

# Communicating Meaning in the Intelligence Enterprise

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# Agenda

- Intelligence analysis often requires significant technical expertise
- Analysis products can be prone to misunderstanding, with dire consequences
- Fuzzy-Trace Theory explains why these misunderstandings occur, and suggests policy interventions to ameliorate
  1. Core constructs: Gist and verbatim – decisions are more informed by gist than verbatim
  2. Gist is developmentally advanced – elicit to-be-communicated gist from experts
  3. Under uncertainty, experts may differ – investigation must resolve discrepancies with higher-level gist
  4. Precise facts matter, but gist matters more – link precise facts to appropriate gist
  5. Personality differences and skills mediate reliance on gist – effective communicators may be recruited and trained
- Examples in context of assessment of Iraqi WMD prior to 2003 invasion

# Case Study

## Intelligence Analysis of WMD in Iraq



- “Iraq’s aggressive pursuit of high-strength aluminum tubes provides compelling evidence that Saddam is attempting to reconstitute a uranium enrichment effort for Baghdad’s nuclear weapons program...” (United States Congress Senate Select Committee on Intelligence, 2004, p. 87).



By Technical Sergeant John L. Houghton, Jr., United States Air Force - <https://arcweb.archives.gov/>, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=1300600>

# Analysis of Tubes

A failure to “[explain the details of the reporting](#)”? (p. 16)



“The Director of Central Intelligence was not aware of the views of all intelligence agencies on the aluminum tubes prior to September 2002 and, as a result, could only have passed the Central Intelligence Agency's view along to the President until that time.” (p. 139).

Aluminum Tube for Uranium Enrichment



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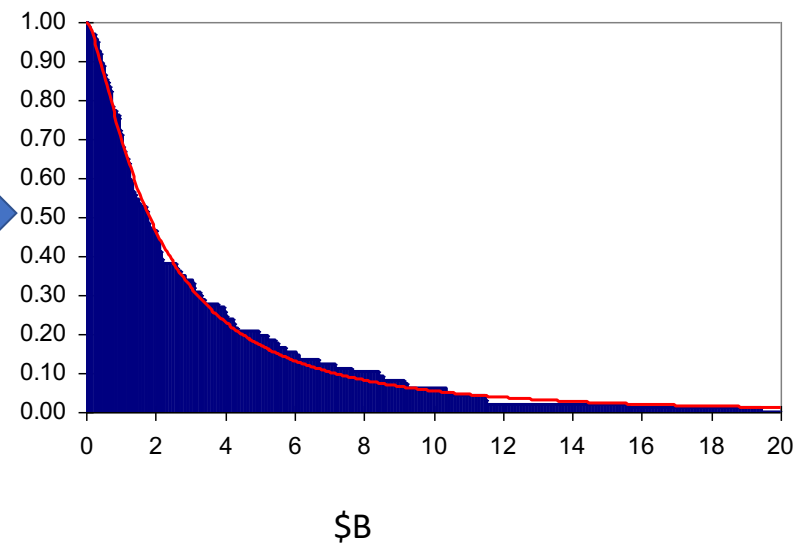
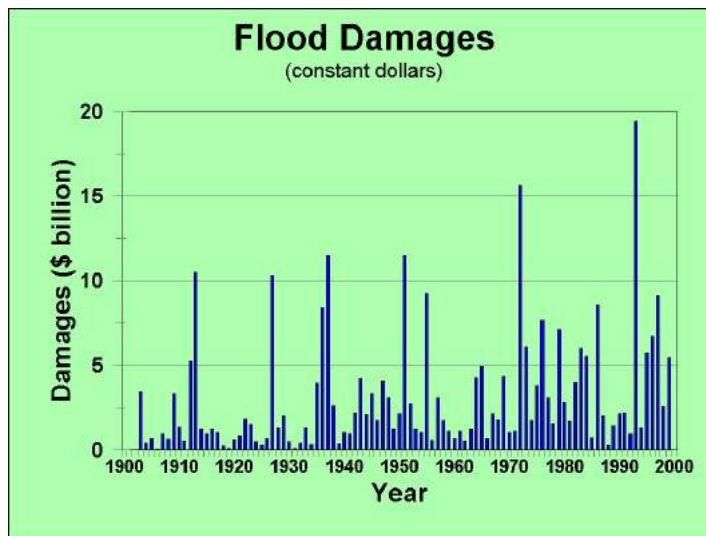
# What Went Wrong?

