



Numeracy and risk perception

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Dual process theory: System 1 and System 2

- System 1

- affective
- intuitive and holistic
- based on our experiences
- fast

- System 2

- deliberative
- analytical and logical
- slower
- monitors the quality of System 1 intuition



Interactions of affect/intuitions and deliberation in decision making

- Feelings/Intuitions ↔ Thoughts
- Feelings are informed by cognitive skills
 - Numeracy and secondary affect
- Numeracy influences what we think about and react to in decisions



Numeracy

- The ability to understand and use basic probability and mathematical concepts
- About 1 out of 2 Americans do not have the minimal math skills needed to use numbers embedded in newspapers (Kirsch et al., 2002)
- Innumeracy associated with less ability to follow complex medication regimens and more hospital and emergency room visits

There are
3 kinds
of **people**:

Those who
can count
and those
who can't.



13

Does numeracy matter?



Numeracy and psychological mechanisms (that influence risk perceptions and decisions)

- Transforming numbers: How much a given frame influences decisions
-
-
-

Peters, Västfjäll, et al., 2006, *Psychological Science*

Framing:

Probability and Relative Frequency in Risk Communication

- Are they the same or different in communicating risk?

e.g., 1% chance

vs.

1 out of 100

Peters, Västfjäll, et al. (2006) Psychological Science.



Risk Communication

A patient — Mr. James Jones — has been evaluated for discharge from an acute civil mental health facility where he has been treated for the past several weeks. A psychologist whose professional opinion you respect has done a state-of-the-art assessment of Mr. Jones. Among the conclusions reached in the psychologist's assessment is the following:



Highly numerate hypothesized to have both formats accessible

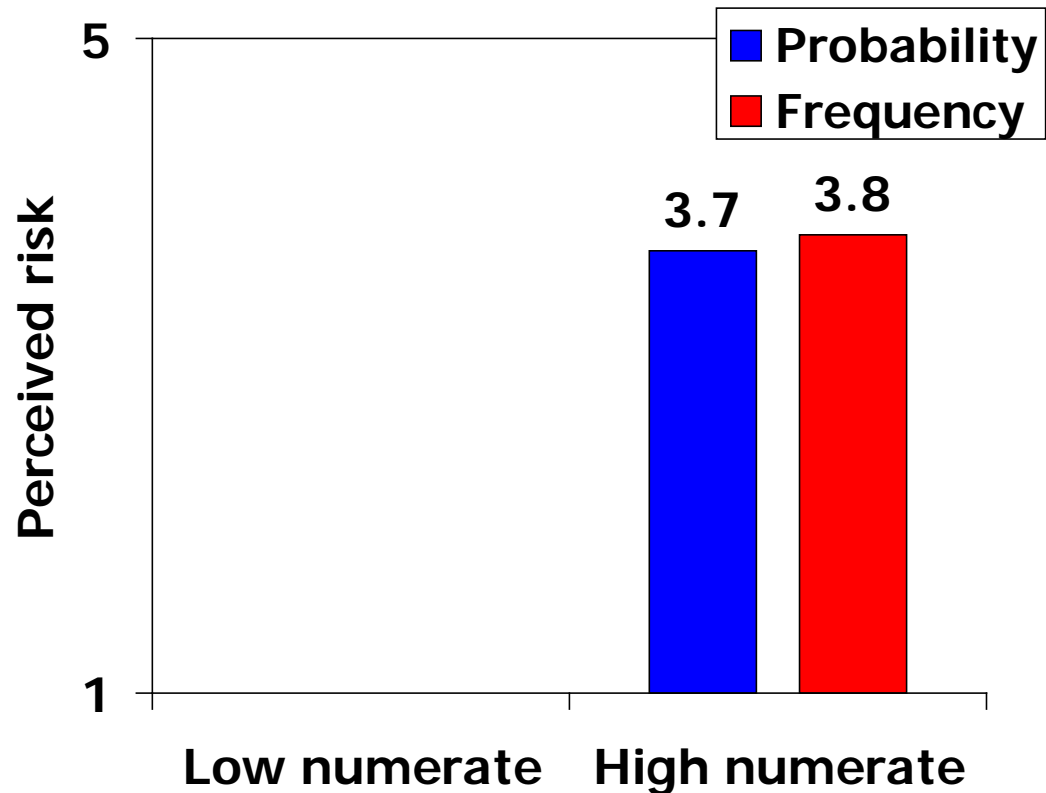
- Probability condition

Of every 100 patients similar to Mr. Jones, 10% are estimated to commit an act of violence to others during the first several months after discharge

