

# **Communicating Risks to the Public: Research on How Individuals Interpret Past Events**

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# OUTLINE

- Research Motivations
  - GAO Challenges for Risk Management: Risk Communication & Behavioral Perspectives
  - Taleb's "*Black Swan*"
- Hurricane Evacuation Context
- Research Findings
- Recommendations

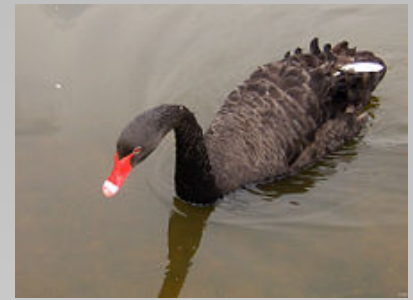
# #1 Challenge: Risk communication

Risk communication challenges include:

- Lack of a common lexicon for risk management
- A focus on unlikely risks with dramatic consequences
- Need to engage public in dialogue about an acceptable level of risk
- Lack of consideration of behavioral impacts

From GAO (2008)'s *Strengthening the Use of Risk Mgmt Principles in Homeland Security*

# “Black Swan” Events



- Our learning from past events is severely limited when events are low probability-high consequence
- After the fact, we concoct explanations that make such events explainable
- Relevant biases:
  - **Confirmation bias**
  - **Narrative fallacy**
  - **Silent evidence**
- “Your life came under a serious threat but, having survived it, you retrospectively underestimate how risky the situation actually was.” (*Black Swan*, p. 112)

# Theoretical Basis: System 1 vs. System 2

- System 1: The experiential one is effortless, heuristic, automatic, fast, opaque
- System 2: The cogitative (analytic) one is what we normally call thinking: effortful, reasoned, slow, logical, serial, progressive, and self-aware
- “Much of the trouble with human nature resides in our inability to use much of System 2, or to use it in a prolonged way without having to take a long beach vacation. In addition, we often just forget to use it.” (*Black Swan*, p. 82)

# Hurricane Evacuations: Lessons Learned from Katrina

- Individuals reasoned: “I survived Camille”
- Gov. Haley Barbour warned of “hurricane fatigue” (people had successfully weathered earlier storms)
- Former FEMA officials described preparations for Katrina as “business as usual”

# Are past events ignored?

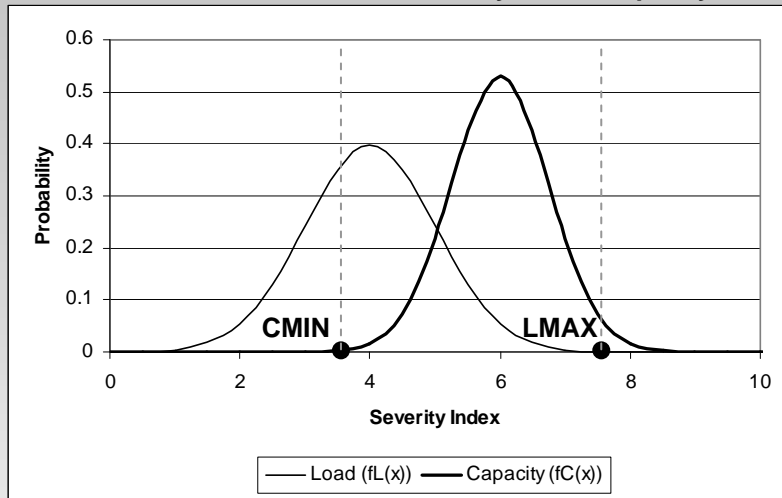
- Past events are attended to and how they are interpreted influence decisions
- Near-miss
  - **An event that has some probability of a negative (even fatal) outcome and some probability of a positive (safe) outcome, and the actual outcome is non-hazardous**
  - **A success that could have been a failure except for good luck**
- Evidence of a system's vulnerability ("almost happened")
- Evidence of a system's resilience ("didn't happen")

