Radiation Exposure PSA Proposal:
Using the Internet to Placate Fears

Response to *Radiation Exposure: What Not to Fear Scholarship Competition*

Ian Wietecha-Reiman
22 March 2018

1. Introduction

From the light emitted by the sun to the gamma rays produced by potassium in our own bodies[1,2], radiation is in every person's life. But among the general public, there is anxiety or even blatant mistrust of the very word radiation. In Japan, following the Fukushima Daiichi nuclear plant incident, a study found that mistrust of low dose radiation stemmed not from lack of knowledge, but rather from uncertainty concerning scientific facts and the government entities providing that information[3].

It is important that we, as the American general public, not only be informed of the rudimentary science of radiation, but also of its validity. Radiation impacts the medical procedures we use, the food we eat, the methods of communication available to us, and more, most of which is regulated by the government. We need to have the knowledge of and confidence in radiation to not only make decisions in our lives, but to elect government officials that can accurately represent us and our needs. If we don't have rudimentary information and confidence about radiation, then our potentially lifesaving and quality of life-enhancing decisions are compromised.

2. Communication Approach

Communication (and education) on radiation needs to be effectively focused, informing the general public about safety, risks, benefits and instilling confidence of these facts so as to dispel unwarranted fear. In identifying specific target audience(s) within the greater collective, we can tailor the message for highest impact on that specific audience. For this purpose, I have made certain assumptions as to who is targeted (see Table 1).

Table 1: Assumptions made about the American general public

Assumptions
They are unknowledgeable about radiation other than what they glean from media (news and movies).
At best, they are neutral towards radiation
At worst, they are hostile towards radiation
In general, they are wary towards radiation
They will not learn about radiation/science out of their own volition (hence the reason for this proposal).
They are English speaking Americans.
They have some form of internet access.

Table 2: Age groups for the American general public

Age Groups
Children in elementary school
Adolescents in high school
Young adults
Adults
Elderly

Based on neuroscience research, Dan Dennett, an American philosopher, writer and cognitive scientist, states that building a relationship through humor is fundamental to getting one's message across and, eventually, 'selling' that idea, in our case, that radiation is a benefit to humankind.

> *'In his Ted talk, Dan Dennett, an American philosopher, writer and cognitive scientist, shares why people get attracted to [four] things: cute, sexy, sweet and… funny. Using humor in advertisement and marketing makes your offer seem more "human" and builds a relationship with your audience, [… which is] fundamental to forming positive relationships. We buy from people we like, and humor is the easiest and fastest way to get there. Any campaign you work on has the objective of selling. But if you break down the process, sales never come first. You have a list of steps your prospects need to go through before they are ready to see the offer. And every step has a different objective. It can be to engage prospects by asking them questions, increase social interaction with social media share buttons and comments, or evoke particular emotions. Here is when you want to focus on humor. And all these steps indirectly prepare your prospects to eventually buy your product.'*[19]

Using identified targeted audience break-outs and assumptions (see Table 1 and Table 2), I believe that making humorous public service announcements (PSAs) in the form of internet infomercials and videos would help to reduce fear factor. (Infomercials provide a message, while entertaining.) Earlier this year, the American think tank Pew Research Center published a study stating that 89% of adults in the U.S. use the internet[4]. Internet access has become almost as ubiquitous as radiation. People have personal computers, cellular devices with internet access, and in many places access to public-use computers, making online PSAs a viable strategy to communicating with the audience.

There are many forms and mediums for communicating online; for simplicity's sake, let's focus on the video streaming model of advertising as it is an effective, yet nuanced process and one of the most widely used services on the internet[5]. On a video streaming service, there are two primary methods of advertising: banners, and videos. Banners present a static, or even animated image to communicate a simple idea using graphics and text. Sometimes audio is embedded, but that is really annoying to the user and will most likely irritate them rather than garner their attention. The focus of a video streaming service is the video, so peripheral banners are unlikely to attract people. Videos, however, flow naturally into the functionality of a video streaming service.