- Frequency condition

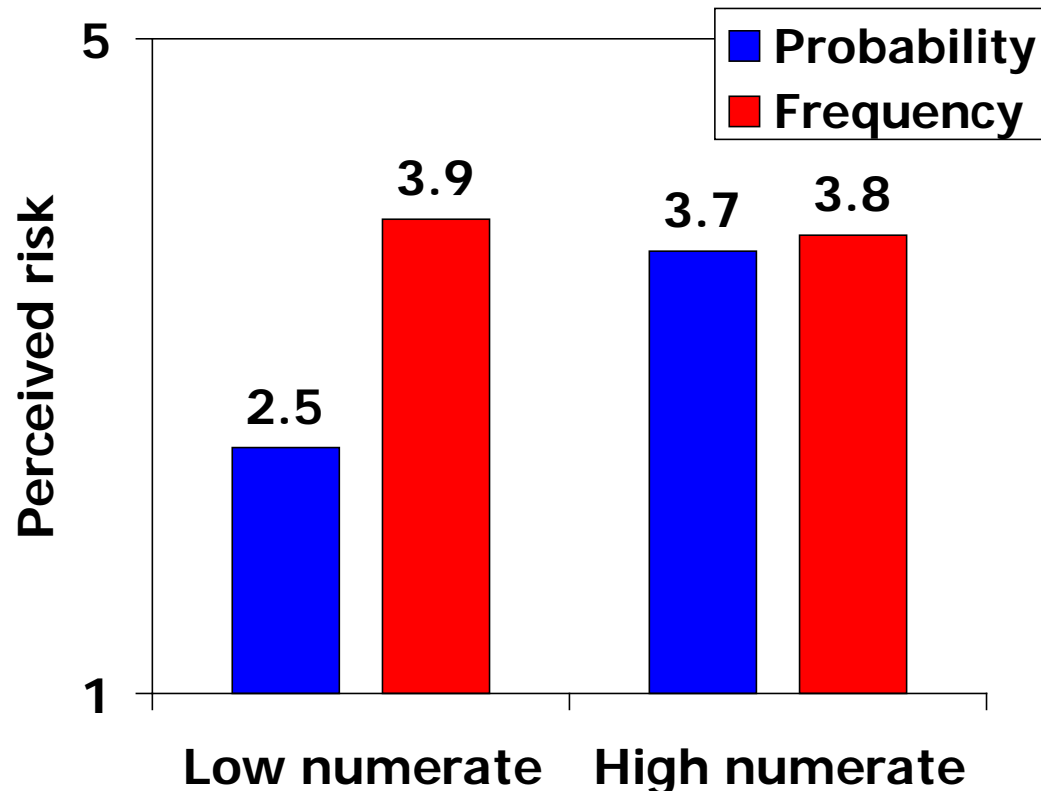
Of every 100 patients similar to Mr. Jones, 10 are estimated to commit an act of violence to others during the first several months after discharge

Perceived risk to others



$F(3,42)=4.4, p<.01$ (Frame, $p<.05$; Numeracy, n.s.; Interaction, $p<.05$)

Less numerate perceive less risk with probability format



$F(3,42)=4.4, p<.01$ (Frame, $p<.05$; Numeracy, n.s.; Interaction, $p<.05$)

Effect remains after controlling for a proxy for intelligence



Numeracy and psychological mechanisms (that influence risk perceptions and decisions)

- Transforming numbers: How much a given frame influences decisions
- Beyond comprehension: How much numeric information is used
-
-

Peters, Västfjäll, et al, 2006, *Psychological Science*;

