

Radiation Safety Decisions How We are Prone to Errors

AAHP Special Session

“New Frontiers in

Radiation Risk Communication”

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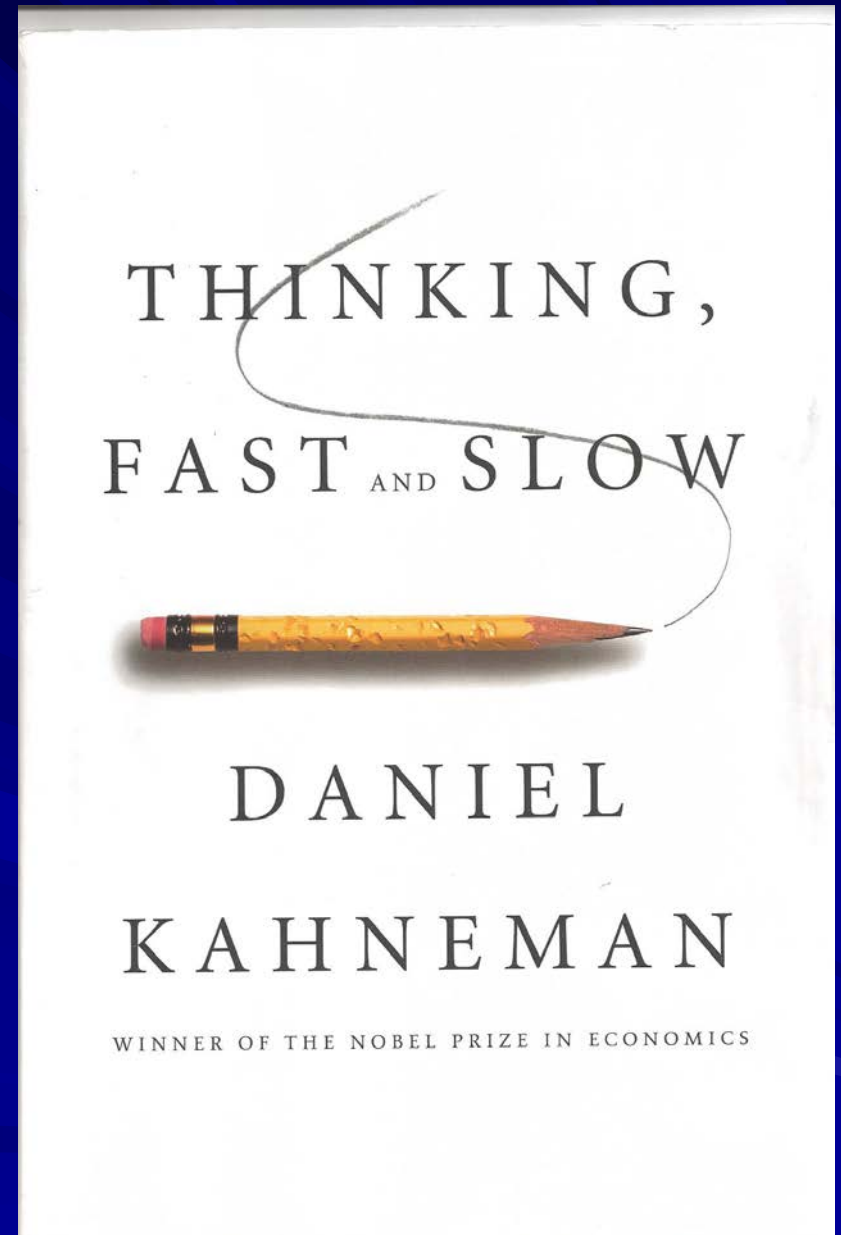


Overview

- How do we make decisions for radiation safety?
 - Do we have all the information needed ?
 - Role of the subconscious mind
- Role of fears and radiation mythology
- How we are prone to errors
- How to help a frightened person

