



THE OHIO STATE UNIVERSITY

Why we don't believe science: A perspective from decision psychology

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Today

How do we judge risks and make decisions?

- Themes from decision psychology!

Beliefs about risks

- Construction of beliefs and belief persistence
- Why don't beliefs change when we're faced with new data? (Selective perception, selective exposure, and confirmation biases)
- Belief persistence may be rational: The climate change example
- Information presentation formats matter



Four themes in the psychology of judgment and decision making

1. Each day we are bombarded with a vast number of decisions and an overwhelming quantity of information.
 - What are some of the decisions you've made today?
 - What's an important decision you've made recently?
2. We have limited resources.
 - We are “boundedly rational” (March & Simon, 1958)



Themes (cont)

3. We take mental shortcuts when judging risks and making decisions about them.
 - We “satisfice” (Simon, 1955).
This is both adaptive (efficient and frequently good enough) and maladaptive (worse decisions).

We use heuristics to judge and decide!



Examples of heuristics

- Concluding that a person is closed or defensive because they have their arms crossed
- Deciding to eat at restaurant B rather than restaurant A only because B has more cars in its parking lot
- Deciding not to swim in the ocean because you just saw the movie Jaws!



Themes (cont)

4. We frequently don't know our "true" value for an object or situation. We construct values, preferences, and beliefs based on cues in the situation.
 - And based on *who we are* as decision makers!



Objective beliefs?

- Ideally, we're objective when we think and decide
- But this is not how the human mind works!
- Instead...
 - (a) we are influenced by a huge number of systematic heuristics and biases
 - we study many of these in my field
 - (b) irrelevant cues influence us outside of our awareness
 - (c) we are influenced by our emotions and moods
 - (d) we seek out, interpret, and weigh information according to our preconceived opinions**



Beliefs color our perceptions of reality Experts too!

- 57 wine experts were asked to taste test two glasses of wine, one red and one white (Morrot, Brochet, & Dubourdieu, 2001)
- The wines were actually the same white wine, one of which had been tinted red with food coloring.
- But that didn't stop the experts from describing the “red” wine in language typically used to describe red wines. One expert praised its “jamminess” while another enjoyed its “crushed red fruit.”
- **Not a single one noticed it was actually a white wine!**



Belief persistence - the tendency to maintain beliefs without sufficient regard to the evidence against them or lack of evidence in their favor.

A. Examples: safety of the five-second rule with food, getting a “base tan” will protect you against sunburn

B. Rational → inspires confidence to try more

C. Irrational → may make worse decisions

(e.g., continue to pursue someone who is not interested, person with clinical anxiety continues with debilitating fear of death)



It's a gray area:
Rational or irrational?

"I have not
failed. I've
just found
10,000 ways
that won't
work."



Thomas A. Edison



Why do we persist in beliefs?

- Selective perception
- Selective exposure
- Which lead to confirmation biases



Selective perception

“See what you want to see”

“Believe what you want to believe”

- Lord, Ross, & Lepper (1979)
 - 1/2 favored capital punishment,
1/2 opposed it



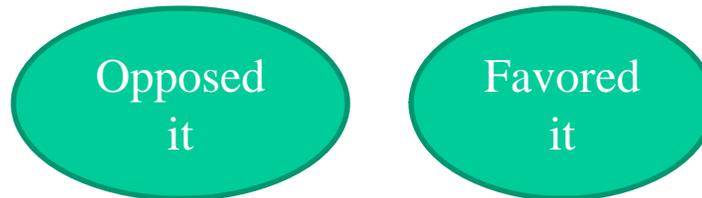
- Everyone read 2 studies, one that confirmed beliefs about capital punishment, and one that disconfirmed beliefs



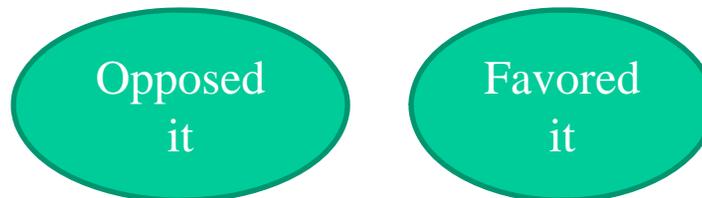
Selective perception

- Report that agreed with own attitude was “more convincing”
- Other report had “more flaws”

Average attitude before:



After reading reports: Attitudes **polarized**:





Selective exposure

“Search only for what you want to see”

Example: Interest in Nixon’s demise depended on whether you voted for Nixon or McGovern in 1972 (Sweeney & Gruber, 1984).

Example: Brochure orders depended on how well the brochure helped to maintain belief (Lowin, 1967)

	If strong arguments	If weak arguments
Order own	More	Less
Order other	Less	More



Belief Persistence

- Beliefs are surprisingly stable
- Because we are often closed to challenges to those beliefs



Confirmation bias – Selective perception and selective exposure lead us to confirm our hypotheses and beliefs

- Rather than testing them against information that might disconfirm them



Do preexisting hypotheses and beliefs influence risk perceptions?

- Risk perceptions in environmental domains (Kahan, Peters, et al., 2012, *Nature Climate Change*)
- Experts believe that:
 - the public doesn't perceive enough risk sometimes (e.g., climate change)
 - they perceive too much risk other times (e.g., nuclear power)



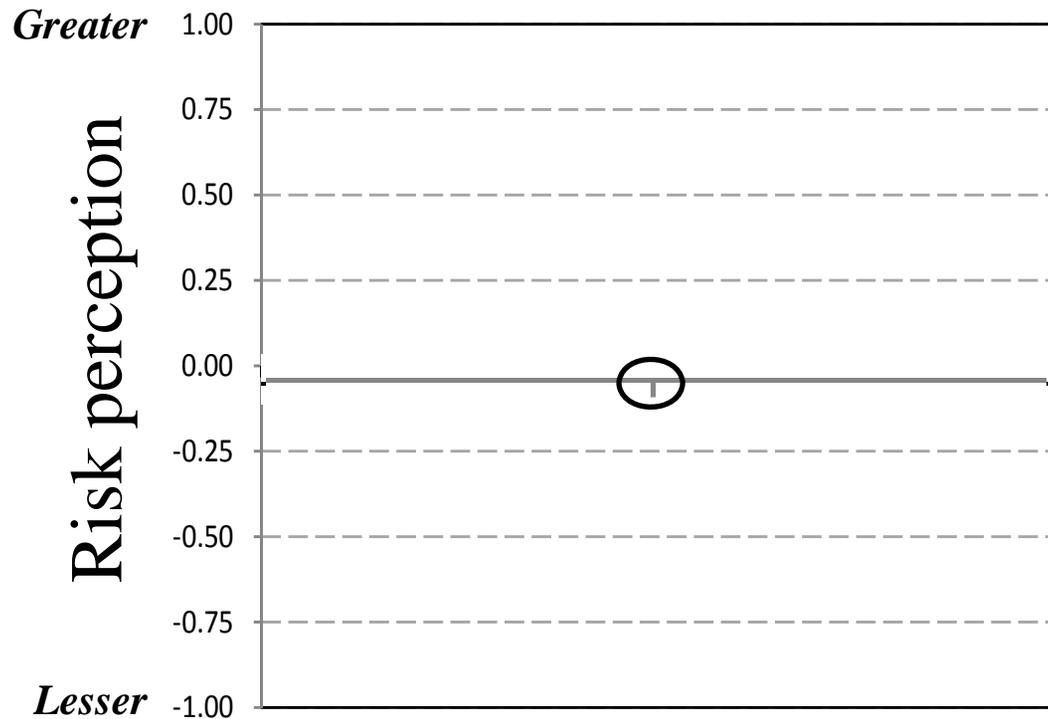
Experts think the public is irrational (Public Irrationality Thesis = PIT)

1. Scientifically illiterate and innumerate
2. “Bounded rationality” and the use of heuristics
3. Other non numeric information (e.g., fears, political leanings)