Peters, Dieckmann, et al., 2007, *Medical Care Research & Review*;

Peters & Levin, 2008, *Judgment and Decision Making*

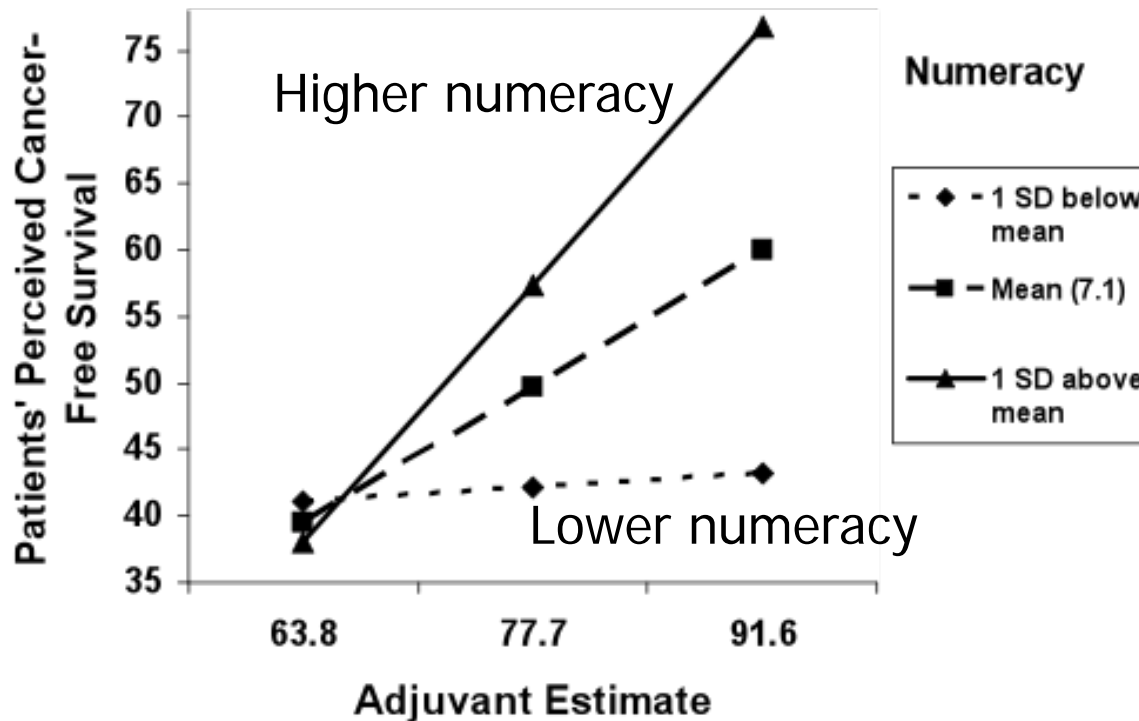


Women with early stage estrogen receptor positive cancers

- N=106 had ER+ disease and received surgery for early cancer (mean age=55 years; 73% Caucasian; 77% at least some college or trade school)
- Now faced with decision about adjuvant treatment options
- Adjuvant Online decision aid (Siminoff et al., 2006)

(Lipkus, Kimmick, Marcom, & Peters, in review)

Personal estimates of cancer-free survival associated with numeracy



(Lipkus, Kimmick, Marcom, & Peters, in review)



Beyond comprehension – Numbers are used more by highly numerate

- Breast cancer patients and benefits of tamoxifen
- Terrorism risks

Less numerate relatively insensitive to different numeric levels



Numeracy and psychological mechanisms (that influence risk perceptions and decisions)

- Transforming numbers: How much a given frame influences decisions
- Beyond comprehension: How much numeric information is used
- Influence of other information: How much normatively less relevant information influences decisions



Peters, Västfjäll, et al., 2006, *Psychological Science*;
Peters, Dieckmann, et al., in press, *JEP: Applied*;
Dieckmann, Slovic, & Peters, in review;
Dieckmann, Peters, et al., in review