Fuzzy-Trace Theory and The Psychology of Risk Perception

# Traditional Definitions

“Risk is a measure of the probability and severity of adverse effects”

SOURCE: William Lowrance, 1976. Of Acceptable Risk.



# Traditional Metrics

## Focus on Precise Rates or Safety Margins

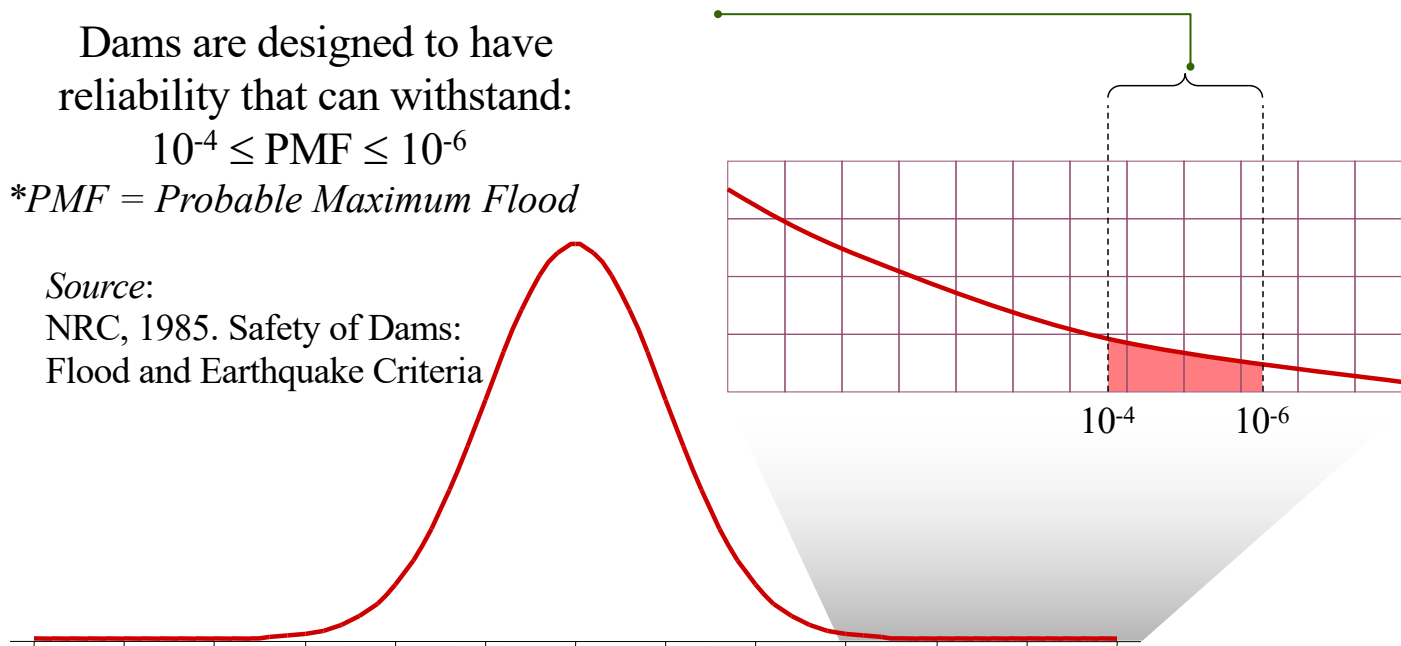
Dams are designed to have reliability that can withstand:

$$10^{-4} \leq \text{PMF} \leq 10^{-6}$$

\*PMF = Probable Maximum Flood

Source:

NRC, 1985. Safety of Dams:  
Flood and Earthquake Criteria



Similar approaches underlie models of human decision-making – maximize value \* probability

Slide credit: Prof. Joost Santos

# Systematic Deviations

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program A is adopted, 200 people will be saved [72%]