We decided to test this Public Irrationality Thesis



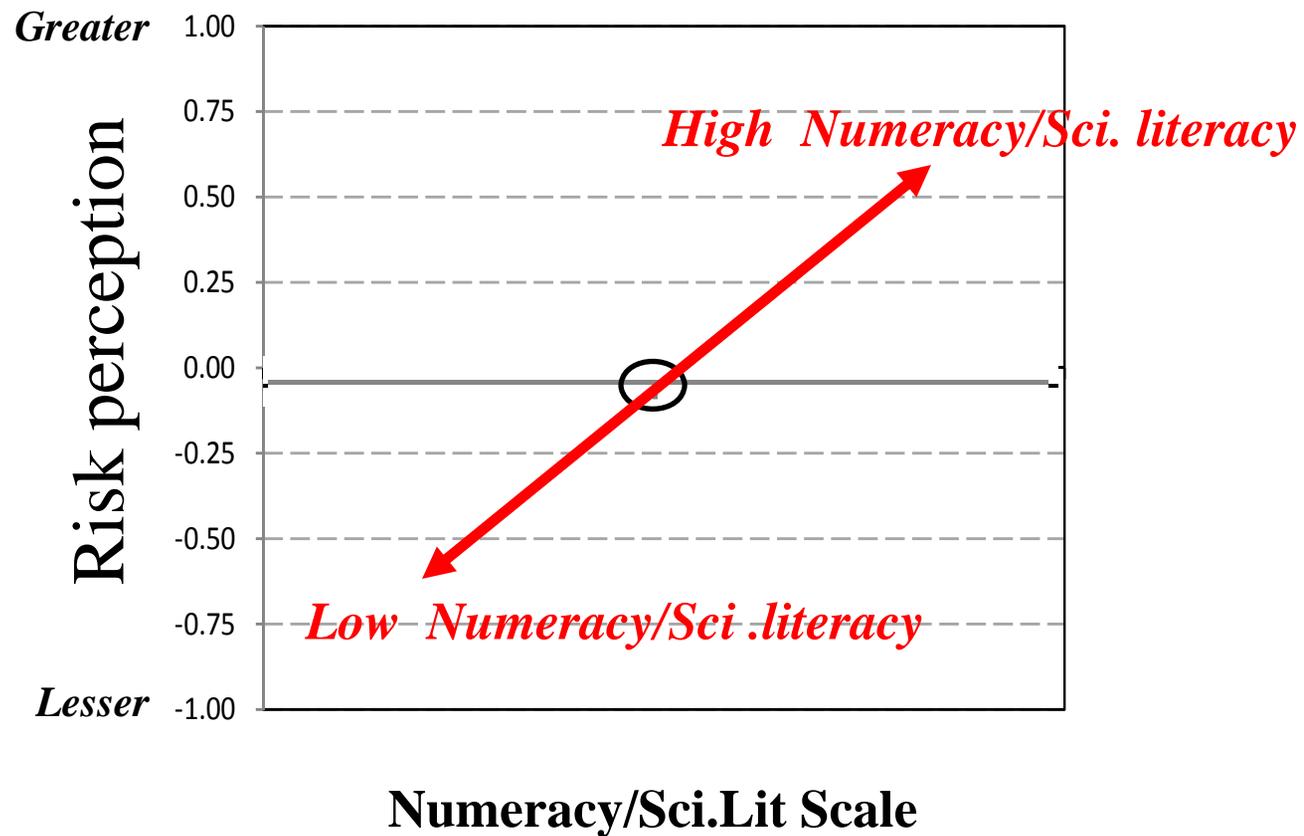
“How much risk do you believe climate change poses to human health, safety, or prosperity?”



U.S. general population survey, $N = 1,500$. Knowledge Networks, Feb. 2010. Scale 0 (“no risk at all”) to 10 (“extreme risk”), $M = 5.7$, $SD = 3.4$. CIs reflect 0.95 level of confidence.

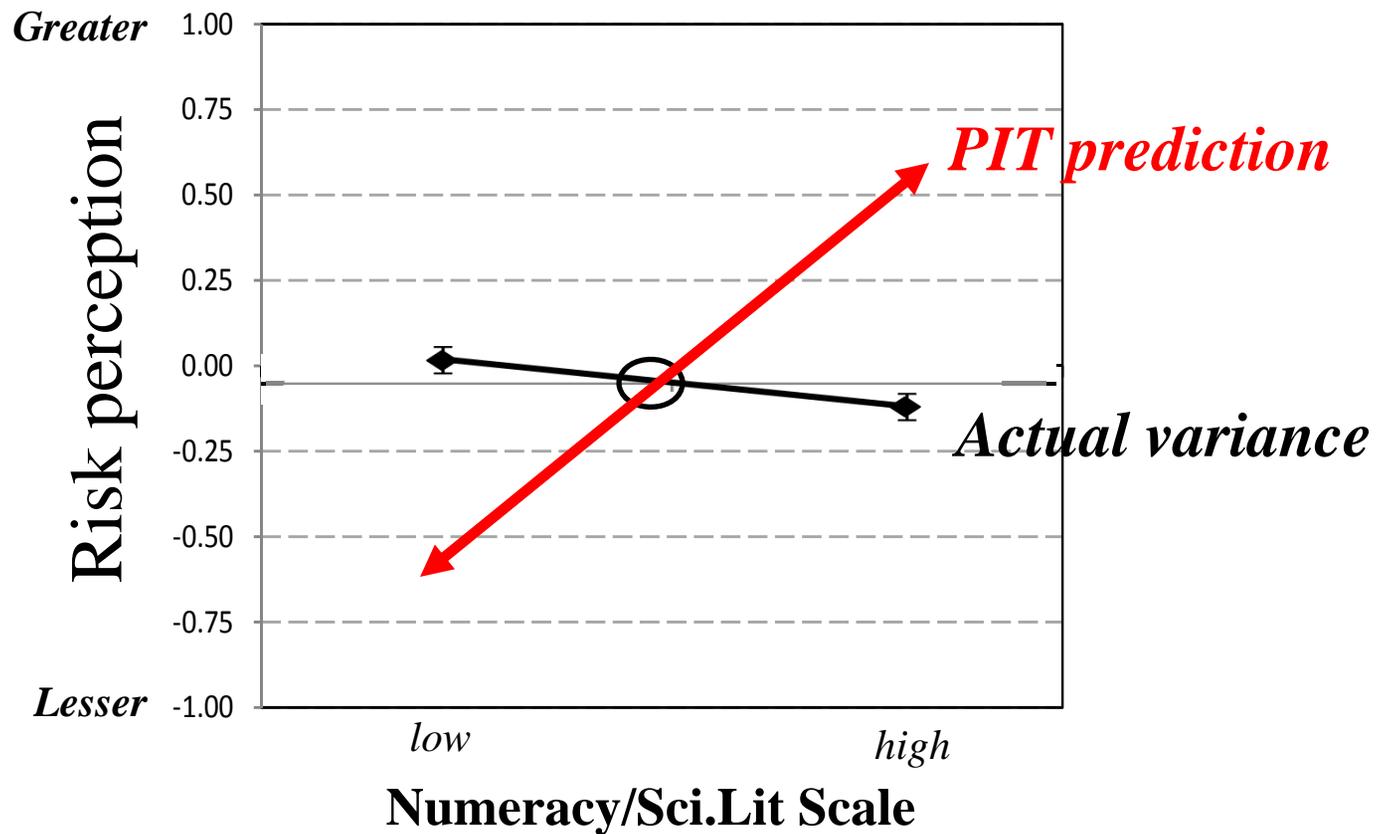


PIT prediction: Innumeracy and Science Illiteracy lead to Bounded Rationality in climate change perceptions