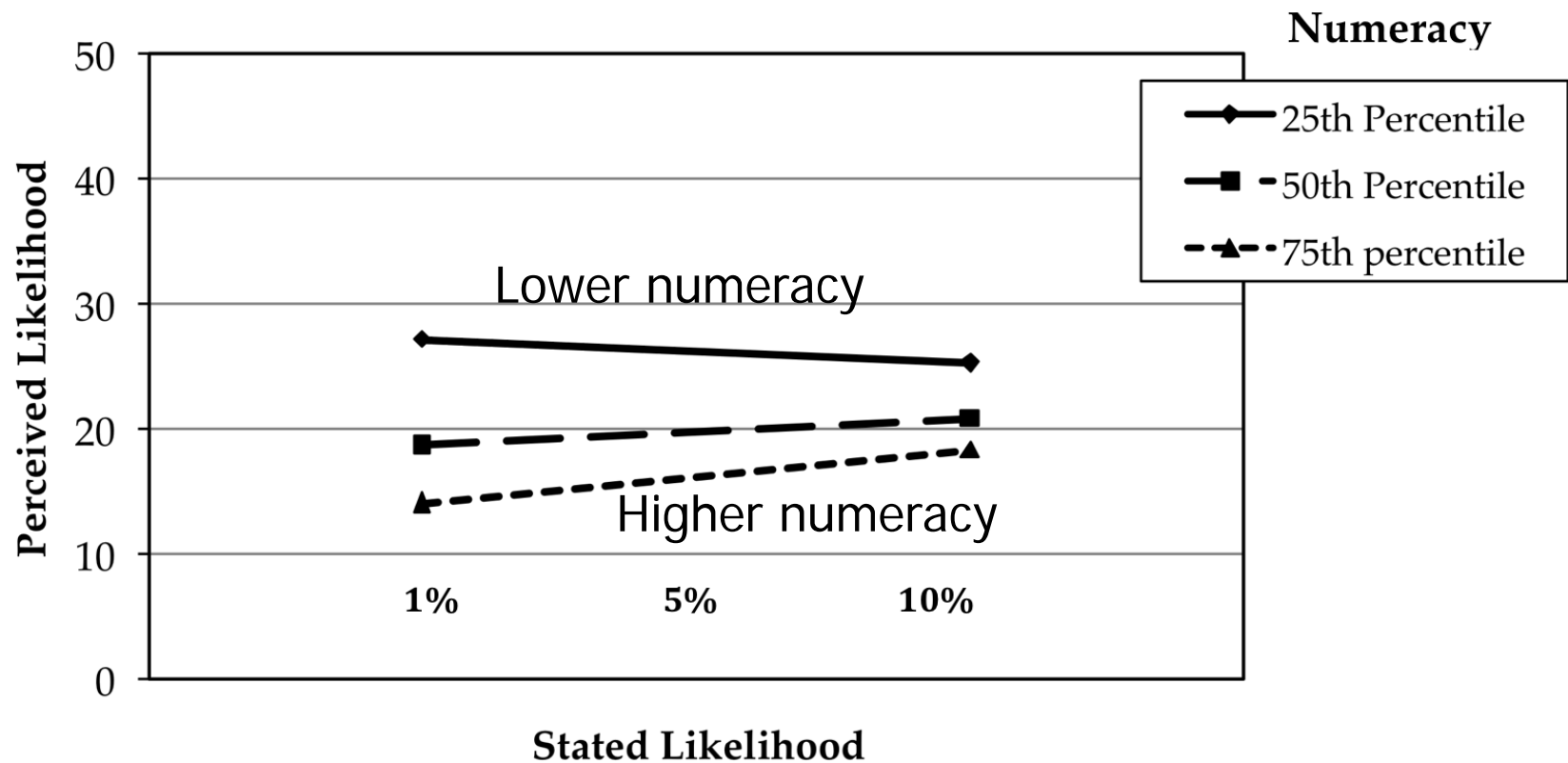


Numeracy and perceptions of terrorist attack

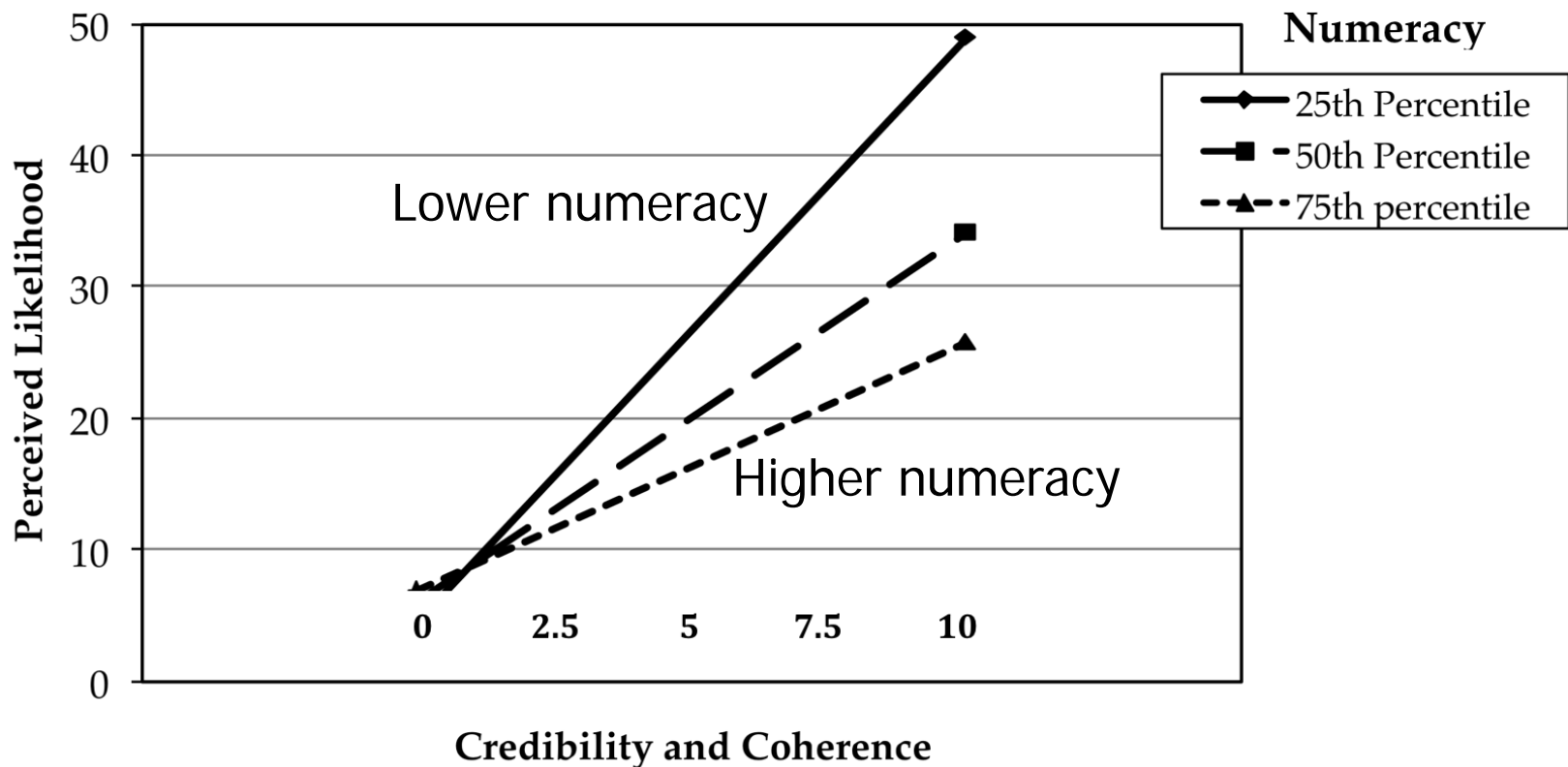
- Highly educated sample (N=58, 91% grad students; 53% female; mean age=28)
- Three simulated intelligence forecasts of a possible terrorist attack
 - Narrative from intelligence report
 - Potential harm = “worst-case scenario would be 1000 deaths and injuries and 50 million dollars in property damage
 - Probability of attack=1%, 5%, and 10%