If Program B is adopted, there is a 1/3 probability that 600 people will be saved and a 2/3 probability that no people will be saved." [28%] (Tversky & Kahneman, 1981)



# Systematic Deviations

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program C is adopted, 400 people will die  
[22%]

If Program D is adopted, there is a  $\frac{2}{3}$  probability that 600 people will die and a  $\frac{1}{3}$  probability that none will die.” [78%]  
(Tversky & Kahneman, 1981)

# More focus on “gist” than “verbatim”

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program A is adopted, **some** people will be saved/**die**  
[**72%**/**22%**]

If Program B is adopted, there is **some** probability that **some** people will be saved and **some** probability that **no** people will be saved/**die**.” [**28%**/**78%**] (Tversky & Kahneman, 1981)

# Removing the “none”

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program A is adopted, **some** people will be saved/**die** [**~50%**]

If Program B is adopted, there is **some** probability that **some** people will be saved and **some** probability that **no** people will be saved/**die**.” [**~50%**] (Reyna & Brainerd, 1991; Reyna et al., 2014)

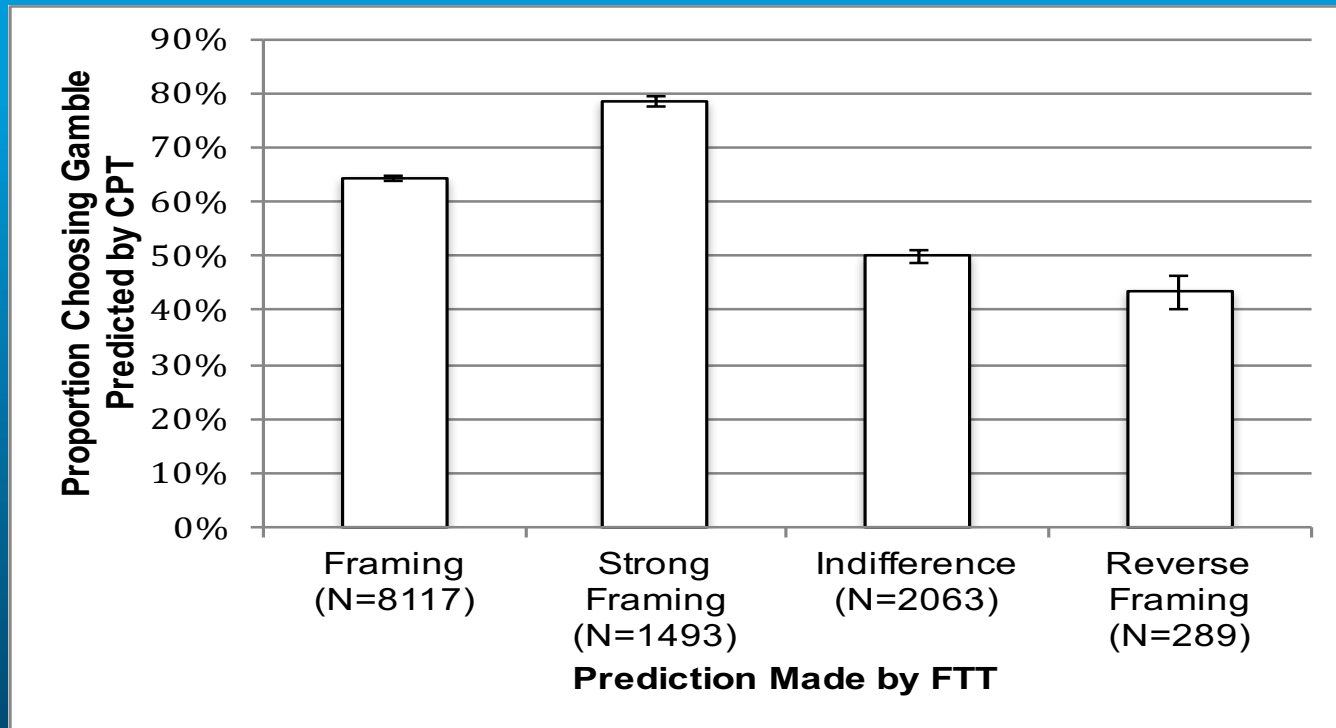
# Removing the “some”

Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program A is adopted, **some** people will be saved/**die** [78%]

If Program B is adopted, there is ~~**some**~~ probability that ~~**some**~~ people will be saved and ~~**some**~~ probability that **no** people will be saved/**die**.” [22%] (Kühberger & Tanner, 2010)

## Comparison to Cumulative Prospect Theory (Tversky & Kahneman, 1992)



# Gists are contextualized

- e.g., “1/3 probability that 600 people will be saved and 2/3 probability that no one will be saved”
  - Appropriate context is that this will only happen once – probability is meaningless! (unless you are Bayesian)
  - Instead, avoid the catastrophic outcome!

*Research Article*

## **Developmental Reversals in Risky Decision Making: Intelligence Agents Show Larger Decision Biases Than College Students**

**Valerie F. Reyna, Christina F. Chick, Jonathan C. Corbin,  
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**aps**  
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Policy Insight #1: Decisions are more informed by gist representations than by verbatim details.

Implication: Express the gist of an analysis; not just the details. The details may be misinterpreted.

# The Role of Expertise

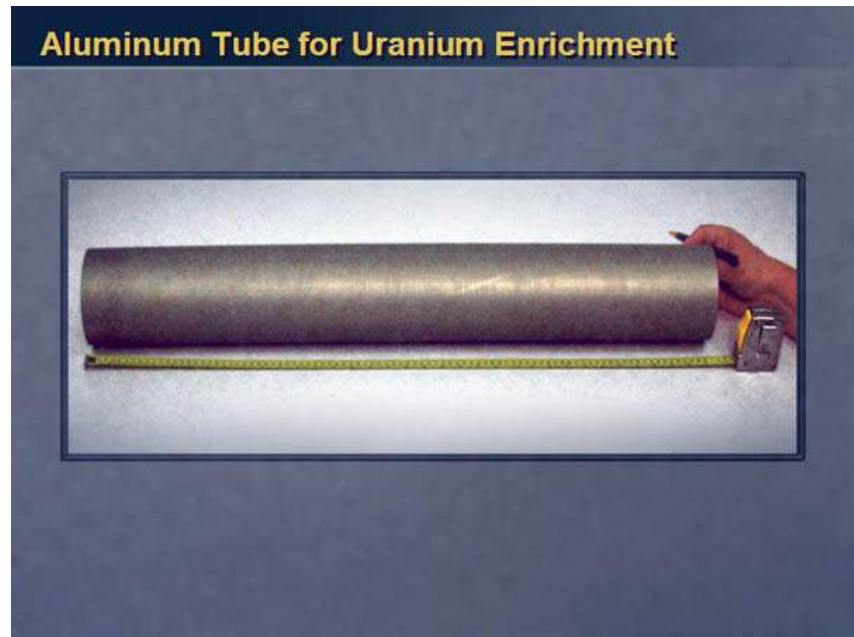
Gist is Developmentally Advanced



# Back to the tubes

A failure to “explain the details of the reporting”? (p. 16)

- In 2001, the IC became aware that Iraq was attempting to procure 60,000 high-strength aluminum tubes manufactured from 7075-T6 aluminum, with an outer diameter of 81 mm, and inner diameter of 74.4 mm, a wall thickness of 3.3 mm and a length of 900 mm. The tubes were to be anodized using chromic acid and were to be shipped, wrapped in wax paper and separated from each other. (United States Congress Senate Select Committee on Intelligence, 2004).