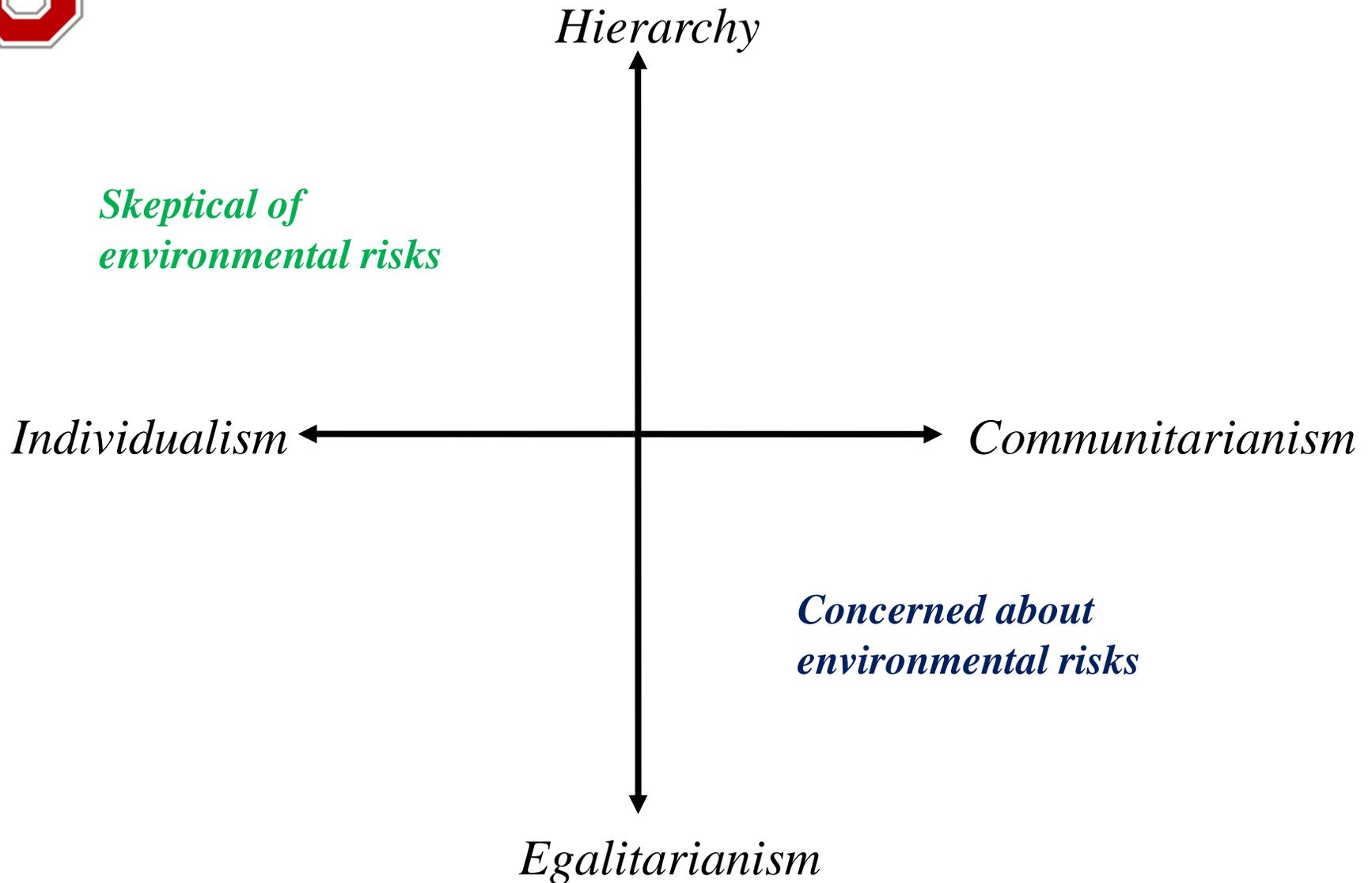


“How much risk do you believe climate change poses to human health, safety, or prosperity?”



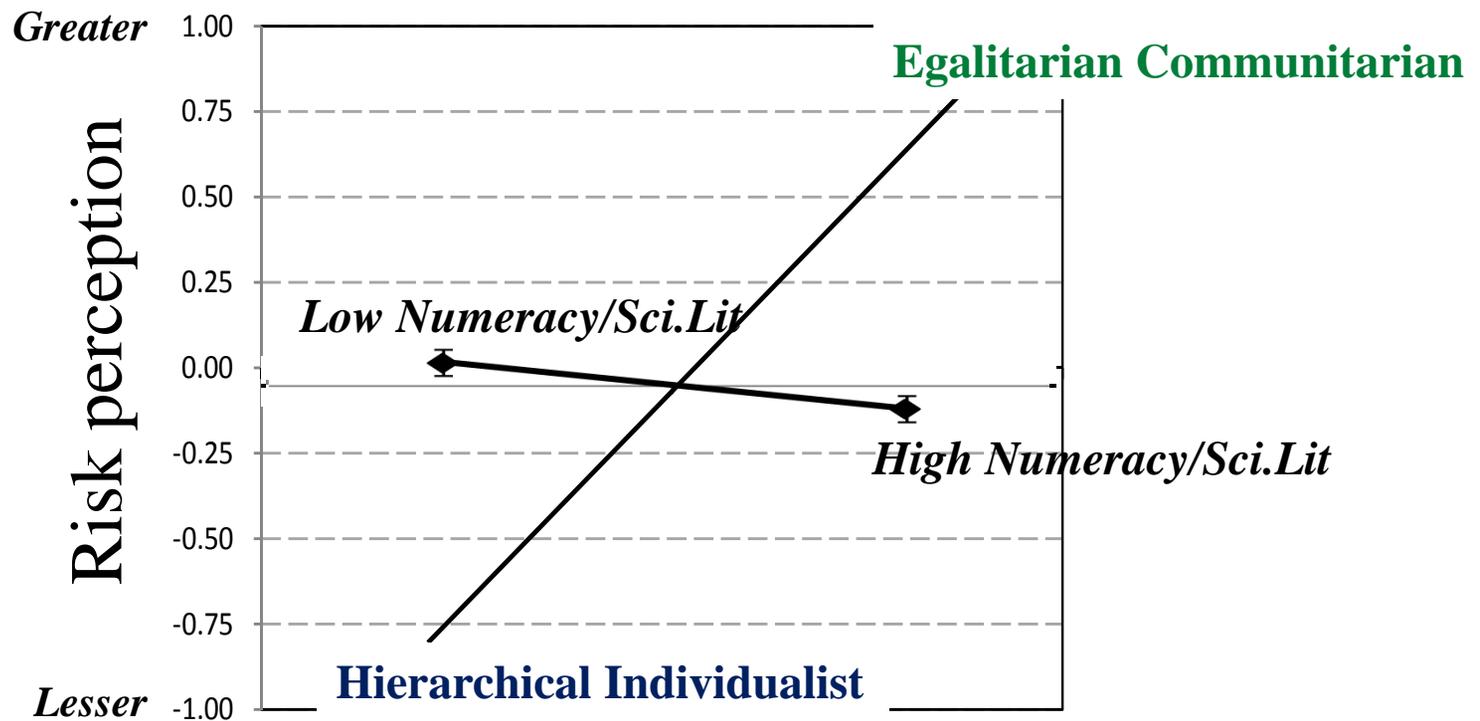


Cultural Cognition “Worldviews”





“How much risk do you believe climate change poses to human health, safety, or prosperity?”