There are several types of videos. Short, non-skippable videos are typically between 5 and 15 seconds long. They use the promise of a brief intermission before their video to make the user feel less inconvenienced by the interruption, while still conveying the message. A more user-friendly iteration is to employ a short, skippable video. The user typically has to watch the first 5 to 6 seconds of the 15 second communication before they can opt out of watching the rest. This option placates the user even more due to the shortened time delay. Additionally, to make sure that they don't have to wait a second longer, people will be eyeing the timer, and along with it the screen, increasing the potential of communicating interest in the message, or at the very least awareness. Along the same line are long, skippable videos. These typically run for 30 seconds to 1 minute. They maintain the benefits of a short, skippable video, and also allow a greater degree of communication. However, the chances of a person watching the whole thing unless they are invested in the topic are much lower.

The last type of video is played on its own, rather than preceding another video. Standalone videos would be the content the user actually wishes to watch. The content and duration of a video is up to the discretion of the publisher. But for it to be successful, people need to know about it and want to watch it, which is where the previous types of communication come into play. While the bulk of the message is communicated through the video (or perhaps a series of videos if they are effective enough and it is prudent to do so), shorter videos can be used to increase the interest of the potential audience and inform them of the existence of a very interesting video that would be well worth their time to watch.

The other option for marketing is social media. Memes, found all over that platform, can be conducive in transmitting information in a humorous form, which for most people helps to anchor that information in the subconscious, again allaying fear and beginning the acceptance of the information.

Marketing in social media typically takes place in sponsored posts which show up in a person's feed (where they see posts from their social media buddies and things they follow). These sponsored posts can sometimes serve as banners or short videos, so the same rationale applies. In this context, it is also showing up coherently with the media the audience is concurrently consuming and has a good chance of garnering their attention, or at least acknowledgement.

An effective PSA campaign should comprise a mixtures a pre-video videos and sponsored posts to drive up attention an interest for the PSA itself. If a PSA is released on its own, there is a good chance that it will just be ignored by the bulk of the intended audience, especially with the massive amount of other media they can consume.

3. Communication Strategy and Supporting Evidence

People generally view what interests or entertains or conforms to their beliefs. Based on the assumptions in Table 1 about people's attitudes towards radiation, two PSA campaigns can be made (with the first one mentioned the more pressing one).

The first target audience, as determined in Table 1, is those who are most distrustful and wary of radiation. They have initial feelings of hostility or wariness of radiation, so we can play upon those feelings. Short, non-skippable video ads can advertise "The Truth about Radiation." These advertisements would be designed to use the sense of ambiguity and mystery to try to intrigue people who are hostile towards radiation. The goal at this stage is not to change anyone's mind. This audience does not care, and potentially does not want their mind changed. Rather, it is to expose them to new thoughts, which can be an effective method over time. With the proper use of imagery and sound to create tone, we can intrigue[20].

The second target audience, as determined in Table 1, will be those who are unsure, or possibly just uninformed, about radiation. They have either neutral or no preconceptions about radiation, leaving little emotion to be played upon. This means the videos have to primarily be entertaining. Short and long skippable ads can help garner possible interest from this audience. These videos can be factual in nature as they have no capability to spread misinformation.

Effective deployment would be to pursue a combination of both campaigns. Though they lead to the same outcome and PSA, they seem overtly different. The first campaign, though no data or information is given to this effect, has a tone that seems to oppose radiation, or at least make it seem like there is something someone doesn't want the general public to know, and it will open the charade right up. The second campaign is a standard information campaign and has pro (or at least neutral) radiation tones. These two campaigns in tandem would make it seem like some really interesting argument is occurring between two camps over radiation (assuming they didn't give too much attention to who produced the video). This could help draw in more interest from an audience that also wants to be entertained.

After viewing the promotional campaigns, the audience then has the option to navigate to the PSA, most likely through an embedded hyperlink allowing the user to simply click the video they watched and be automatically navigated to reduce the amount of perceived work they have to do. The PSA should address the misconceptions people hold about radiation in a credible and relatable way to dispel unwarranted distrust and misgivings about radiation. Additionally, the PSA can have embedded links that will take the user to further, and possibly more in depth sources of information if they are so interested.

The following paragraphs layout the structure of the PSAs and present background information. Though some of the information to follow might be inappropriate for the audience,

and certainly for audience retention, higher level information serves as foundations to effectively convey lower level information.