# More Precise Definition

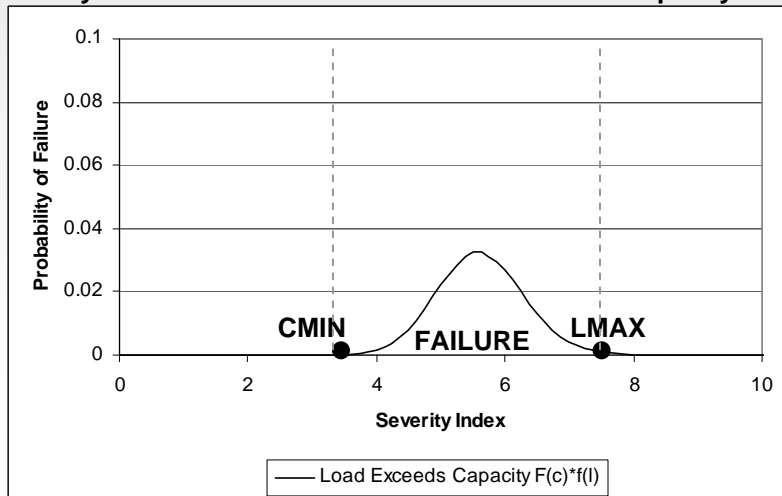
- Stressors put pressure or load on a system
- Systems have capacity to withstand loads
- Failure: when load exceeds capacity
- Success: when capacity exceeds load
- Near-miss: when capacity exceeds load yet load could have exceeded capacity but for luck

# What is a Near-Miss?

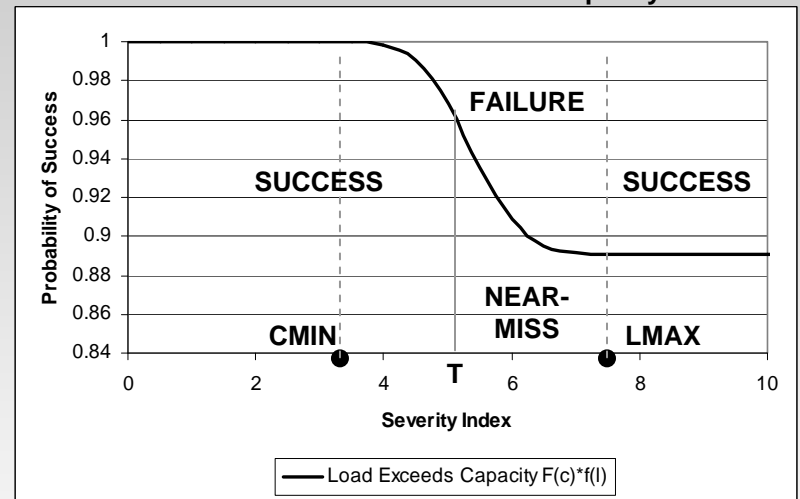
**FIGURE 1**  
Definition of Event's Load and System's Capacity



**FIGURE 2**  
System Failure Occurs When Load Exceeds Capacity



**FIGURE 3**  
Near-miss Occurs When Load Could Exceed Capacity But For Luck



# Different Types of Near-misses: Didn't vs. Almost

- Events have an objective probability (usually based on base rate data)
- Events also have subjectively experienced or “felt” likelihood of the event that almost occurred, usually based on causal scripts
- Near-misses with salient event cues may trigger the person to envision how the event almost occurred



# Research Hypotheses

1. People with near-miss “didn’t” information will choose the risky option (stay) when given warning of an impending hurricane (more than people with no near-miss information).
2. People with only near-miss “didn’t” information will feel that the situation of the impending hurricane is less risky than people with no near-miss information.
3. People with near-miss “almost” information will choose the safer option (evacuate) when given warning of an impending hurricane (more than people with near-miss “didn’t” information).