(Dieckmann, Slovic, & Peters, in press, *Risk Analysis*)

Perceived likelihood of attack – Less numerate insensitive to probability



Less numerate were more sensitive to perceptions of the narrative evidence

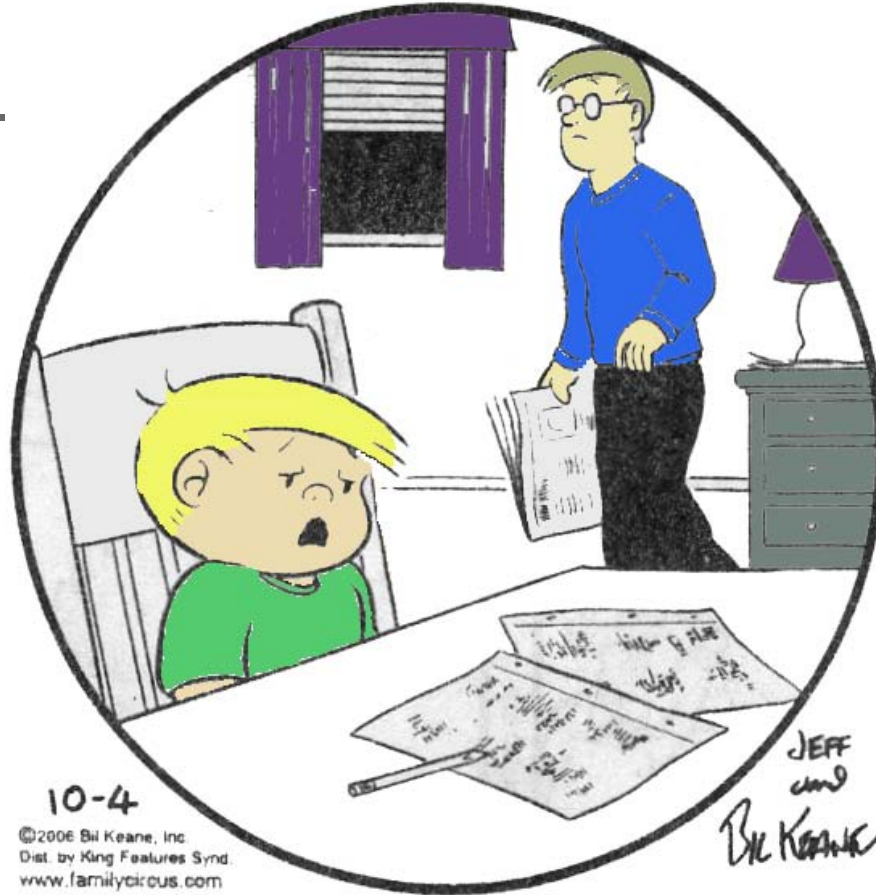




Influence of less normatively relevant information - conclusions

- Highly numerate are sensitive to numeric information
- Less numerate respond to less normatively relevant information
 - Frame of information
 - Narrative information
 - Mood states
 - Number (not %) of individuals with AIDS

FAMILY CIRCUS

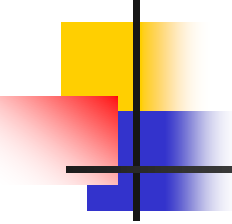


“Math has way too many numbers in it.”



Numeracy and psychological mechanisms (that influence risk perceptions and decisions)

- Transforming numbers: How much a given frame influences decisions
- Beyond comprehension: How much numeric information is used
- Influence of other information: How much normatively less relevant information influences decisions
- Attention to numbers



Attention to numeric information?