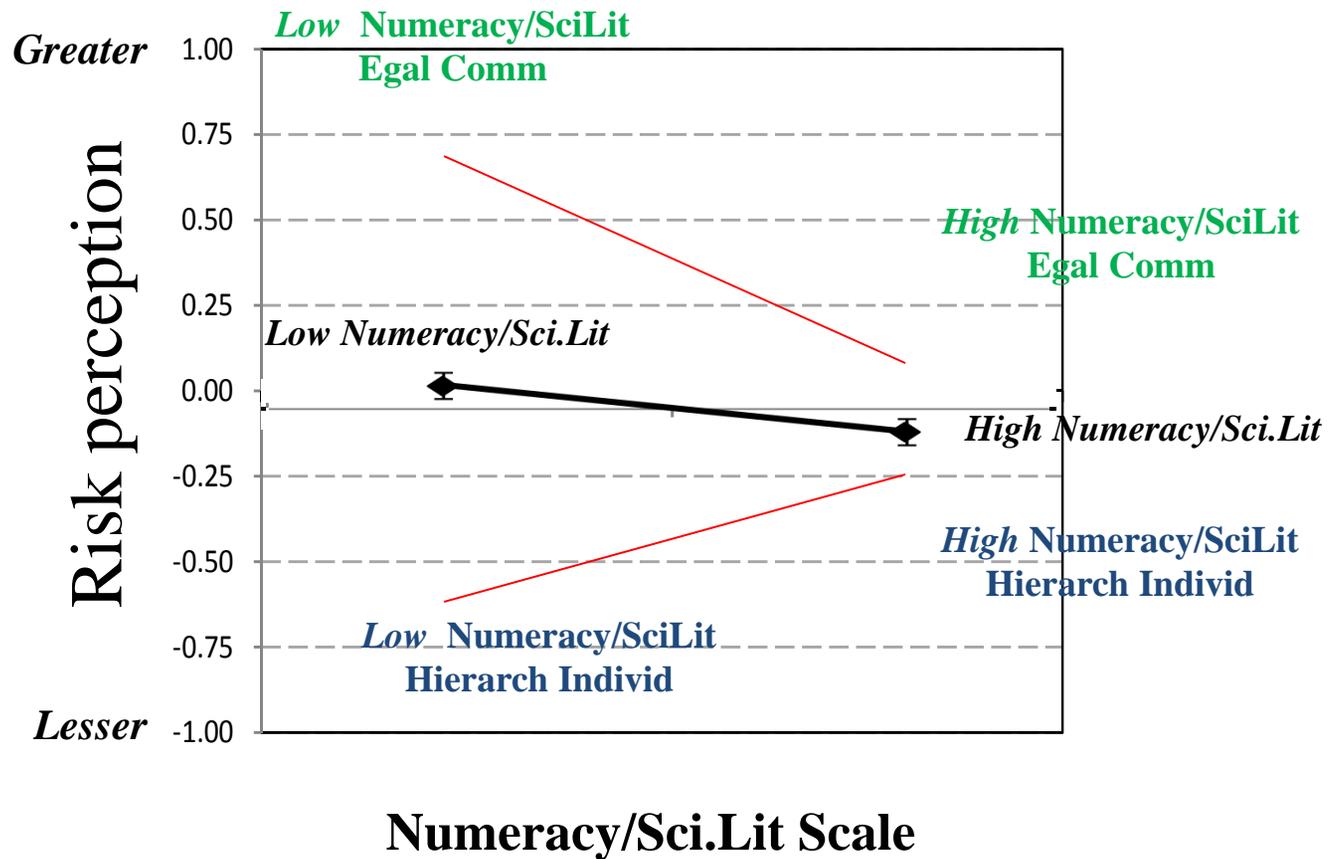
PIT Prediction:

Cultural cognitions will be used as a
heuristic substitute

And they will be used more by people who
are lower in numeracy and scientific literacy