# Counterfactual thinking if “almost” happened

4. People with near-miss “almost” information will show more evidence of counterfactual thought than people without near-miss “almost” information.

Counterfactual thinking: the ability to mentally play with conjectures typically by vividly imagining the alternative failure state

# Data Collection Task

- An impending hurricane and participant must decide whether or not to evacuate
  - 30% chance of hitting the community with moderate force within 36 hours
  - Participant lives alone with no pets
  - Evacuating is a sure loss of \$2,000
  - Staying risks collateral damage to self, car, etc. of \$10,000

# Manipulations

- **Control:**

You have no specific data regarding past hurricane impacts to your property.
- **Near-miss (“Didn’t”):**

You have lived in this house through three prior storms similar to that forecasted and you and your neighbors have never had any property damage.
- **Near-Miss (“Almost”):**

You have lived in your house through three prior storms similar to that forecasted and have never had any property damage. In the last storm, however, a tree fell on your neighbor’s house completely destroying the second story. If anyone had been inside, they would have been seriously hurt.

# Results– Experiment 1

		Evacuate	Don't Evacuate	Total
Near-Miss (Didn't)	Count	41	31	72
	Expected Count	49	23	72
	Residual	-8	+8	
	Row %	57%	43%	100%
Near-Miss (Almost)	Count	39	18	57
	Expected Count	39	18	57
	Residual	0	0	
	Row %	68%	32%	100%
No near-miss	Count	46	10	56
	Expected Count	38	18	56
	Residual	+8	-8	
	Row %	82%	18%	100%
	Column Total	126	59	185
	Row %	68%	32%	100%

# Perceptions of riskiness of situation

condition	Mean	N	Std. Deviation
Near-Miss (Didn't)	4.18	72	1.079
Near-Miss (Almost)	4.37	57	.938
No Near-Miss	4.68	56	.936
Total	4.39	185	1.011

Post hoc contrast tests (using Tukey HSD) showed that the near-miss “didn’t” was significantly different from the near-miss “almost” and the control, but the latter two were not significantly different from each other.

# Factor Analysis

- Also asked about commonly accepted hurricane evacuation factors:

- 1
  - The probability of the storm
  - The cost to evacuate
  - The potential costs if you stay
- 2
  - Where you would go if you evacuated
  - The safety of your possession from theft if you left
  - The evacuation could be dangerous
  - The roads could be too crowded to leave
- 3
  - Your past experience with hurricanes
  - No officials said an evacuation is mandatory
  - Weather forecaster can be pessimistic
  - You think your home is well-built and you and your property will be safe at home

# Impact of Factors

- Near-miss “didn’t” answered lower on the first scale (problem facts)
- Near-miss “didn’t” answered higher on middle scale (evacuation issues)
- Near-miss “didn’t” answered higher on third scale (feel safe, trusting yourself)
- Thinking evacuation issues are bad (middle scale) is not predictive of the decision to stay or go
- Problem facts (first scale) and feeling safe/trusting yourself (third scale) do some mediation on decision

# Results– Experiment 2 (Tulane)

		Evacuate	Don't Evacuate	Total
Near-Miss (Didn't)	Count	14	12	26
	Expected Count	20	6	26
	Residual	-6	+6	
	Row %	54%	46%	100%
Near-Miss (Almost)	Count	25	4	29
	Expected Count	22	7	29
	Residual	+3	-3	
	Row %	86%	14%	100%
No near-miss	Count	24	3	27
	Expected Count	21	6	27
	Residual	+3	-3	
	Row %	89%	11%	100%
	Column Total	63	19	82
	Row %	77%	23%	100%

# Perceptions of riskiness of situation

condition	Mean	N	Std. Deviation
Near-Miss (Didn't)	3.85	26	1.434
Near-Miss (Almost)	4.24	29	1.354
No Near-Miss	4.44	27	1.340
Total	4.18	82	1.380

Type of near-miss information did not, overall, have a significant effect on perceptions of risk. This is likely because of our smaller sample size as the pattern of means by condition replicates those of Study 1.