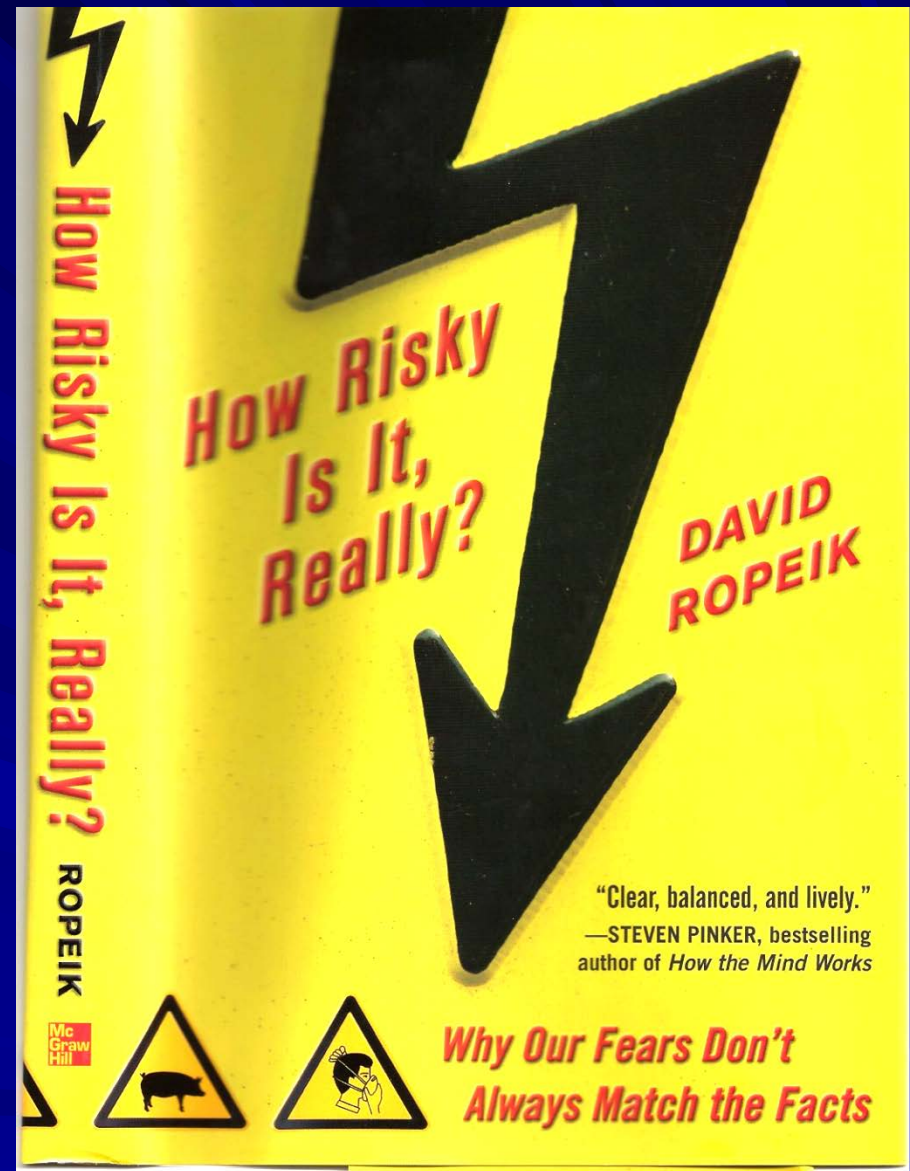


**Ferrar,
Straus,
and Giroux,
New York
2011**



McGraw –
Hill

2010



How Do We Make Radiation Safety Decisions?

- What information do we rely upon ?
- What observations ?
- What experience ?
- What others have told us ?
- How do we evaluate this information ?



Are Your Radiation Sources Safe?

- How do you know that ?
- What does “Safe” mean ?
- What data or understanding did you bring to your decision ?
- How long did you take to answer ?



Name five pieces of information related to your decision

1. _____
2. _____
3. _____
4. _____
5. _____

What is the Most Important Factor ?

- Survey measurements
- Dosimetry
- Sealed source design
- Regulatory limits
- Radiation Safety Plan
- Training
- ALARA –
Time, Distance, Shielding
- Inspections and audits
- Swipes and leak tests



**Do you have all the facts needed for
a fully informed, analytical,
rational decision ?**

- How much do you rely on information provided by others ?**
- How do you judge trustworthy data ?**
- Who do you respect as a resource ?**
- How would you defend your decision ?**

How does the Public Make Decisions for Radiation Safety ?

- Many of you were able to answer the question about radiation safety because you already have knowledge and experience
- How would you answer the question without direct knowledge or experience ?
- What information would you rely upon ?
- What source would you trust ?
- What would you conclude about safety ?
- How long would it take to decide ?

Making Decisions for Safety

- **We make countless decisions for safety every day**
- **Many are automatic and we do not even think about them**
 - Looking carefully before pulling into traffic
 - Watching where we step
- **We are constantly on the alert for danger**
- **When alerted - we make instant decisions for safety?**

Role of Fear in Decisions for Safety?