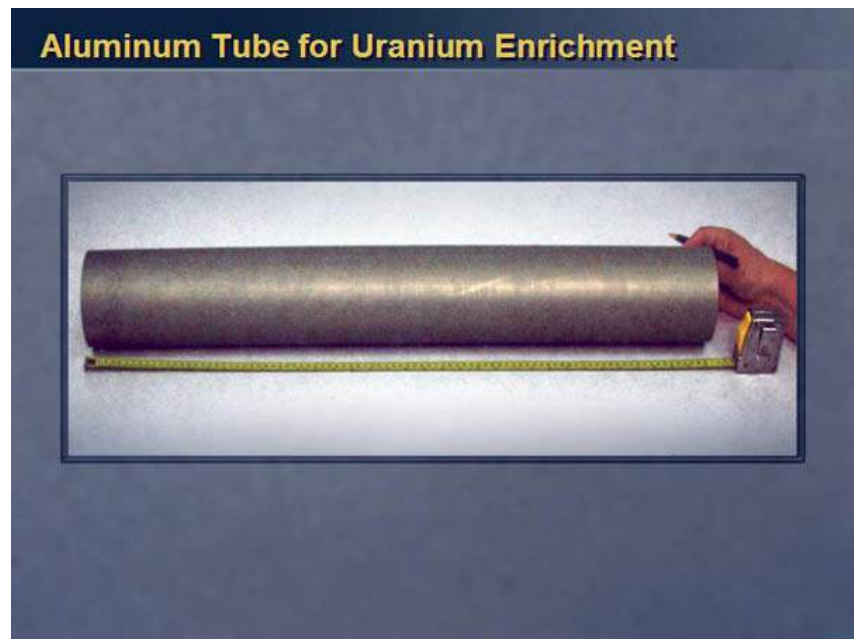


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# Verbatim Representation

## The Details

- A rote set of rules:
- “Seven-thousand series aluminum alloy ... when formed into a tube of more than 75 mm in diameter, is a controlled item ... which Iraq is prohibited from importing because it could have nuclear applications.” (p. 88)



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# Verbatim Representation

## The Details

- A rote set of rules:
- “**Seven-thousand series aluminum alloy** ... when formed into a tube of **more than 75 mm in diameter**, is a controlled item ...which Iraq is prohibited from importing because it could have nuclear applications.” (p. 88)
- In 2001, the IC became aware that Iraq was attempting to procure 60,000 high-strength aluminum tubes manufactured from **7075-T6 aluminum**, with an **outer diameter of 81 mm**, and inner diameter of 74.4 mm, a wall thickness of 3.3 mm and a length of 900 mm. The tubes were to be anodized using chromic acid and were to be shipped, wrapped in wax paper and separated from each other. (United States Congress Senate Select Committee on Intelligence, 2004).

Conclusion: IRAQ COULD BE GOING NUCLEAR!

# Verbatim Rules

## Where do they come from? Basic engineering equations

- Tubes must be strong enough to enrich uranium without structural failure
- Here, expert judgment is crucial
  - Iraq already had centrifuges that were more advanced than were represented by these tubes (pp. 88-89) – using these for uranium enrichment would be a technological step backwards
  - The engineering equations mentioned above assume the tubes lack structural defects – an unreasonable assumption
    - The CIA found that “the failure speeds of the tubes ranged from 96,000 rpm to 100,100 rpm... just above the speed the tubes were expected to be run in an operating centrifuge – 90,000 rpm...” (p. 108).
- A verbatim thinker would say:  $96,000 > 90,000$
- An expert, but “fuzzy”, gist: “Running your car up to 6,500 rpm briefly does not prove that you can run your car at 6,500 rpm cross country. It just doesn’t. Your car’s not going to make it.” (p.108)

It did **not make sense** to many experts that these tubes would be used for a centrifuge

**Policy Insight #2: Gists must be elicited from experts.**

**Implication: Several gists are possible; not all are informed. Get your gist from an expert!**

# Experts May Differ

Gist is Developmentally Advanced

# Are All Gists Correct?

Ex: mismatch between  
expertise and context

*Research Article*

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## **Developmental Reversals in Risky Decision Making: Intelligence Agents Show Larger Decision Biases Than College Students**

Psychological Science  
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# “Lay” Expertise

- Often based on spurious correlation to fit an existing gist
- “REPORT from Physicians in the Crop-Sprayed Villages regarding Dengue-Zika, microcephaly, and mass-spraying with chemical poisons”