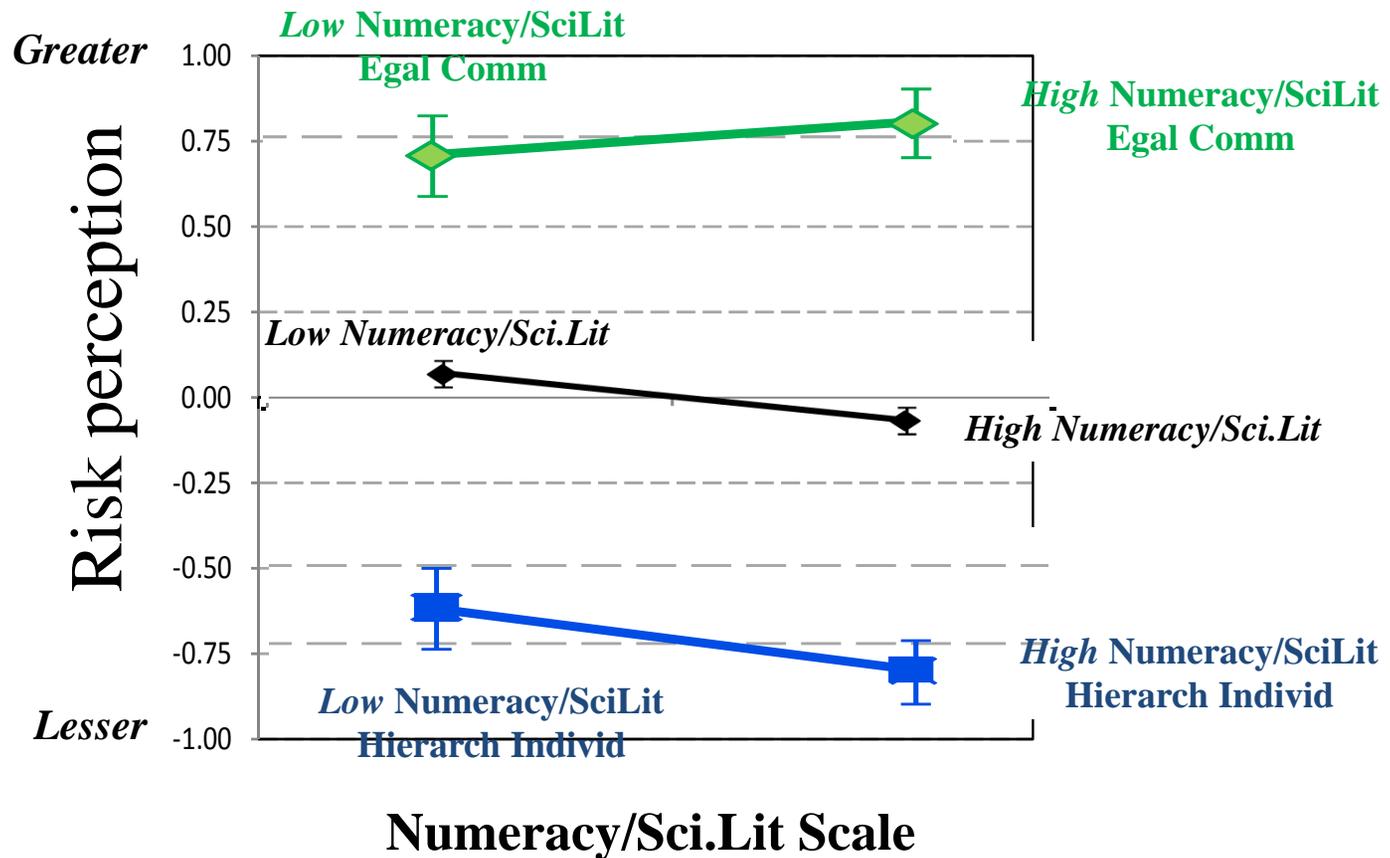


PIT-predicted interaction with Numeracy/SciLit



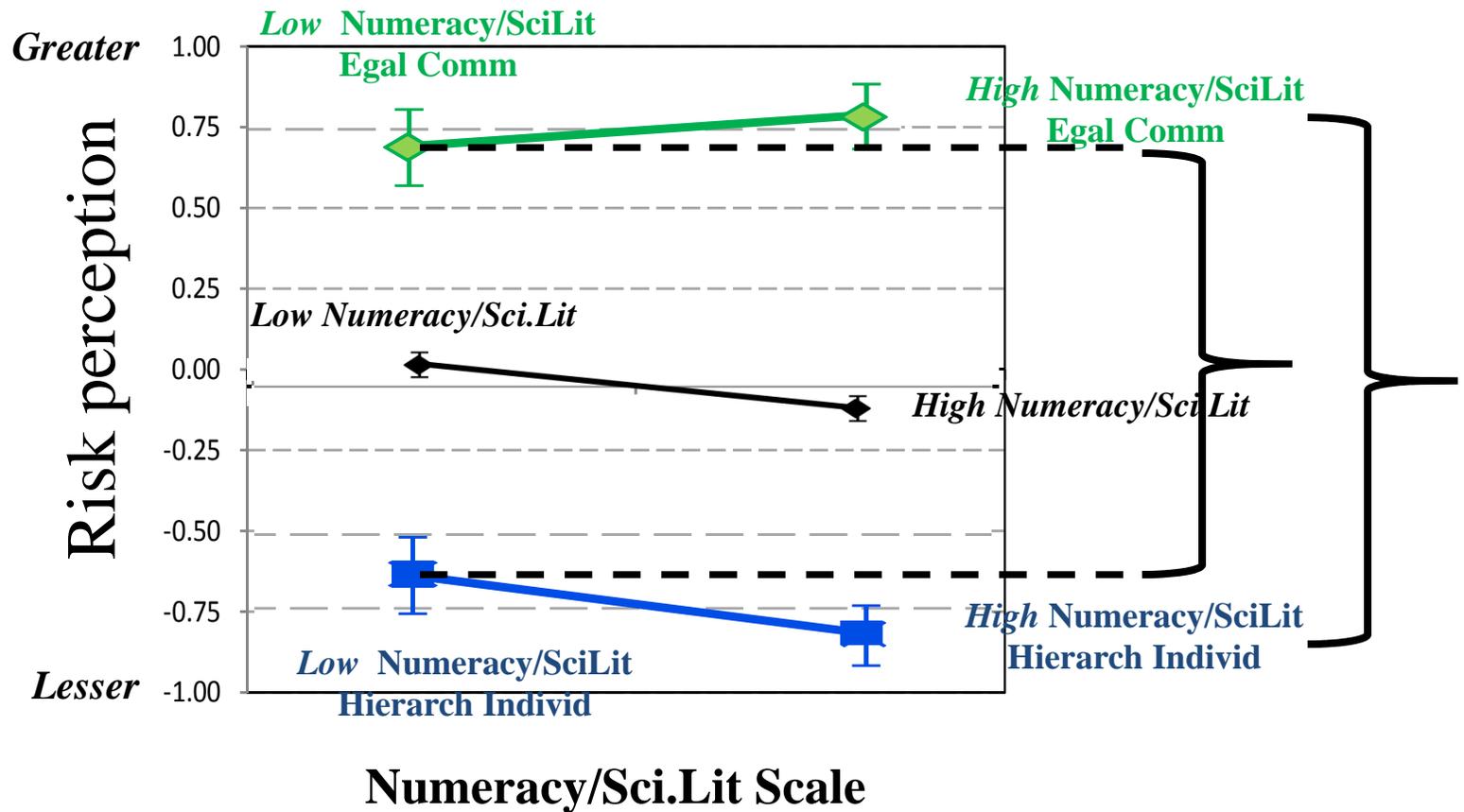


Actual interaction of Culture & Numeracy/SciLit





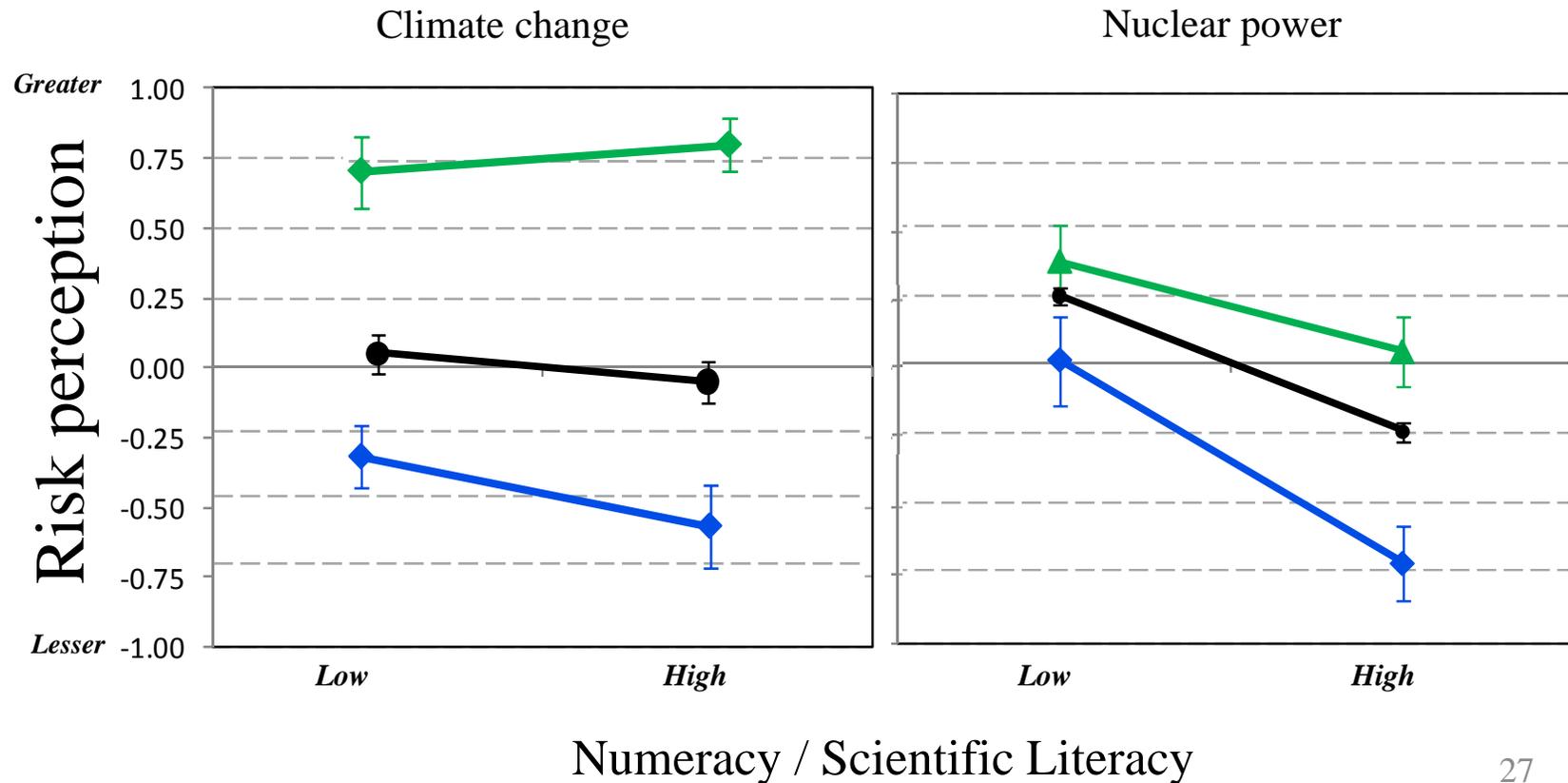
POLARIZATION INCREASES as Numeracy/SciLit increases





Similar polarization effects for both climate change and nuclear power

◆ Egalitarian Communitarian ■ Hierarchical Individualist ● Population





Why might polarization increase with higher numeracy and scientific literacy?

- We think that the goal is to learn the facts and allow them to influence our beliefs
- Instead, people want to remain part of their groups
We have strong goals to belong!
 - Belief persistence may be rational for individuals
 - And those with more skills may be better at it
- Even though society is worse off because we cannot agree on the facts!



But at least

- We should be able to agree on the answer to a math problem.
- $2 + 2 = 4$
- Right?

- Unless selective perception matters when it comes to objective facts...



Math in a “Skin cream experiment”

Medical researchers have developed a new cream for treating skin rashes. New treatments often work but sometimes make rashes worse. Even when treatments don't work, skin rashes sometimes get better and sometimes get worse on their own. As a result, it is necessary to test any new treatment in an experiment to see whether it makes the skin condition of those who use it better or worse than if they had not used it.

Researchers have conducted an experiment on patients with skin rashes. In the experiment, one group of patients used the new cream for two weeks, and a second group did not use the new cream.

In each group, the number of people whose skin condition got better and the number whose condition got worse are recorded in the table below. Because patients do not always complete studies, the total number of patients in each two groups is not exactly the same, but this does not prevent assessment of the results.

Please indicate whether the experiment shows that using the new cream is likely to make the skin condition better or worse.

	Result	
	Rash Got Better	Rash Got Worse
Patients who <u>did</u> use the new skin cream	223	75
Patients who did <u>not</u> use the new skin cream	107	21

What result does the study support?

- People who used the skin cream were more likely to get better than those who didn't.
- People who used the skin cream were more likely to get worse than those who didn't.



“Skin cream experiment”

Please indicate whether the experiment shows that using the new cream is likely to make the skin condition better or worse.

	Result		
	Rash Got Better	Rash Got Worse	
Patients who <u>did</u> use the new skin cream	223	75	<u>Got better</u> 74.8%
Patients who <u>did not</u> use the new skin cream	107	21	83.6%

What result does the study support?

People who used the skin cream were more likely to get better than those who didn't.

People who used the skin cream were more likely to get worse than those who didn't.



Experimental condition: We varied whether the skin cream made the rash increase or decrease

**Skin cream
made it worse:
Rash Increases**

	Result	
	Rash Got Better	Rash Got Worse
Patients who <u>did</u> use the new skin cream	223	75
Patients who did <u>not</u> use the new skin cream	107	21

What result does the study support?

- People who used the skin cream were more likely to get better than those who didn't.
- People who used the skin cream were more likely to get worse than those who didn't.