- **Origin of fears**
- **What is real vs what is imagined ?**
- **Does it make a difference ?**
- **Conscious vs subconscious mind**
- **How we make decisions for radiation safety ?**
 - **Why do people decide to run ?**

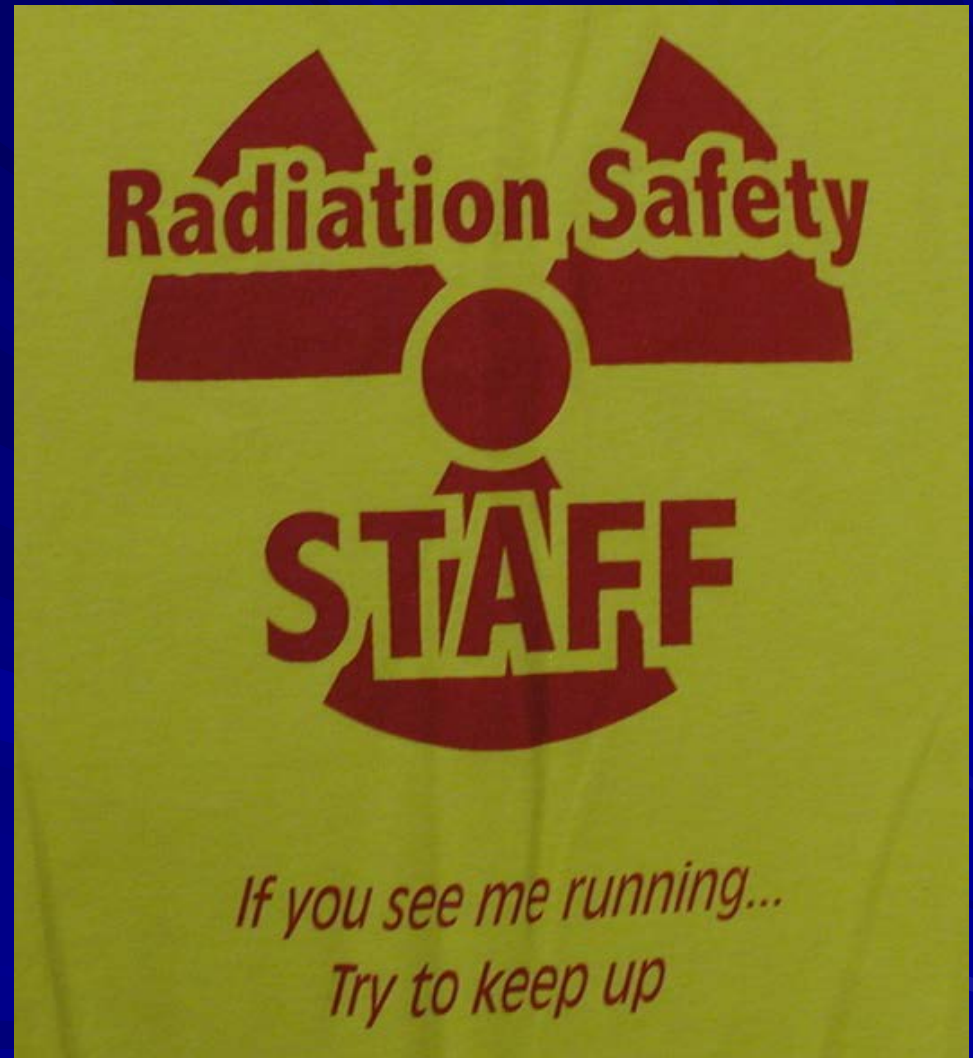
Is It OK to be Afraid of Radiation ?

- Fear is a feeling and all feelings are OK
 - Not to be judged as good or bad
- Difficult when basis of fear does not seem justified
- Fear is a response to pain or danger
- A car sliding sideways off the road will cause fear
- Radiation does not produce any sensation or specific stimulus to warn us of danger
- Radiation fears are not a true fear
- Radiation fears are based on imagination and mythology



Is it OK to be Afraid ?

■ What will you
think of doing
when the first
responders
are running ?