# Discussion

- Near-miss “didn’t” information made participants more likely to select the riskier option of staying.
- Near-miss “almost” information attenuates this near-miss bias towards the riskier option.
- Perceptions of risk appear to explain why near-miss information either makes people choose the riskier option of staying or evacuating.
  - Participants with near-miss “didn’t” information feel the situation is less risky and decide to stay.
  - Participants with near-miss “almost” information do not feel the situation is less risky and tend to evacuate at the same rate as those without near-miss information.

# Counterfactual Thinking

- Half of the participants after their deciding were asked the extent to which they:
  - Imagined collateral damage to their property
  - Thought about injuries
  - Pictured what might happen if they stayed and a hurricane actually hit their house.

# System 2 Decisions (?)

- After making decision whether or not to evacuate (completing first task), participants made decisions about 6 gambles.
  - (a) You have been offered a gamble. If you choose to take the gamble, you have a 50% chance of winning \$200 and a 50% chance of losing \$100. It does not cost any money to accept the gamble. Do you accept or decline this gamble?*
  - (b) You have been offered a gamble. If you choose to take the gamble, you have a 50% chance of winning \$300 and a 50% chance of losing \$300. It does not cost any money to accept the gamble. Do you accept or decline this gamble?*
  - (c) What is the maximum amount that you would pay to play a gamble that has a 60% chance of winning \$1,000 and a 40% chance of winning nothing (\$0)?*

# More gambles

- (d) You are stuck with a losing gamble. If you take the gamble, you have a 30% chance of losing \$1,000 and a 70% chance of losing nothing (\$0). You can avoid the gamble, by paying \$200 up-front. Do you accept the gamble or pay the \$200?*
- (e) You are stuck with a losing gamble. If you take the gamble, you have a 30% chance of losing \$10,000 and a 70% chance of losing nothing (\$0). You can avoid the gamble, by paying \$2,000 up-front. Do you accept the gamble or pay the \$2,000?*
- (f) You are going skiing in the mountains this weekend. There is a 30% chance of a severe snow storm. If you are caught in a severe snow storm without snow tires, you are sure to slide off the road, in which case the damage to your car will be \$1,000. Should you buy the snow tires before your trip? Snow tires cost \$200.*

# Results– Experiment 3

		Evacuate	Don't Evacuate	Total
Near-Miss (Didn't)	Count	27	27	54
	Expected Count	39	15	54
	Residual	-12	+12	
	Row %	50%	50%	100%
Near-Miss (Almost)	Count	56	14	70
	Expected Count	50.4	19.6	70
	Residual	+5.6	-5.6	
	Row %	80%	20%	100%
No near-miss	Count	69	19	88
	Expected Count	63.4	24.6	88
	Residual	+5.6	-5.6	
	Row %	78%	22%	100%
	Column Total	152	60	212
	Row %	72%	28%	100%