**Made it better:
Rash Decreases**

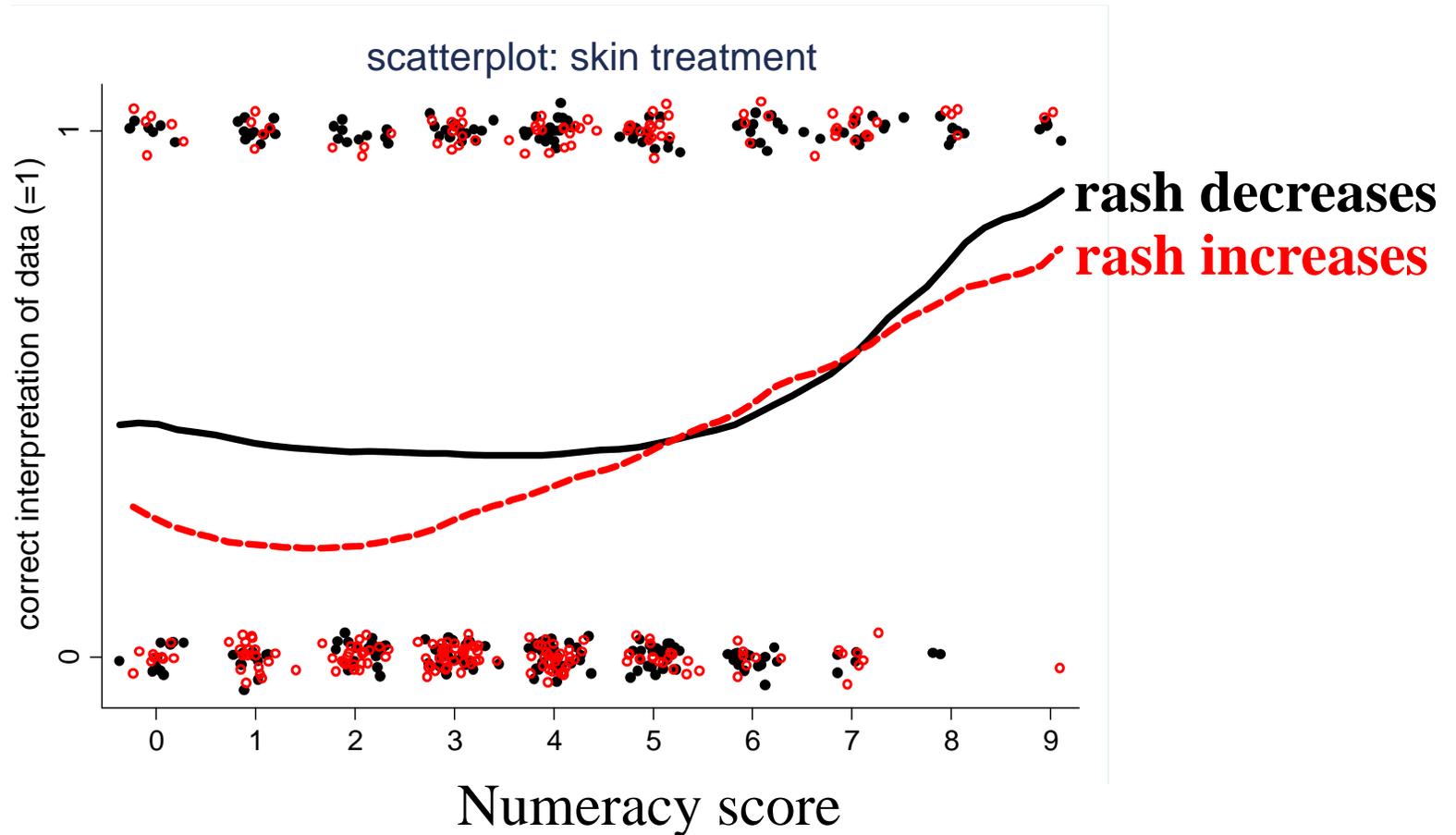
	Result	
	Rash Got Worse	Rash Got Better
Patients who <u>did</u> use the new skin cream	223	75
Patients who did <u>not</u> use the new skin cream	107	21

What result does the study support?

- People who used the skin cream were more likely to get better than those who didn't.
- People who used the skin cream were more likely to get worse than those who didn't.



Skin cream problem: Proportion of participants who answered correctly



Lowess smoother superimposed on raw data.



Math in a “Gun ban experiment”

YouGov[®] What the world thinks



A city government is trying to decide whether to pass a law banning private citizens from carrying concealed handguns in public. Government officials are unsure whether the law will be more likely to decrease crime by reducing the number of people carrying weapons or increase crime by making it harder for law-abiding citizens to defend themselves from violent criminals.

Researchers completed a study of two groups of cities to answer that question. The study involved comparing changes in annual crime rates for one group of cities that had banned concealed handguns with changes in annual crime rates for a second group of cities that had not banned concealed handguns.

In each group, the number of cities in which the crime rate decreased and the number of cities in which the crime rate increased are recorded in the table below. The exact number of cities in each group is not the same, but this does not prevent assessment of the results.

Please indicate whether the study shows that banning private citizens from carrying concealed handguns in public is likely to decrease crime or to increase crime.

	Result	
	Decrease in crime	Increase in crime
Cities that <u>did</u> ban carrying concealed handguns in public	223	75
Cities that <u>did not</u> ban carrying concealed handguns in public	107	21

What result does the study support?

- Cities that enacted a ban on carrying concealed handguns were more likely to have a decrease in crime than cities without bans.
- Cities that enacted a ban on carrying concealed handguns were more likely to have an increase in crime than cities without bans.





Spoiler alert:

It's the same math problem as the skin cream problem!



Experimental condition: We varied whether having gun control laws decreased or increased crime

Crime Decreases

	Result	
	Increase in crime	Decrease in crime
Cities that <u>did</u> ban carrying concealed handguns in public	223	75
Cities that <u>did not</u> ban carrying concealed handguns in public	107	21

What result does the study support?

- Cities that enacted a ban on carrying concealed handguns were more likely to have a decrease in crime than cities without bans.
- Cities that enacted a ban on carrying concealed handguns were more likely to have an increase in crime than cities without bans.

Crime Increases

	Result	
	Decrease in crime	Increase in crime
Cities that <u>did</u> ban carrying concealed handguns in public	223	75
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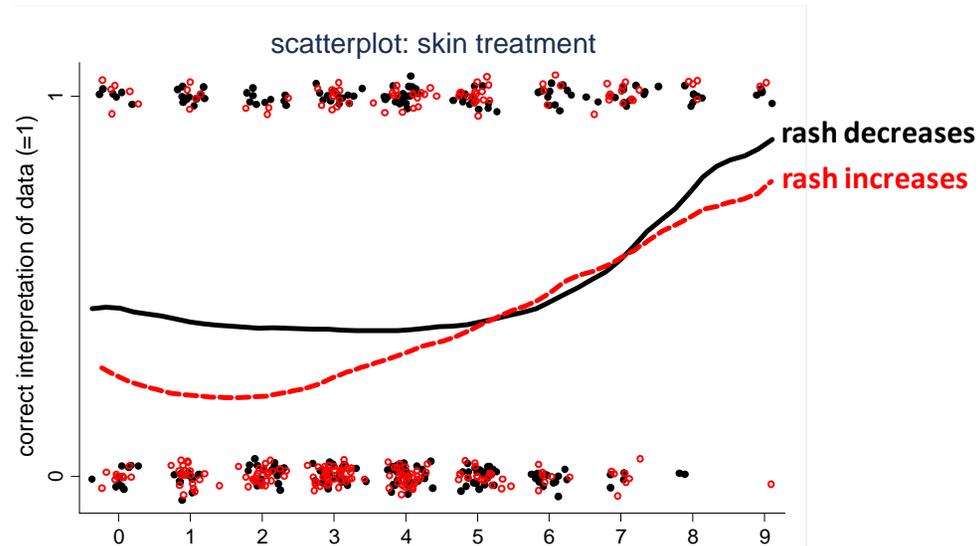
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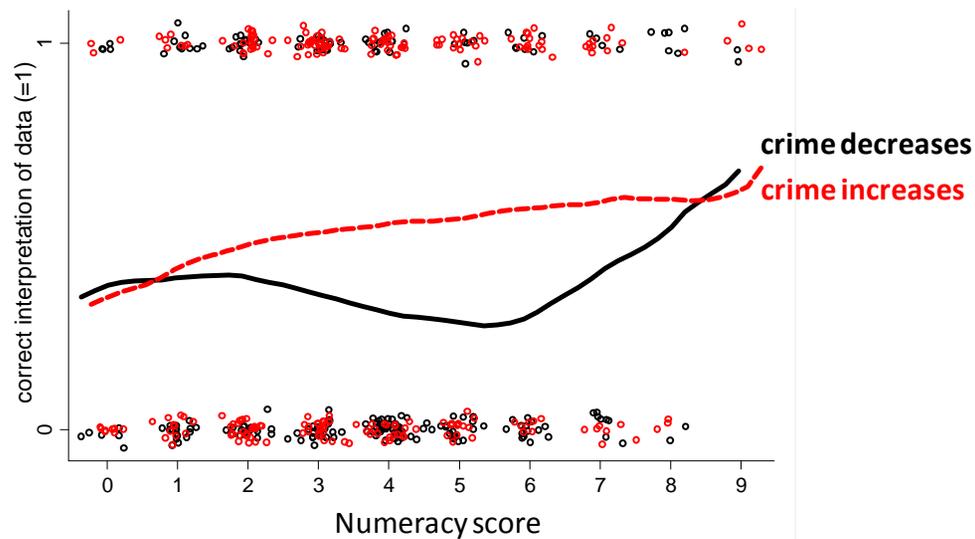