Fears are Natural and OK

- Fear is a natural response of our minds for our protection
- Our minds are always alert to danger
- We have survived by paying attention to our fears and when to react for safety
- However, all of our thoughts about being harmed

–May themselves be harming us

Fear May Be the Greatest Danger

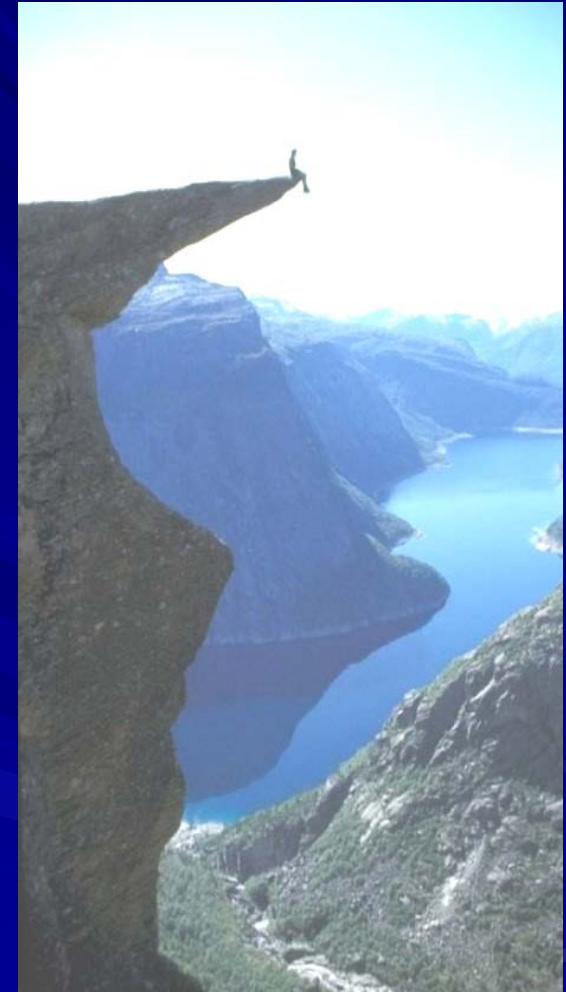
■ Fear, anxiety, stress, and worry kill through

- high blood pressure
- addictions, drugs
- heart disease
- weight loss or gain
- depression, insomnia
- suicides, abortions
- post traumatic stress disorder



Fears and Imagination

- All fears are based on imagination
- Fears summon powerful predictive forces
- Fear is about what might happen next
 - Not what is happening now
- Example – fear of heights
- If we tell that person,
“You do not need to be afraid,”
will that help them?
- Radiation fears are based on imagination of unacceptable consequences
 - Cancer and death



Two Systems for Safety Decisions

1. Conscious –

- Reason and rational analysis of facts -
- Favored by technical specialists
- May lead to intelligent decisions, but, **very slow** and takes effort
- For safety decisions, we often do not have all the facts, time to gather facts, or knowledge to understand them

2. Subconscious - Emotion, instinct, and gut reactions , **very fast**,

- Does not need all the facts
- Origin of most decisions, especially for safety

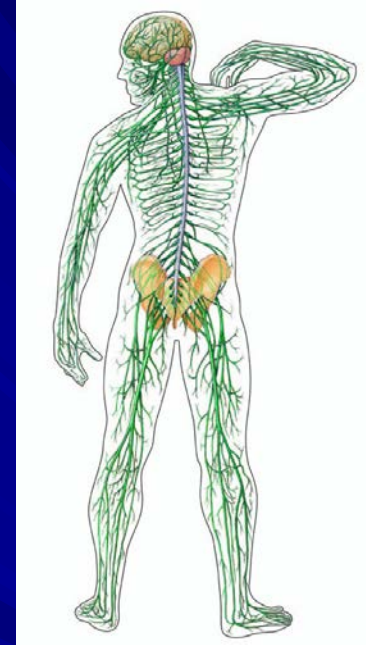
Role of Our Conscious Mind < 1%

- **Very Slow**, deliberate, rational, thinks, reasons, makes decisions and choices based on sensory input
- Source of knowing and awareness
- Serves as the captain of our ship, the giver of orders
- Processes information to make decisions
- Can only deal with one thing at a time



Subconscious Mind > 99.999%

- The seat of our emotions / creativity.
- Takes orders from the conscious mind without judgments
- A **Very Fast**, super computer
- Functions 24 / 7 operating the machine we call our body
 - Regulates our heart, our breathing, digestion of food, healing of cells, etc
- Handles thousands of inputs simultaneously for our health and protection
- Programmed to fear / react instantly to danger



Role of the Subconscious Mind

- The subconscious reacts automatically to messages from the conscious mind
- Most health effects could be controlled by the subconscious mind
- The subconscious does not judge good or bad
 - Carries out expectations of the conscious mind
- Placebo effect
- What happens to retirees ?
- What happens when a spouse dies ?
- What will happen in Japan ?