# Thinking about counterfactuals?

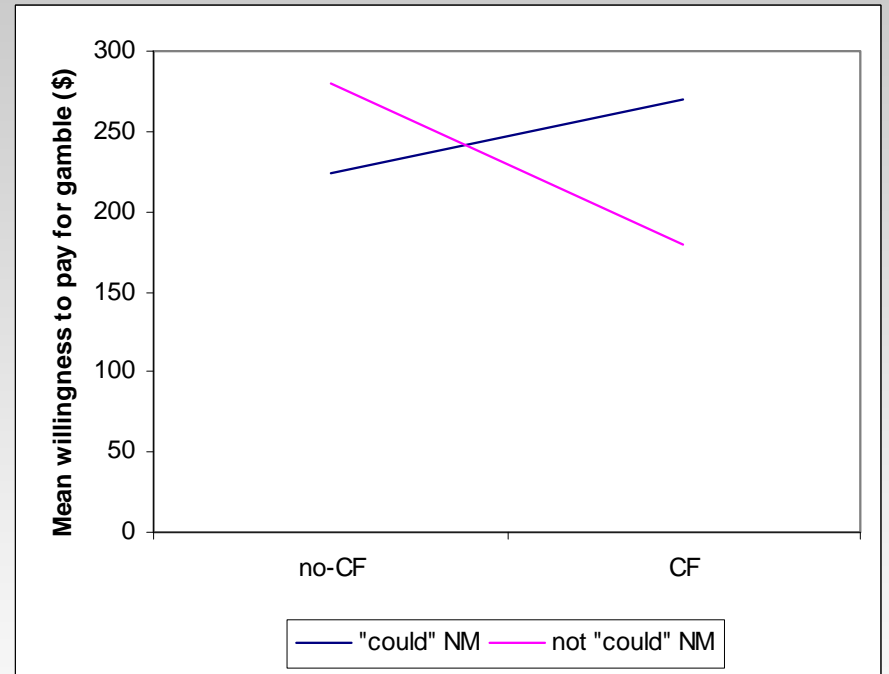
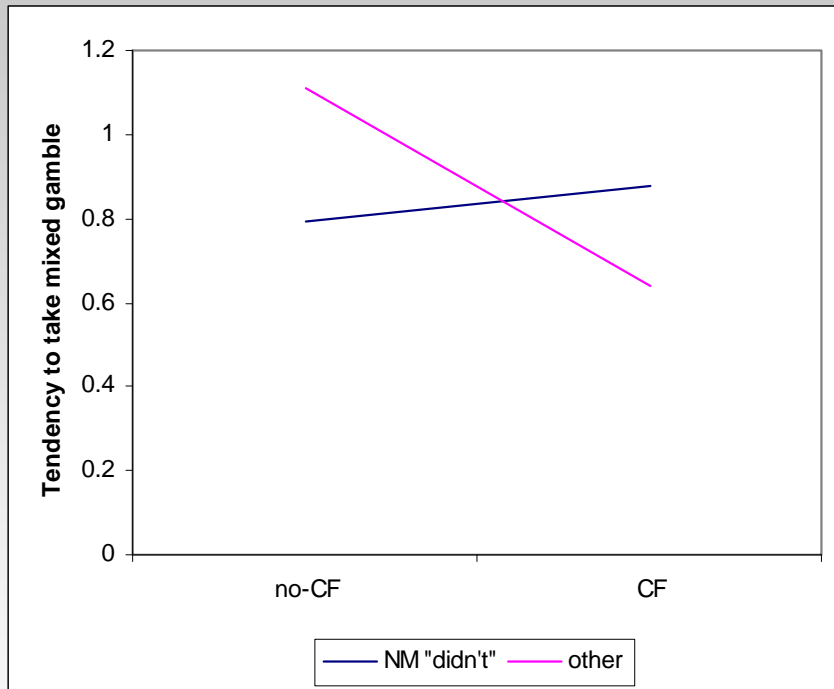
condition	Mean	N	Std. Deviation
Near-Miss (Didn't)	3.17	25	1.21
Near-Miss (Almost)	2.58	46	0.96
No Near-Miss	2.63	49	1.21
Total	2.72	120	1.14

Extent of counterfactual thinking as the dependent variable and condition as the independent variable showed only marginal effects and the means were not in the predicted direction.