% of participants who answer correctly

Skin
cream



Gun
control

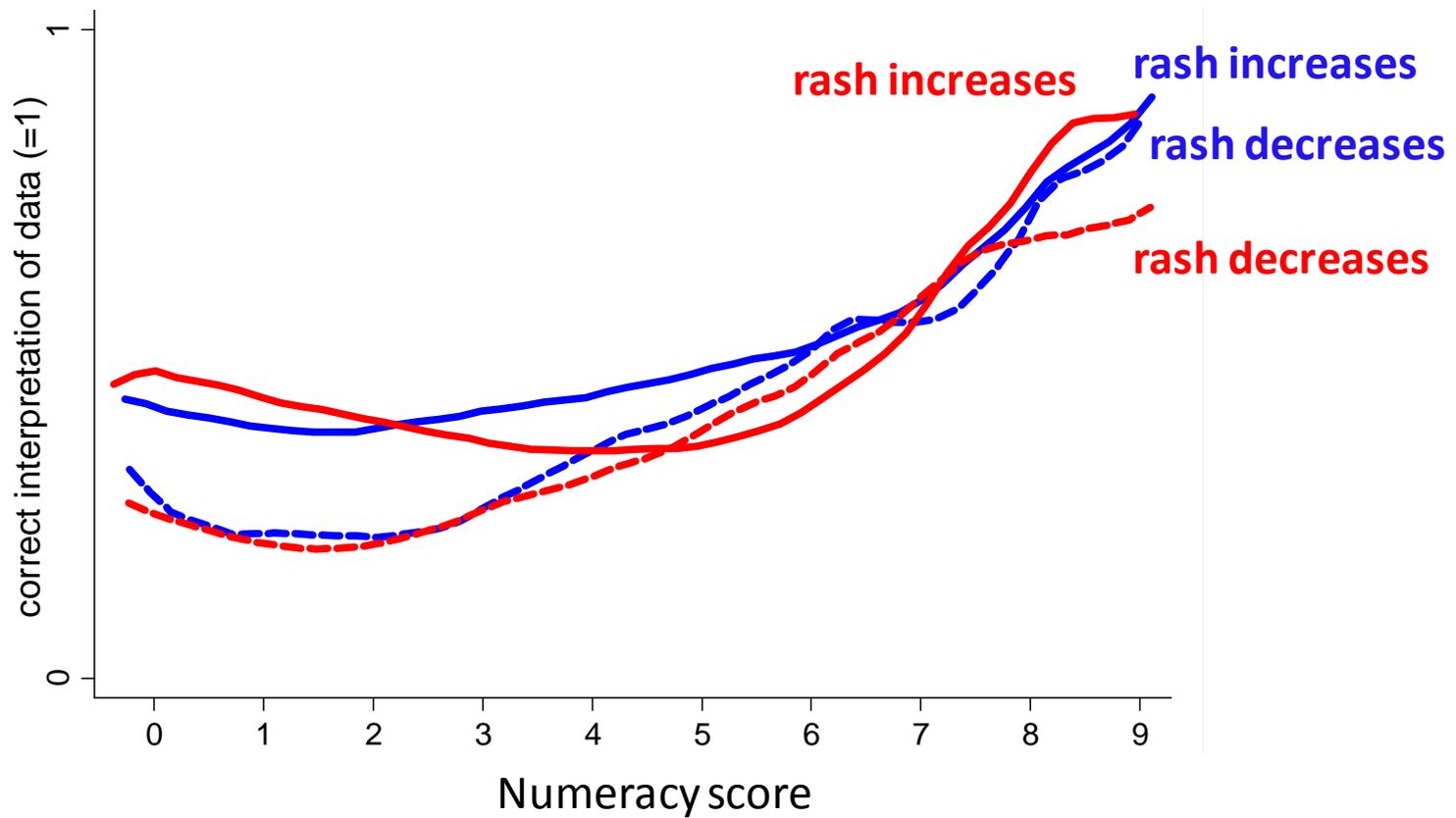




Skin cream: The more numerate were correct more often. Political leanings didn't matter.

Liberal Democrats (< 0 on Conservrepub)

Conserv Republicans (> 0 on Conservrepub)



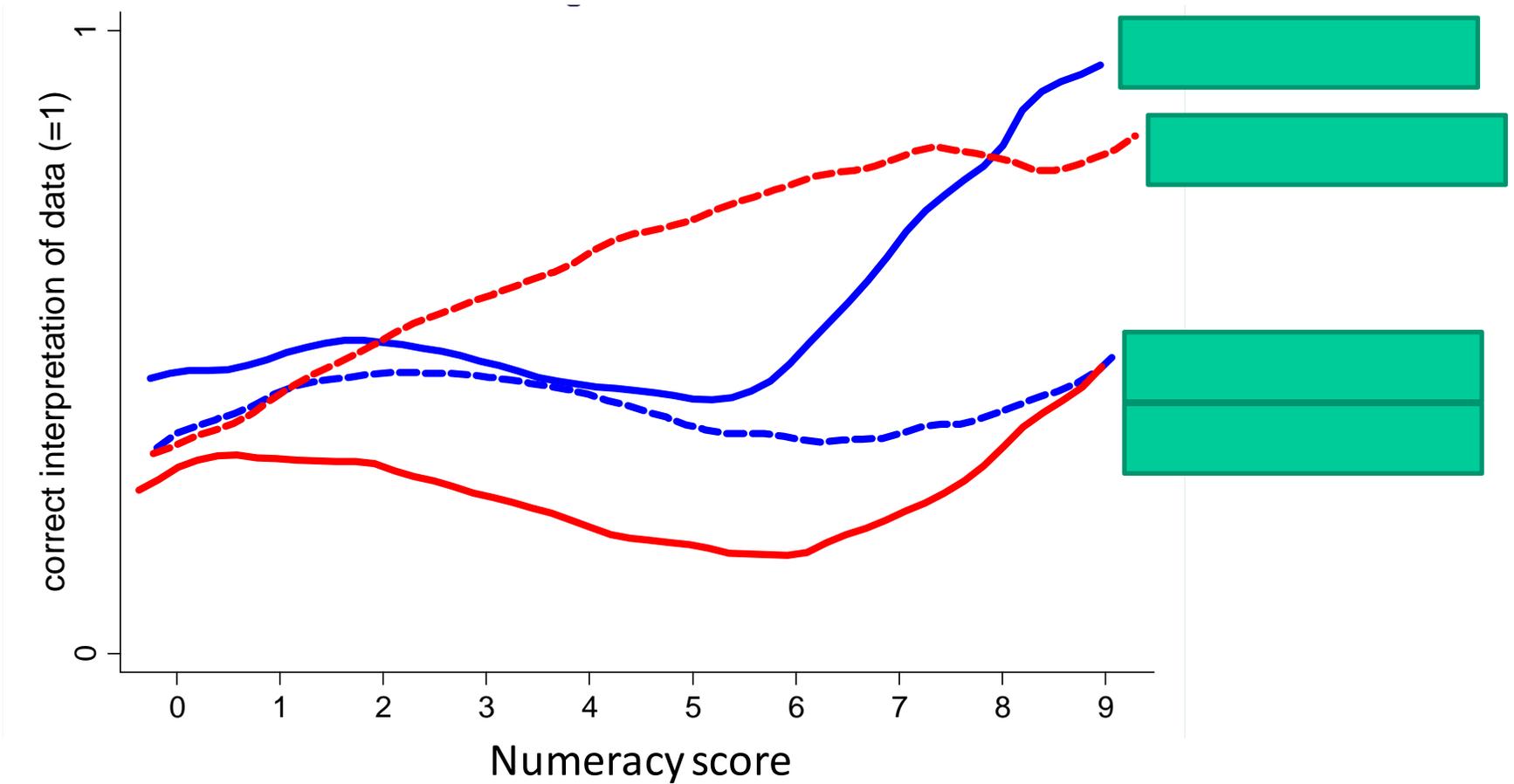
Lowess smoother superimposed on raw data.