Word search puzzle

- N=151 undergraduates
- Asked to find as many words as possible in four minutes
- The key at the bottom identified 10 color words and 10 number words
- Matched for number of characters (e.g., green and eight)

Word Search Puzzle

F S P O B W A H X D P U J Y E
 M Q L D O R P E Y R U L L N E
 R K Y L C B X E F J R O I U E
 V N L T C T H R E L P N F L I
 B E E P N A X H G A L P E R O
 Y T C E Z E S T N E E V Q U C
 U G B J T E W Y A T E P B O E
 P M D E V R D T R N I L Y F V
 E D P E S N I E O T W E L V E
 U N N W U E I H D E R L Q C S
 L X E G I G F F T H E E B I S
 B A R E H Q K C A L B T X V W
 E U I T R L I C E N O I G J B
 B W V H K G N D X L C H L A D
 E E I C D C F P L B D W U X O

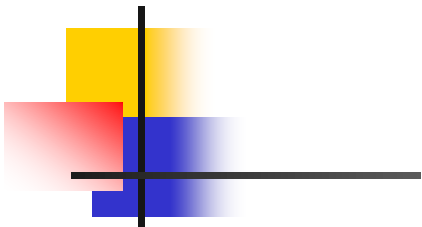
	BLACK
	WHITE
	ORANGE
	GREEN
	TEAL

	EIGHT
	TWELVE
	ELEVEN
	FOUR
	NINE

	BURGUNDY
	YELLOW
	BLUE
	PURPLE
	RED

	SEVEN
	SIX
	THIRTEEN
	THREE
	TWENTY

Word Search Puzzle



F S P O B W A H X D P U J Y E
 M Q L D O R P E Y R U L L N E
 R K Y L C B X E F J R O I U E
 V N L T C T H R E L P N F L I
 B E E P N A X H G A L P E R O
 Y T C E Z E S T N E E V Q U C
 U G B J T E W Y A T E P B O E
 P M D E V R D T R N I L Y F V
 E D P E S N I E O ~~T W E L V E~~
 U N N W U E I H D E R L Q C S
 L X E G I G F F T H E E B I S
 B A R E H Q K C A L B T X V W
 E U I T R L I C E N O I G J B
 B W V H K G N D X L C H L A D
 E E I C D C F P L B D W U X O

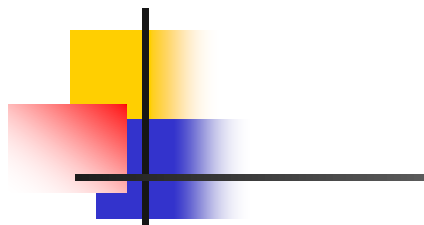
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Word Search Puzzle



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 M Q L D O R P E Y R U L L N E
 R K Y L C B X E F J R O I U E
 V N L T C T H R E L P N F L I
 B E E P N A X H G A L P E R O
 Y T C E Z E S T N E E V Q U C
 U G B J T E W Y A T E P B O E
 P M D E V R D T R N I L Y F V
 E D P E S N I E O T W E L V E
 U N N W U E I H D E R L Q C S
 L X E G I G F F T H E E B I S
 B A R E H Q K C A L B T X V W
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 E E I C D C F P L B D W U X O