The PSAs should be structured in a way that addresses the audience's concerns and misgivings, while minimizing complexity. The first section is to introduce the audience to the general concept of radiation. Here, we try to help them associate radiation simply with energy transfer. Radiation is no more dangerous than conduction (transfer of heat through a solid) or convection (transfer of heat through a fluid). Just like touching a hot oven, too much energy from any source can be dangerous, but shining a flashlight on your hand has the same amount of danger as placing your hand on a room temperature plate. That should be the guiding principle throughout the PSA because there are forms of radiation people should protect themselves from, like using sunscreen to protect the skin from ultraviolet (UV) radiation, but microwaves travelling through the air are also radiation. At worst they make things a bit warm, but generally they will transmit through solid matter[14].

After that, non-ionizing versus ionizing radiation is covered to discuss how energetic radiation needs to be to be damaging and what they do. Understanding this is a key point in understanding what radiation is safe and what radiation actually warrants caution.

Non-ionizing radiation does not possess enough energy to remove an electron from an atom (ionization) [6]. On the quantum length scale, energy is not continuous like it is in classical physics. Rather, it is discretized. The discretization of energy is demonstrated by atomic absorption and emission lines, and by stimulated emission (which is used to generate LASERs). While a blackbody (a perfect absorber and emitter of light) will emit a continuous spectrum of light corresponding to its temperature, water in the atmosphere absorbs light of wavelengths 5.5-7.0 micrometers, and ozone absorbs harmful UV light[15]. Non-ionizing radiation broadly consists of microwaves, infrared (IR) radiation, and visible light. Microwaves and IR radiation do not have enough energy to change the electronic state (energy) of electrons. When they do interact with matter, they cause molecules to rotate and vibrate, respectively. Visible light, while it has enough energy to electronically excite electrons, does not have enough energy to ionize the atom[14, 16]. This mechanism is largely responsible for colors in materials.

Conversely, ionizing radiation has enough energy to remove an electron from an atom. This is the type of radiation that can cause damage. While a person can think of their self as a conglomerate of atoms, electrons are what hold those atoms together. Ionizing radiation removes an electron from an atom or molecule, forming a radical. Radicals can undergo chemical reactions with other molecules to oxidize them and change, or even break bonds. Most radicals are generated from water molecules in a person's body, which then go onto react with cellular components such as DNA. When the DNA strand is broken, the cell is not able to remake itself correctly and will either mutate, pass on aberrations, or die[17]. Shielding is also utilized to minimize exposure. Different parts of the body are less transparent to X-ray light, and it is this transparency and material density that vary the amount of X-ray photons detected to make the image[18].

At this point, people would be more interested in the type of radiation they should be cautious about. In this section, we talk about natural and artificial sources of gamma-rays. Gamma rays are high energy photons. When they are artificially made, they are called X-rays. But just because they are high energy doesn't mean they can only damage things. When a person

breaks a bone, the doctor takes an X-ray. The dose of ionizing radiation dwarfs what a person picks up from background radiation in their life[11]. X-ray photons are also used to make sure our food is clean. It is important to inform the audience that the duration and location of exposure matter concerning radiation.

This can smoothly lead into X-ray uses in medicine and food production, as well as a brief recap of other uses of radiation (radio transmissions, heating food, computer monitors).

And, as said before, the PSA should attempt to bring people in and retain them with humor. But sarcasm is the last tone this PSA should take. Though some people find sarcasm funny, it rarely is when directed at a person. So humor should be used, but never sarcastic or condescending.

Humor is where the issue of age group (see Table 2) is most prominent. For the mistrust campaign, the age groups that are most likely going to have developed a mistrust or radiation are young adults and older, possibly adolescents in high school, which could very easily define the target audience age. The goal of the proposal and the campaigns is to change people's set ideas, not influence developing minds (i.e. not the children). While children could be in the effected audience, the target audience is most likely adolescents and young adults, with adults and the elderly increasingly less likely. These age groups correlate better for their media intake, and possibly for humor, as well as still having the possibility to being open to new ideas.

