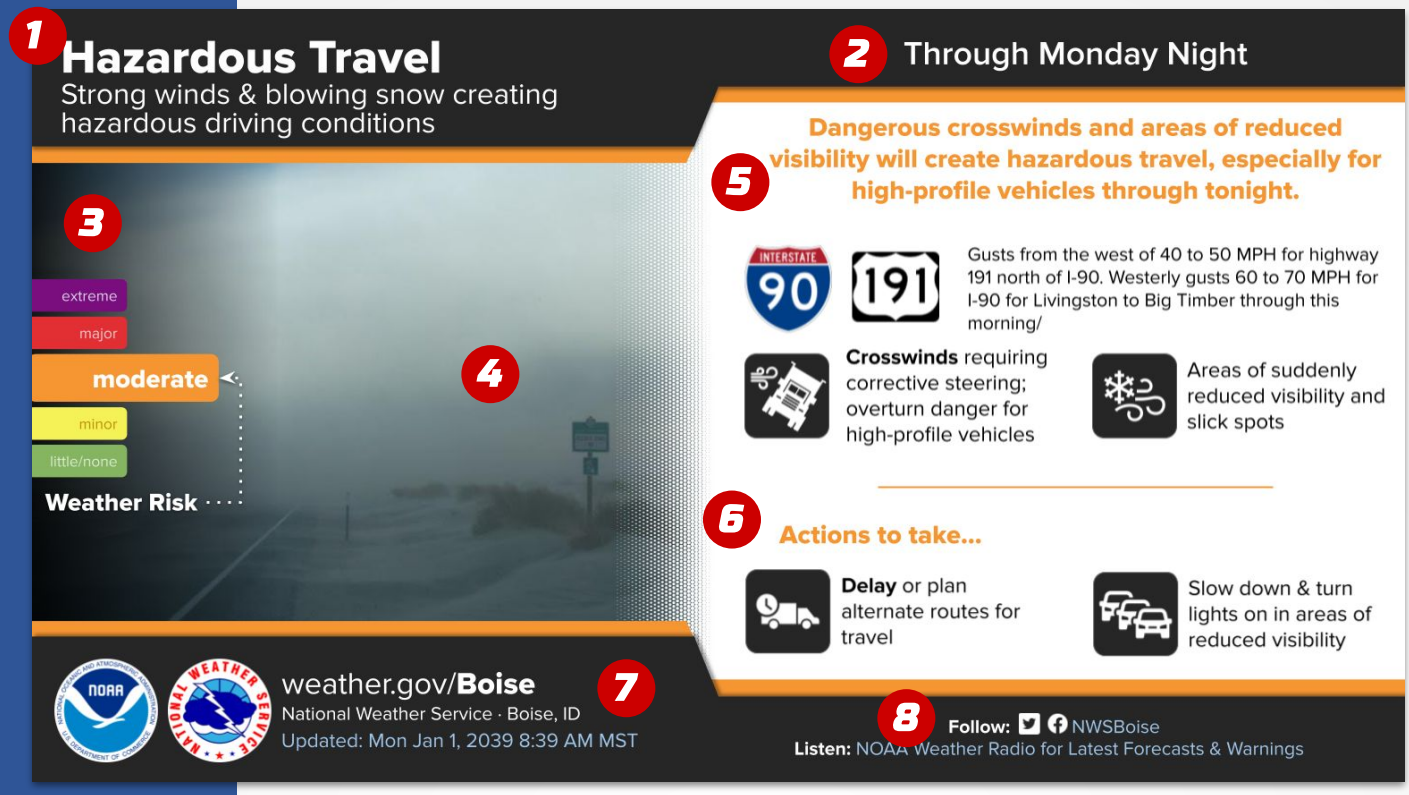
informed design
prototype

Atmospheric Science + Social Science + Graphic Design

Fusing atmospheric science, social science, and graphic design principles to enhance the effectiveness of forecast information - helping to take it the 'last mile' and ensure the right actions are taken by the right people at the right time. An application of the Informed Design Concept.