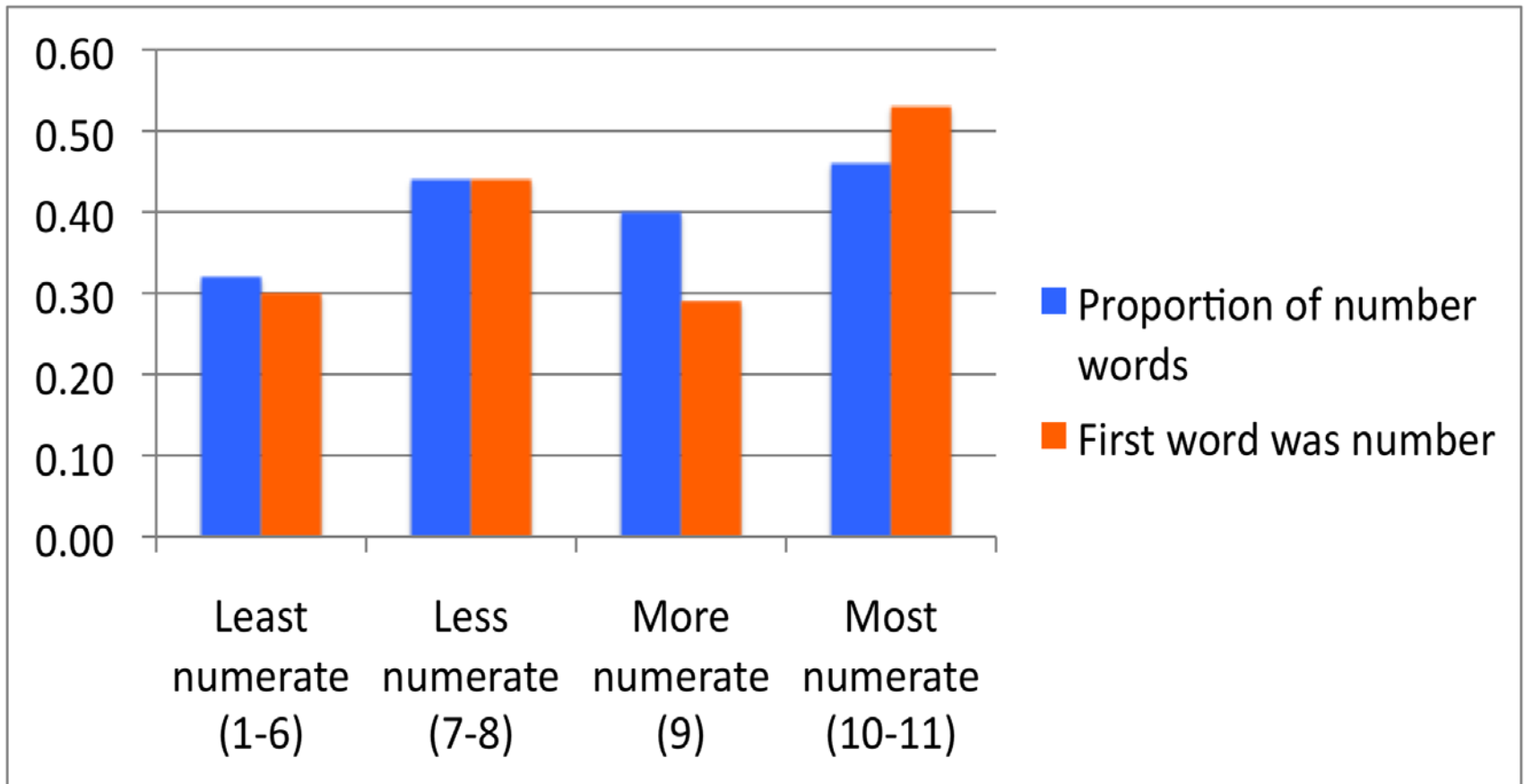
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	THREE
	TWENTY

Word search puzzle





Why does numeracy matter in today's world?

- Innumeracy associated with less ability to follow complex medication regimens, more hospital and emergency room visits, less comprehension of risks, benefits, food labels, etc.

Recent Reviews:

- Gigerenzer et al. (2008). *Perspectives on Psychological Science*.
- Nelson et al. (2008). *Annals of Behavioral Medicine*.
- Peters et al. (2007). *Health Affairs*.



Conclusions

1. Numbers are just numbers



Conclusions

1. Numbers are just numbers
2. Numeracy influences how numeric and non numeric sources of information are processed



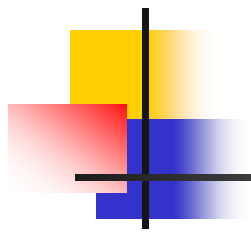
Conclusions

1. Numbers are just numbers
2. Numeracy influences how numeric and non numeric sources of information are processed
3. Understanding the effects of numeracy will help us design better risk communications



Conclusions

1. Numbers are just numbers
2. Numeracy influences how numeric and non numeric sources of information are processed
3. Understanding the effects of numeracy will help us design better risk communications
4. How can we “level the playing field” for those with less ability?
 - Short term - Information presentation
 - Long term - Educate numeric abilities



Thank you!