Subconscious – Source of Fears

- Fear is a natural response for safety
- We survive by paying attention to fears
 - Reacting as needed for protection
- Some fears we think about before acting
- Others result in automatic subconscious reactions
 - Can we take the time to think about the danger of a snake ?



Fears of Radiation are Involuntary

- Instinctive fears of heights, snakes, spiders, closed spaces, submersion, public speaking,
- Repeated message “Deadly Radiation”
 - Transferred to subconscious mind for protection
 - Radiation is now an instinctive source of fear
 - Fear of radiation – not a conscious choice
- Subconscious reacts automatically to radiation without consulting the conscious mind
- Decision to “RUN” is now automatic

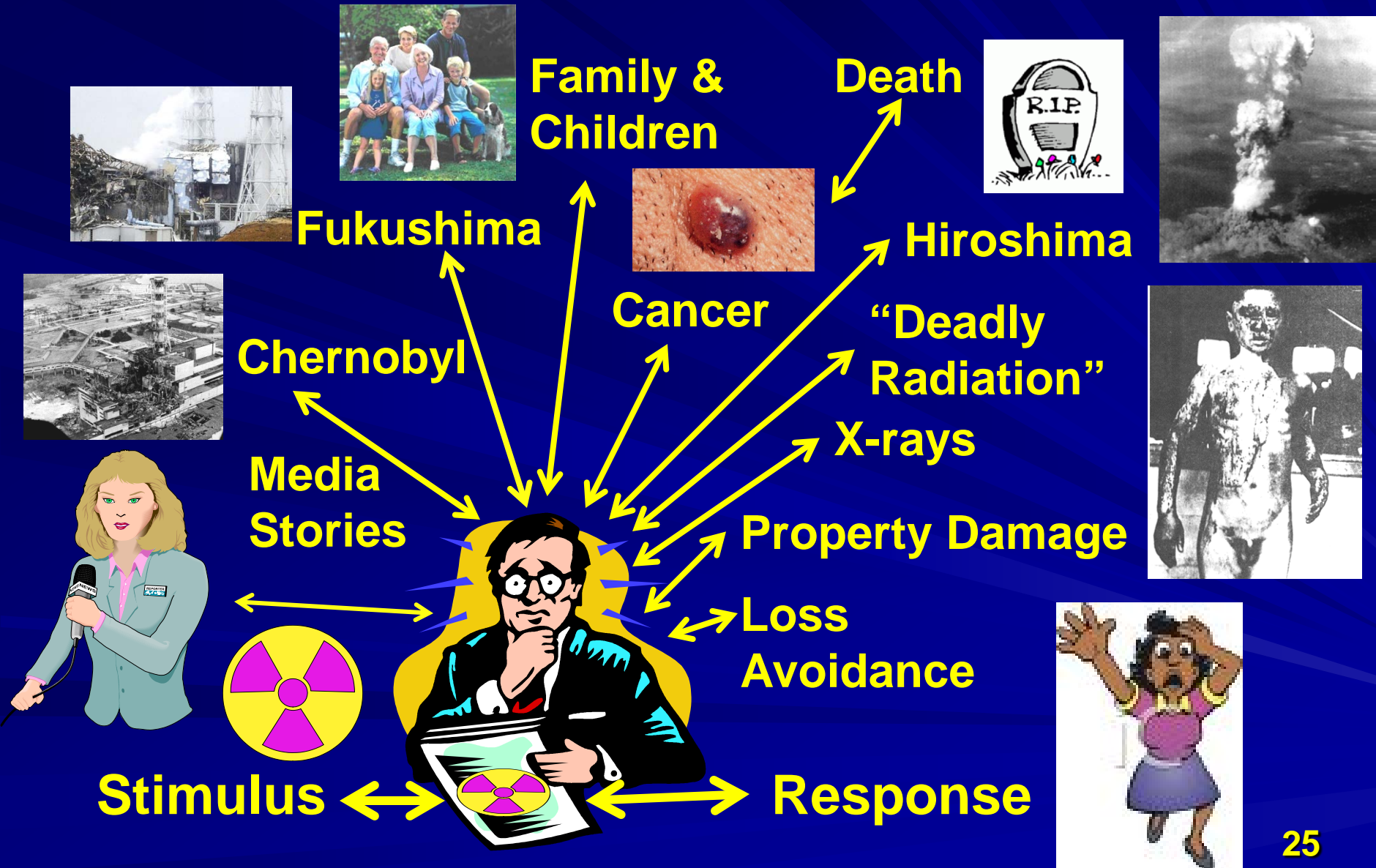


How We Make Quick Decisions

- We process, sort, compare, categorize, and analyze information, in relation to
 - Immediate circumstances - radiation
 - Experiences – what have we heard ?
 - Life factors, such as health, wealth, traditions, and lifestyles
 - Loss aversion – need to be safe
- With all these inputs we come up with instant judgments
 - Quick judgments are crucial to survival
- Based on limited information – associations in memory - May not be best in the long term