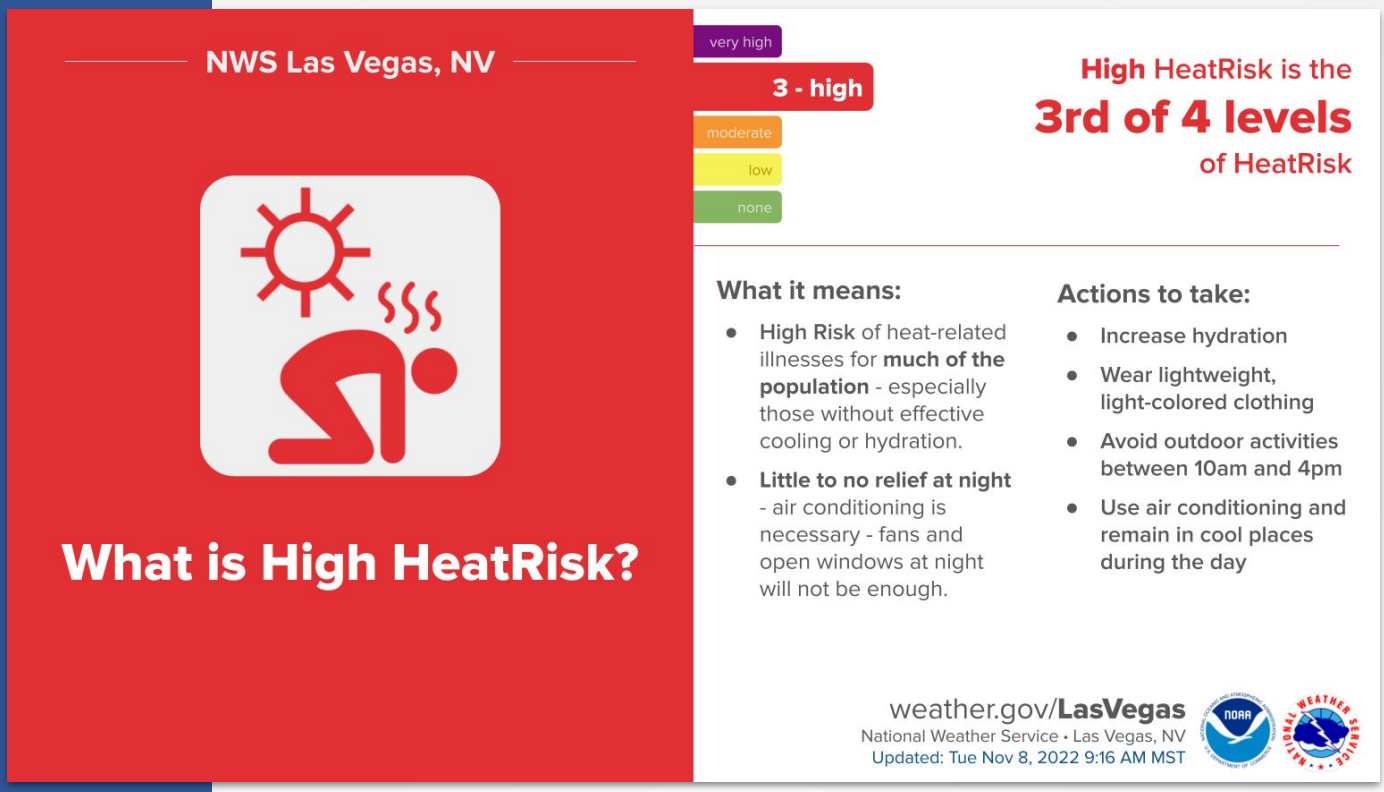
The current framework for applying the informed design concept into a prototype is almost entirely based on the work of Dr. Ann Gordon (social scientist) and Eric Chimenti (graphic designer) at Chapman University [NWS Messaging Study].



The Informed Design Prototype Event Template

Two-part layout with intentionally designed, consistent, information zones and color.

1. Title in upper-left corner (where eyes tend to go first)
2. Timing information clearly presented above our main information zone
3. Threat/risk scale identification **[perceived severity]**
4. Picture of hazard to take advantage of associative and pictorial superiority effect (as opposed to a “nice” picture) **[perceived severity, perceived susceptibility]**
5. Concise summary of weather and impacts, including the use of icons **[perceived severity, perceived susceptibility]**
6. Actions to mitigate impacts **[self-efficacy, response efficacy]**
7. Consistent branding in bottom left corner **[recognition, consistency, trust]**
8. Additional resources **[self-efficacy]**



The Informed Design Prototype Educational Template

- Large colorblock design
- Features large icon, scale, and clear description
- Explanation of what the level/hazard means
- Clear actions to take (messaging efficacy)
- Two-part layout with designed information zone- eye is drawn from upper-left by color and large icon, then down to lower right corner by branding

Resource:
[Informed Design Google Site]