• [http://www.reduas.com.ar/wp-content/uploads/downloads/2016/02/Informe-Zika-de-Reduas\\_TRAD.pdf](http://www.reduas.com.ar/wp-content/uploads/downloads/2016/02/Informe-Zika-de-Reduas_TRAD.pdf)



Monsanto does not  
make or use  
pyriproxifen



Pyriproxifen  
doesn't cause  
microcephaly



Spurious Correlation:  
Mosquitos & larvicide



# Why are these claims compelling?

They satisfy the “search for meaning”

- Effective health messages help readers retain the meaning in memory and facilitate availability of the knowledge at the time of behavior implementation
- Two types of memory:
  - Verbatim: precise details
  - Gist memories: basic meaning.
- Decisions tend to be based on gist memories – or the basic meaning – not verbatim facts.
- According to this theory, therefore, websites that produce more coherent and meaningful gist will be more influential (even if they are not factually accurate!).
  - Ex: Child got vaccinated -> child developed autism. Therefore, vaccines cause autism
  - In fact, symptoms of autism appear around the same time as vaccination schedule

They **make sense** to someone who does NOT have appropriate expertise

# Dueling Expertise

“[the tubes] have little use other than for a uranium enrichment program” (p. 88)

vs.

“...the tube specifications and quantity appear to be generally consistent with their use as launch tubes for man-held anti-armor rockets or as tactical rocket casings.” (p. 89)

Both cases are plausible

Verbatim: “Either way, Iraq violated international law”

Gist: “If we’re wrong, and we invade without justification, the effects could be catastrophic”



**Policy Insight #3: Gists may differ if they are informed by different sources of expertise (including “lay” cultural expertise)**

**Implication: If experts differ, an overarching gist must be extracted to place each experts’ gist in context (e.g., which gist is most relevant, both are plausible, indicating deep uncertainty, etc.)**

# When Multiple Gists are Plausible

# Dueling Expertise

“[the tubes] have little use other than for a uranium enrichment program” (p. 88)



vs.

“...a gas centrifuge application is credible but unlikely and a rocket production application is the more likely end-use for these tubes.” (p. 92).



Both are “some chance of bad outcome”

# The "Allais Paradox"

Experiment 1				Experiment 2			
Gamble 1A		Gamble 1B		Gamble 2A		Gamble 2B	
Winnings	Chance	Winnings	Chance	Winnings	Chance	Winnings	Chance
\$1 million		\$1 million	89%	Nothing	89%	Nothing	90%
		Nothing	1%	\$1 million	11 %		
		\$5 million	10%				

# Descending the Hierarchy of Gist: Ordinal Comparisons

- What if a decision cannot be made?
- Ex: Allais Paradox second gamble (Allais, 1953)
  - 89% chance of \$0 OR 11% chance of \$1m
  - 90% chance of \$0 OR 10% chance of \$5m
- Categorical representation:
  - Some chance of no \$ OR some chance of some \$
  - Some chance of no \$ OR some chance of some \$
- Revert to more precise ordinal representation:
  - More chance of no \$ OR less chance of **less \$**
  - More chance of no \$ OR less chance of **more \$**
- More \$ is Better.

# Which one was communicated?

“[the tubes] have little use other than for a uranium enrichment program” (p. 88)

vs.

“...a gas centrifuge application is credible but unlikely and a rocket production application is the more likely end-use for these tubes.” (p. 92).



“DIA analysts found the [categorical] CIA presentation to be very compelling” (p. 128)

“Fuzzy Processing Preference”

Less precise representations are more compelling



These assessments were “limited in their...or were very narrow in scope” (p. 91).