Instant Subconscious Processing



Sources of Radiation Fears

- Perceptions of radiation risks
 - Related to images of unacceptable consequences
- Lack of information
 - Forces people to rely on
 - What they have heard or believe about radiation
 - “Deadly Radiation”
 - Use of imagination, anticipation of losses,
 - Worst case images of disaster
 - Radiation Myths



Radiation Myths Abound

- **When dealing with radiation fears, consider:**
- **Most of what people believe is mythology, without special training in radiation safety,**
- **People rely on what they have always heard as the basis for understanding radiation**
- **Myths help explain science in ways that are understandable to lay persons**
- **Perpetuated by the media**

Myth of “Deadly Radiation”

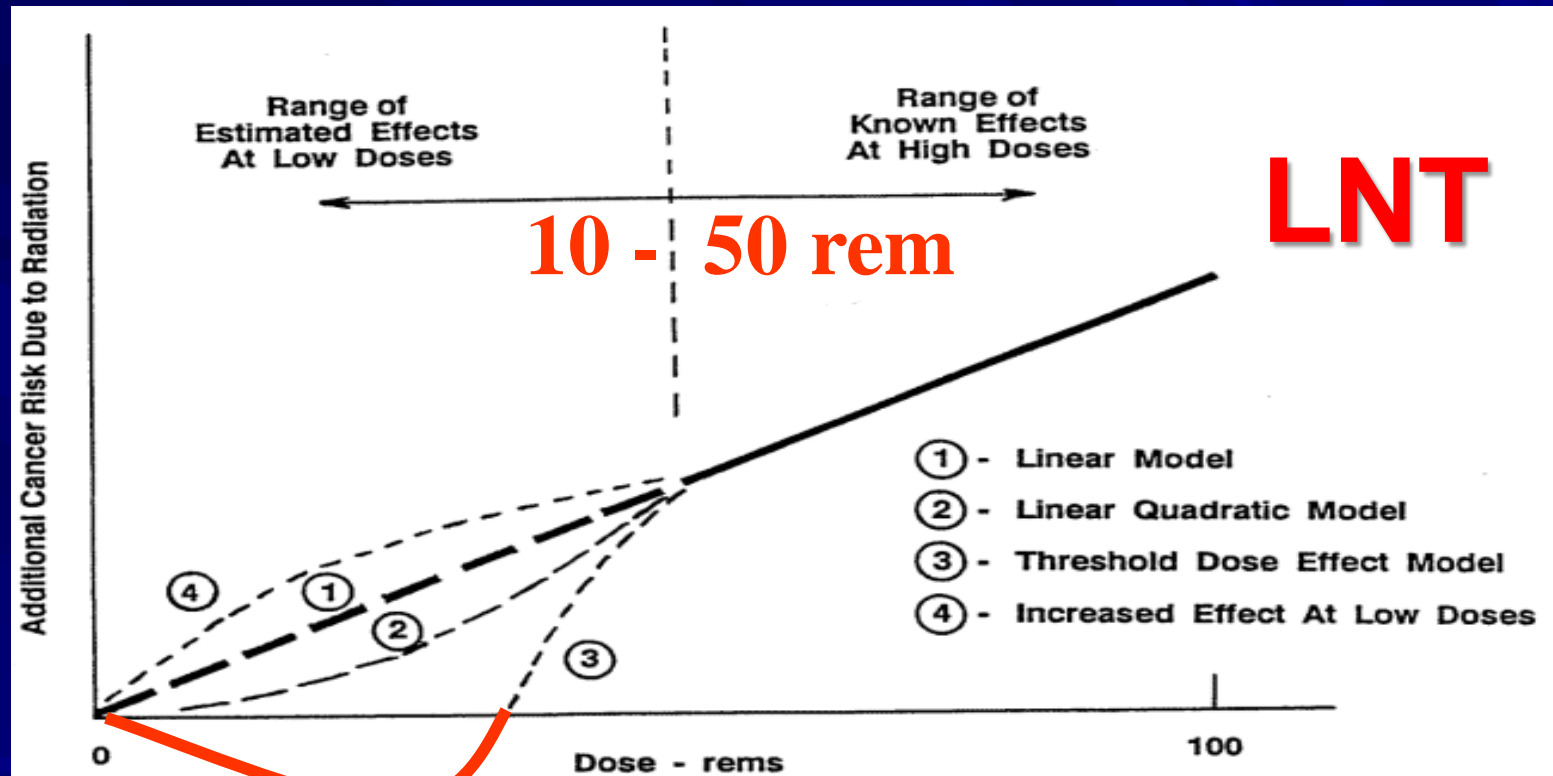
- Media has used these words for over 60 years
- Now accepted as basis for understanding radiation
- Assumes cause and effect automatically
 - Analogy with “Deadly Aspirin”
- Results
 - Fears of radiation seem out of proportion to risks as we would technically understand them