Gun control: Political leanings mattered for correct interpretation of data

Liberal Democrats (< 0 on Conservrepub)

Conserv Republicans (> 0 on Conservrepub)





Partisan differences in correct interpretation of the data

- The highly numerate were more likely to get the right answer
- But political polarization of what was considered a “fact” was higher among the highly numerate



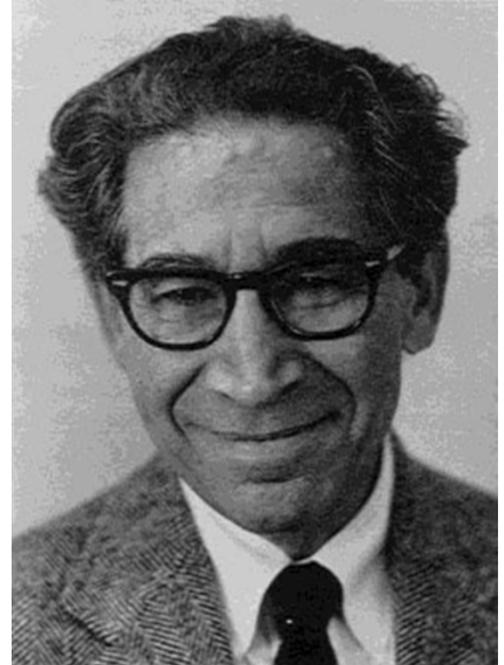
Getting it right seems to depend on:

- The correct answer
- But also whether the correct answer agrees with what you want to see
 - And especially if you're more numerate



Why we don't believe science

1. Numeracy and Science literacy
2. Bounded rationality (and use of heuristics)
3. Confirmation biases driven by selective exposure and selective perception
 - “**A MAN WITH A CONVICTION** is a hard man to change. Tell him you disagree and he turns away. Show him facts or figures and he questions your sources. Appeal to logic and he fails to see your point.”
Leon Festinger





That doesn't mean that it's hopeless



How you present information matters





Evidence-based communication strategies

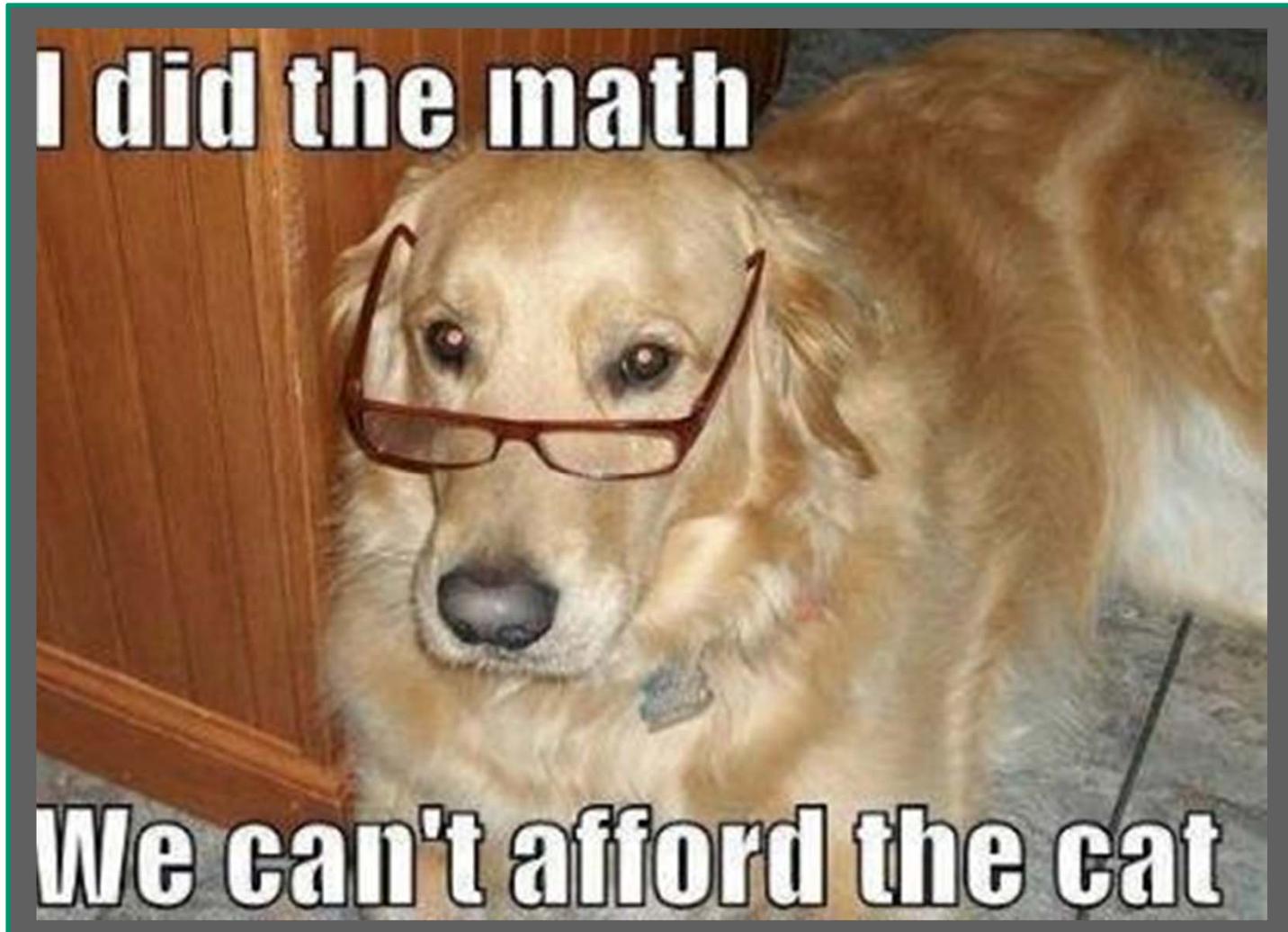
(Peters et al., 2014, IOM)

1. Provide numeric information (as opposed to not providing it)
2. Reduce cognitive effort
3. Provide evaluative meaning, particularly when information is unfamiliar
4. Draw attention to important information

Careful choices of how information is presented will increase comprehension and use of information



But sometimes motivated information processing occurs





Climate change beliefs

- The evidence says that 97% of climate scientists have concluded that human-caused climate change is happening
- But only 44% of Americans believe humans are causing climate change vs. 77% who believe that aliens have visited Earth
 - Nicholas Kristoff (*NYTimes*, January 19, 2014)



What to do when beliefs may be motivated



Best ways to change or give up beliefs

Ask others to critique their own judgment. You should do it too. Assume the logical opposite of your beliefs and see how well the data fit (Gilbert, 1991).

To give up a belief, merely saying it's false doesn't help. Instead, replace it with a plausible alternative belief or hypothesis (Dawes, 1988).



Conclusions (1)

- Preferences and beliefs in scientific data should be independent
 - They're not independent
- People don't always believe science
 - and for a variety of reasons, some of which are motivated



Conclusions (2)

- Communication is not an easy task
- Communicators overestimate:
 - What others know
 - How well they themselves communicate
- And the public is not adept at using the complex, often numeric information important to good climate decisions
- Evidence-based communication techniques exist
 - Should be used strategically
 - Decide what the communication goals are
 - And then carefully choose how to present information



Conclusions (3)

- But we also need more research into how to communicate best in areas where beliefs are motivated!



Thank you!

For more information on OSU's Decision Sciences Collaborative, please see <https://decisionsciences.osu.edu/>

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