# What led to online shares about vaccines?

- Results are consistent with Fuzzy Trace Theory
  - Significant effects of gist **and** verbatim, but NOT stories
- Stories are effective to the extent that they communicate gist

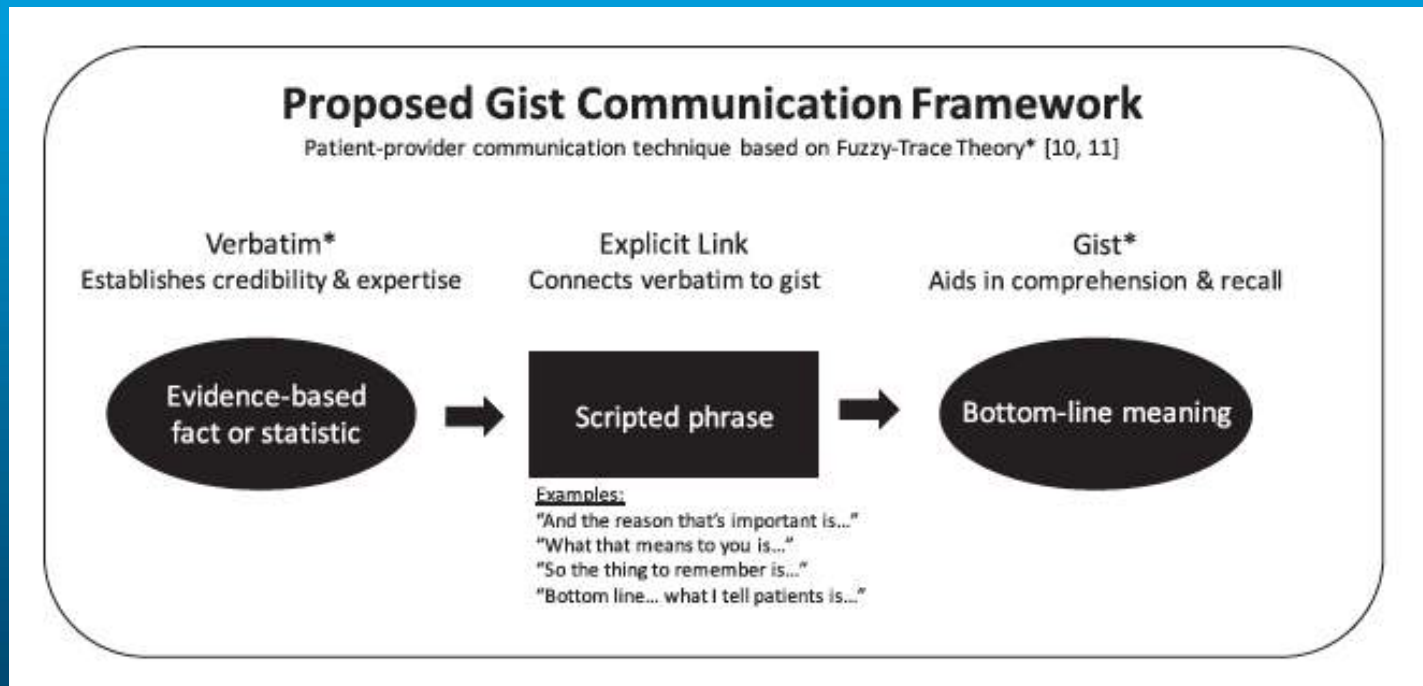
Coefficients of logistic regression analysis for whether an article was shared at least once on Facebook ( $n = 4580$ ,  $df = 10$ ).

	$\beta$	SE $\beta$	z-value	OR
Length	$-5.56 \times 10^{-4}$	$8.93 \times 10^{-5}$	-6.22***	1.00
Readability	$-7.23 \times 10^{-4}$	$1.49 \times 10^{-3}$	-0.49	1.00
Image	0.59	0.09	6.91***	1.80
Stories	0.34	0.19	1.82	1.41
Statistics	0.29	0.08	3.48***	1.33
Gist	0.82	0.15	5.36***	2.27
Stories $\times$ Statistics	0.05	0.22	0.24	1.05
Stories $\times$ Gist	0.25	0.32	0.80	1.29
Statistics $\times$ Gist	-0.17	0.20	-0.85	0.85
Stories $\times$ Statistics $\times$ Gist	-0.35	0.40	-0.89	0.70
(Intercept)	-1.08	0.12	-8.91***	

Note. \*\*\* =  $p < 0.001$ .  $\beta$  = logistic regression coefficient; SE  $\beta$  = standard error of  $\beta$ ; OR = Odds Ratio.