“No Safe Level of Radiation” - Myth

- **The only safe level is zero radiation**
- **Predicted by LNT**
- **Every radioactive atom is harmful**
- **Every atom must be removed**
- **Basis of antinuclear sentiments and opposition to nuclear technology**
- **Ignores radiation all around us**

Myth of Models for Estimating Risk



Hormesis

Are small doses of radiation beneficial ?

Myth of LNT

- Leads to views - “No Safe Level of Radiation”
 - No level without risk
 - The only safe level is zero
- However,
 - **There is no zero**
 - We are all exposed to radiation all the time
- The debate on low dose effects will go on
 - because of lack of data
- Propose a new message:

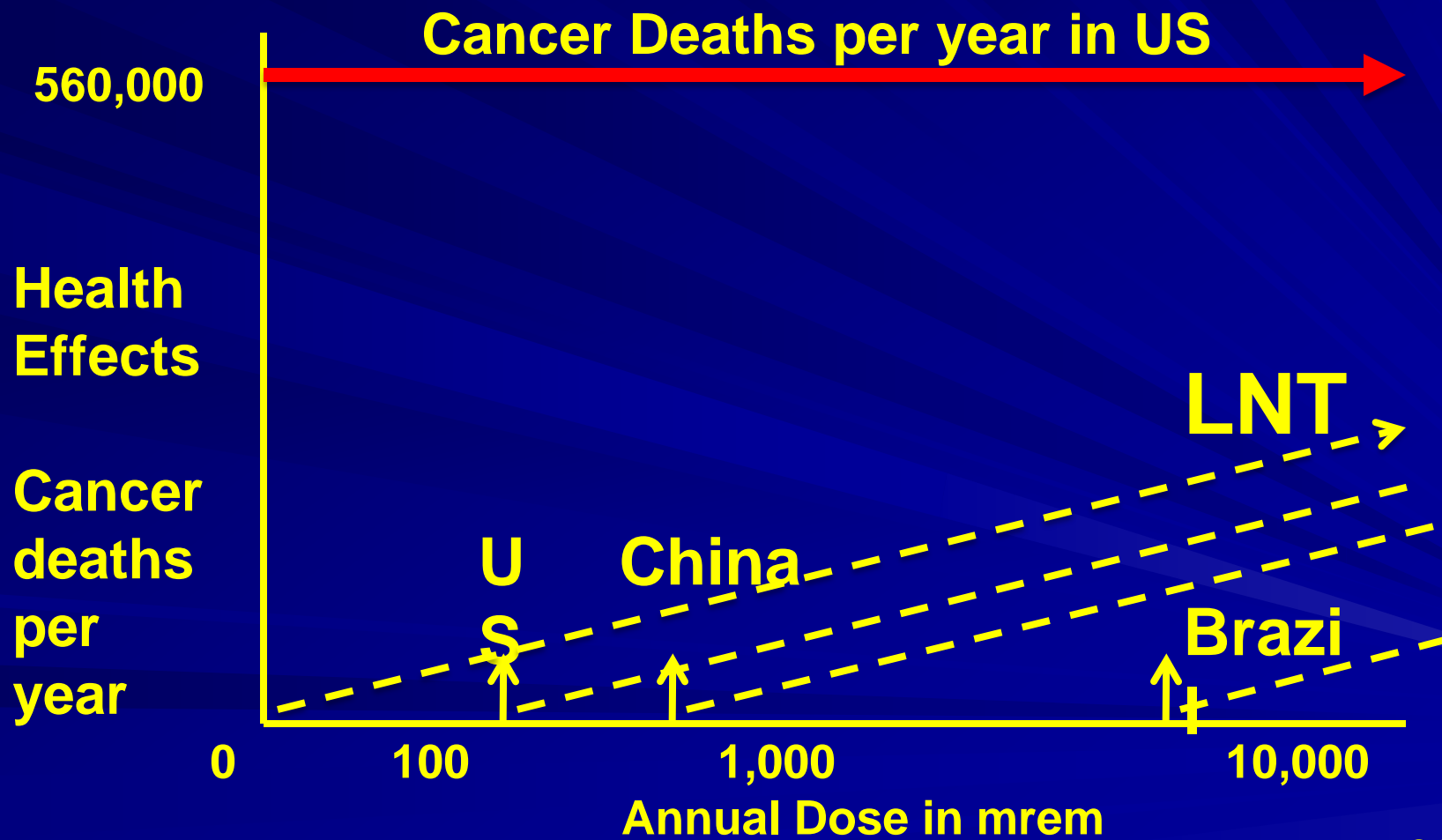


“It is actually very difficult to seriously harm someone with radiation!”

What Does Zero Mean ?

- **Zero health effects start at 560,000 cancer deaths a year in US**
- **Zero radiation starts at background**
 - 310 mrem / year average across US
 - 600 – 800 mrem / yr in Yangjiang, China
 - 1,500 – 2,500 mrem / yr in Kerala, India
 - 6,000 - 8,000 mrem / yr in Guarapari, Brazil
 - 10,000 – 26,000 mrem / yr in Ramsar, Iran

True Model for Estimating Cancer Risk



Ways we are Prone to Errors

- **Decisions by subconscious mind are crucial for safety – especially for imminent danger**
 - Does not do well for dangers that are not imminent
- **Subconscious acts on impressions which may not be based on good information**
 - Not based on evaluations and therefore has no clues to errors or biases
- **Conscious mind is not inclined to second guess subconscious decisions**
 - Wants to conserve energy

Emotion as a Basis for Judgments

- We make decisions on feelings of liking or disliking, without deliberation
- When confronted with a difficult decision and no knowledgeable solution,
 - We substitute an easier question related to what we like or dislike
- We may not understand radiation risks, but we know how we “feel” about cancer

Answering Easier Question

- We are never stumped
- People draw conclusions about probability of radiation risks without understanding either probabilities or radiation.
- Rather than analyzing the math – people will substitute an easier question, “How do I feel about dying of cancer?”
- By matching intensity of fears with dollars, people can conclude that a lot should be spent to avoid radiation.