# Results from gambles task

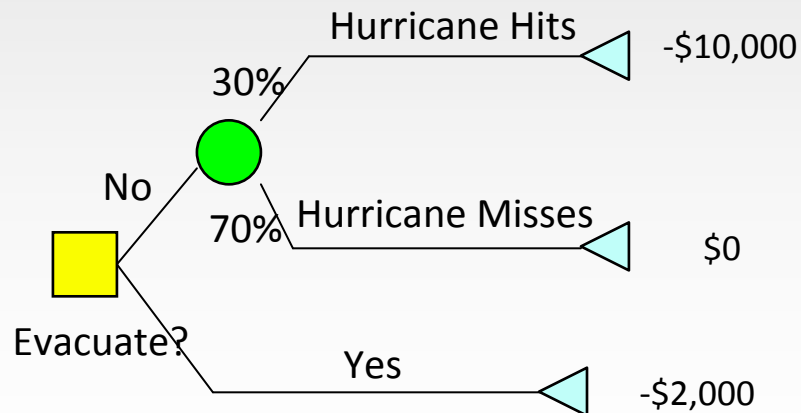
- For the mixed gambles there was a significant influence when participants were asked about counterfactuals: it made them more cautious and less likely to take the mixed gambles.
- For gamble (c), participants were willing to pay significantly less money when they had the counterfactual questions than when they did not
- Counterfactual information exerts a negative influence on tendency to take the gambles, however this cautious tendency is negated when a participant has near-miss “didn’t” information, i.e., the near-miss “didn’t” information encourages riskier decisions in these unrelated gamble tasks.

# Counterfactual x Near-Miss “Didn’t”



# What is Happening?

- Near-Miss “Didn’t” Info: System 1 -> Risk Tolerant
- Near-Miss “Almost” Info: System 1 -> Risk Averse
- Control/No Near-Miss:
  - System 2:  $EV(\text{Evacuation}) < EV(\text{Stay})$
  - Or Still System 1 thinking: Hurricanes bad -> Evacuate



# Hurricane Decision vs. Gamble (e)

		Harbor Bay Decision			Gamble (e) (no CF)		
		Evacuate	Don't Evacuate	Total	Pay -\$2,000	Take Gamble	Total
Near-Miss (Didn't)	Count	27	27	54	13	16	29
	Expected Count	39	15	54	15	14	29
	Residual	-12	+12		-2	+2	
	Row %	50%	50%	100%	45%	55%	100%
Near-Miss (Almost)	Count	56	14	70	14	11	25
	Expected Count	50.4	19.6	70	13	12	25
	Residual	+5.6	-5.6		-1	+1	
	Row %	80%	20%	100%	56%	44%	100%
No near-miss	Count	69	19	88	21	18	39
	Expected Count	63.4	24.6	88	20	19	39
	Residual	+5.6	-5.6		+1	-1	
	Row %	78%	22%	100%	54%	46%	100%
	Column Total	152	60	212	48	45	93
	Row %	72%	28%	100%	52%	48%	100%

# Gamble (d) vs. Gamble (f)

		Gamble (d)			Gamble (f)		
		Pay \$200	Take Gamble	Total	Buy Snow Tires	Risk Accident	Total
Near-Miss (Didn't)	Count	26	28	54	7	47	54
	Expected Count	28	26	54	7	47	54
	Residual	-2	+2		0	0	
	Row %	48%	52%	100%	13%	87%	100%
Near-Miss (Almost)	Count	41	30	71	11	60	71
	Expected Count	37	34	71	9	62	71
	Residual	+4	-4		+2	-2	
	Row %	58%	42%	100%	15%	85%	100%
No near-miss	Count	44	44	88	9	79	88
	Expected Count	46	42	88	11	77	88
	Residual	-2	+2		+2	-2	
	Row %	50%	50%	100%	10%	90%	100%
	Column Total	111	102	213	27	186	213
	Row %	52%	48%	100%	13%	87%	100%

# Take-Aways

- Context is important for individual decision making
- Individuals are biased by narratives
  - NM “Didn’t”: 30% not so bad
  - NM “Almost”: 30% is bad
- Risk analyses are usually presented assuming people will use System 2 thinking
- If you give people rules where you assume rationality will dictate behavior, only the economists will evacuate.