Broniatowski, D. A., Hilyard, K. M., & Dredze, M. (2016). Effective vaccine communication during the disneyland measles outbreak. *Vaccine*. <http://doi.org/10.1016/j.vaccine.2016.04.044>

## Policy Insight #4: More precise analysis will be more compelling if it is linked to a categorical gist



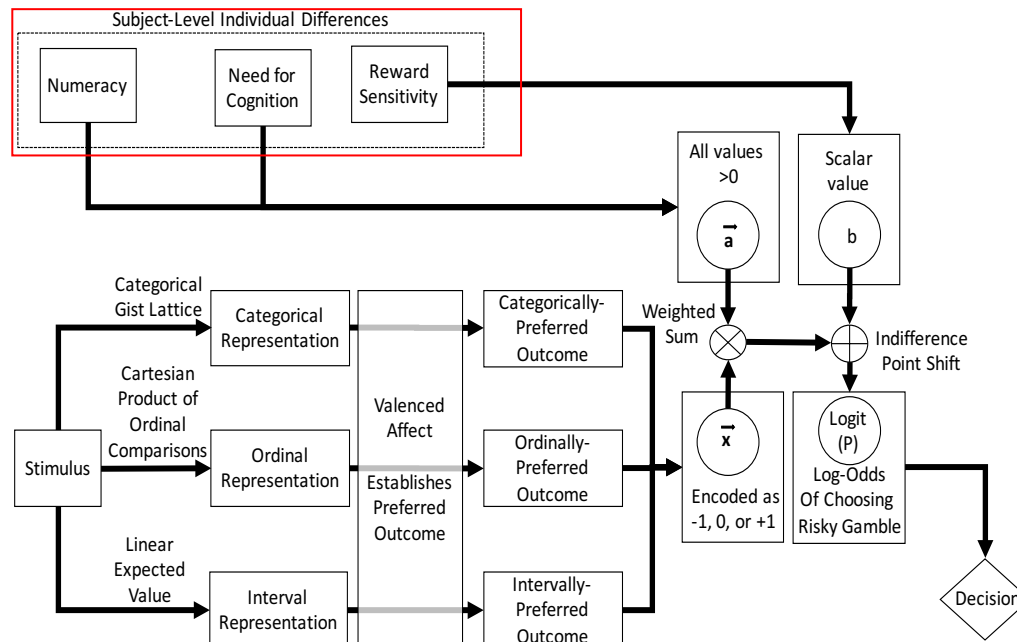
# Selecting and Training Gist Communicators

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# Can we train people to make these linkages?

- Some people are more resistant to decision biases than others
- Factors include:
  - Numeracy – mathematical ability
  - Need for Cognition – how much deliberation vs. “gut feeling” is preferred
- Communicators should be people who can take an analysis product and translate it to the appropriate gist
  - These people must have the willingness and ability to do the analysis
  - They must also have the willingness and ability to understand how it fits within the bigger picture.

# Schematic Model



1. Decisions are encoded at detailed **verbatim** level and several abstract **gist** levels simultaneously. Gist encodes **meaning**.
2. Each representation has a preferred outcome according to **values** stored in long-term memory
3. Representations are weighted according to individual differences in personality traits – metacognitive monitoring and motivational factors

Broniatowski, D. A., & Reyna, V. F. (2017). A Formal Model of Fuzzy-Trace Theory: Variations on Framing Effects and the Allais Paradox. *Decision*. <https://doi.org/10.1037/dec0000083>

**Policy Insight #5: The innate and acquired factors that enable effective gist communication may directly inform recruitment and training efforts within the IC.**

**Implication: Identify, train, and retain a cadre of expert gist communicators**

# Policy Recommendations

1. Beyond simply providing decision makers with more details, communicators should aim to express the gist of an analysis product—that is, its meaning in context.
  - Absent such context, any detailed information may be prone to misinterpretation.
2. Several gists are possible, and not all are informed. Gists should, therefore, be elicited from experts in relevant domains.
3. When gists from different sources of expertise do not agree, communicators should seek an overarching integrative gist.
4. Details, when communicated, should be explicitly linked to corresponding categorical gists.
5. Individuals who excel at gist communication and translation should be identified, trained, and retained.

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