Saying, ‘It is Safe’

- **Difficult for many reasons**
- **First – What does safe mean ?**
 - For many, safe means NO radiation
- **Second – if we share what we believe is safe**
 - People can discount our views
 - People can disagree
- **Acceptable answer can only be determined by individuals**

How can we Help a Frightened Person ?

- Rather than saying, “It is Safe”
- Let them know, “It’s OK to be afraid”
- We can be a technical resource
- Provide information and evidence
 - From which people can derive their own answers of what safe means for them
 - Show-and-tell, common radioactive items
 - Fiesta ware, lantern mantels, K-40, depression glass, and Vaseline glass
 - Compare with radiation sources

Steps from “Cause to Effect”

1. What are properties of radiation
 - α , β , γ , x-ray ?
 - Form and quantity ?
2. Where is it located - Inverse square law ?
3. How is it contained - Shielding ?
4. How will it move in the environment ?
5. What are the exposure conditions – mR / hr ?
6. What is the duration of the exposure – hr ?
7. How much energy is deposited in our body - mrem ?
8. What are the health risks at 1 death / 1,000 person - rem

Review

- How do we make decisions for safety ?
- Are our decisions based on specific, provable, rational, technical information ?
- Do we make such decisions fast or slow ?
- All decisions for safety come from our fast subconscious mind
 - Immediate reaction to fear
 - Imagination will win every time
- We may rationalize later (conscious mind)



Review

- It's OK to be afraid
- Fears are natural for our protection
- How “afraid” - Is fear appropriate for the situation ?
 - Imminent harm is unlikely
 - We are very resistant to harm by radiation
- Fears (worry) can also be harmful
- How to answer question, “Is it safe?”
- Best answer determined by each person
- We can be a resource to demonstrate radiation and explain steps from cause to effect

References

- **Thinking, Fast and Slow. Daniel Kahneman, 2011**
- **How Risky is it Really? Why Our Fears Don't Always Match the Facts, David Ropeik, 2010**
- **The Genie Within Your Subconscious Mind, How it Works and How to Use it, Harry W. Carpenter, 2009**
- **The Power of Your Subconscious Mind. Joseph Murphy**
- **The Psychology of the Solar Plexus and Subconscious Mind. Julia Seton Sears**

Questions ?



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