With the proper use of facts, humor, and pathos, I truly believe this idea could work. The audience is clearly defined and can be written for, and the medium used allows dispersal of information without having to rely on traffic to a website people would have to go out of their way for. The facts are solid and well researched, and the topics are organized rationally.

4. Conclusion

There is unwarranted mistrust of the very concept of radiation among the American populace. But radiation is all around us. Most times it doesn't really affect a person, other times it can be harmful, and other times radiation can even be helpful. By communicating this idea to people, they can effectively made decisions in their lives that involve radiation without misconceptions or fear harming the process.

Based on a series of assumptions about the American general public and age groups, internet infomercials for PSAs would be most effective to reach the largest audience base most effectively. These infomercials and PSAs would use a combination of humor, information, and pandering to preconceptions to interest, and subsequently teach the audience.

In this manner, the American general public could be persuaded away from undue fear of potential radiation exposure.

The following table lists statements, facts, and statistics that could be used to design and organize the PSA.

Table 3: Facts and Statements to be used in the information campaign consisting of direct quotes, and statements.

Section	Statements and Facts
Introduction to radiation	Radiation is a way to transfer energy, just like conduction. Touching your hand to a cold window doesn't harm you, and neither does the radiation given off from a light bulb which is non-ionizing. Touching a hot oven is damaging, and so is the radiation from a nuclear blast, which are ionizing.
	Radiation transfers energy through very small particles, like helium ions, photons (light), or electrons. None of these are inherently dangerous ▪ Balloons are inflated with helium ▪ We use light to see ▪ Our body uses electrons to function The danger comes in how much energy the particle has
Non-ionizing vs ionizing radiation	"Non-iodizing radiation is low-energy radiation that includes radiation from sources such as sunlight, microwaves, radio frequencies, radar and sonar."[6]
	"Non-ionizing radiation has enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to remove electrons from atoms"[7]
	Non-ionizing radiation is also emitted from the earth as radio waves and infrared light (heat).[8]
	"Ionizing radiation is the high-energy radiation" "contains enough energy to remove an electron (ionize) from an atom or molecule and to damage DNA in cells" , nuclear weapons, radioactive material, x-rays[6]

Where does ionizing radiation come from?	"Ionizing radiation comes from the nuclei of atoms", "an unstable atom has excess…energy", "unstable nucleus emits excess energy as radiation in the form of gamma rays or fast-moving sub-atomic particles." [9]
	There are even radioactive isotopes of carbon (an isotope is an atom with a different amount of neutrons, but the same amount of protons) that is radioactive (C-14), and C is the most abundant element.
Why is it ionizing?	Ionizing radiation: It has enough energy to remove an electron from a molecule rather than make it vibrate.[10]
X-rays vs Gamma rays	X-rays are artificial, gamma rays are natural
Uses of Radiation and radiation in life	Radio communications
	Microwaving food
	Food irradiation "does not make foods radioactive, compromise nutritional quality, or noticeably change the taste, texture, or appearance of food. In fact, any changes made by irradiation are so minimal that it is not easy to tell if a food has been irradiated."[12] "Kills microorganisms that cause illness or spoil food."[12] "Uses Gamma rays from Cobalt 60 or X-rays from electron beams impacting heavy metal targets."[12]
	Medical "When x-rayed, our bones and other structures cast shadows because they are denser than our skin, and those shadows can be detected on photographic film." [11] "radioactive iodine (specifically iodine-131) is frequently used to treat thyroid cancer."[11] "Millions of Americans every year depend upon medical imaging exams to diagnose disease and detect injury, and thousands more rely on radiation therapy to treat and cure their cancers."[13]

Statistics	• Incidence of cancer in U.S. in 2013 population has decreased by 11% from 1990[21] • Five-year Relative cancer survival rates increased from 39% in 1975 to 62.7% in 2006 among African American populations[22] • "Aviation deaths since 1938: 54,000", "33,134 [coal miners and transporters] killed from 1931 to 1995", "56 Chernobyl deaths", "U.S. civilian nuclear reactor program: 0 deaths"[23] • Doses below 100mSv won't increase risk of reproductive effects[24]. Natural background radiation is around 3.1 mSv, though many people get excess of 20mSv annually.[25]

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