Numeracy and Decision Making

Joselyn Hathaway-Undergraduate Researcher
Dr. Michael Serra-Mentor

Background

- Numeracy
  - The ability to understand and work with numbers
- Low vs. High Numeracy
  - An individual's level of understanding of numerical concepts
  - Measurement of someone's level of numeracy

Background (cont.)

- Low numerate people will make poorer decisions than higher numerate people
- Individuals level of numeracy can affect their judgment and decision making

Purpose

- The purpose of this research is to identify:
  - Numeracy
  - Importance
  - Role in every day life

Questions

- How does numeracy relate to decision-making?
- Does numeracy relate to reaction times?

Variables

- Participant Variable (non-manipulated)
  - High vs. low numeracy
- Independent Variables
  - Vary by study
  - Ex. Positive vs. negative frame
  - Ex. Frequency vs. percent
- Dependent Variables
  - Choices and ratings in risk and decision making task
  - Reaction time (completion time per task)

Methodology

- Replication
  - Numeracy and Decision Making
  - Peters et al. (2006)
  - Single sample
- Expanded numeracy measure
- MTURK survey
  - Payment of 20¢ (regardless of completion)

Methodology (cont.)

- Numeracy measures
  - Lipkus Scale (11 questions)
  - Berlin Scale (4 questions)
- Judgment and decision tasks
  - Attribute framing (correct vs. incorrect)
  - Risk representation
  - Affective information
  - Affect and Betting

Lipkus Scale

+ Ex. Chances of a disease

If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1,000?

Berlin Scale

+ Ex. Rolling a die

Imagine we are throwing a five-sided die 50 times. On average, out of these 50 throws how many times would this five-sided die show an odd number?

- ○ 5 out of 50 throws
- ○ 25 out of 50 throws
- ○ 30 out of 50 throws

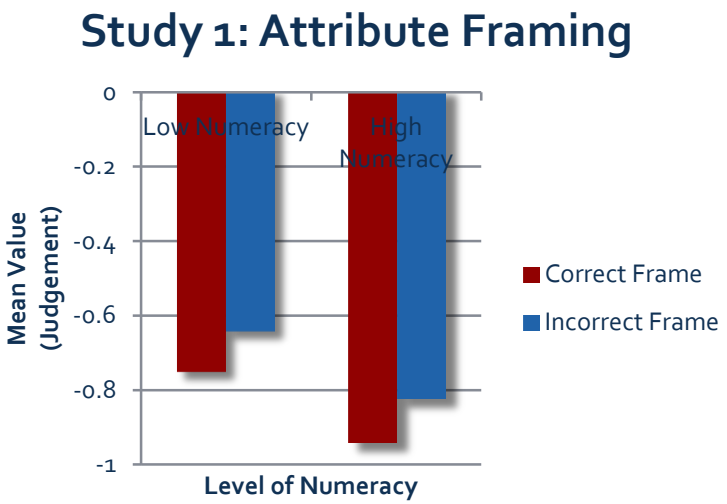
Expected Result

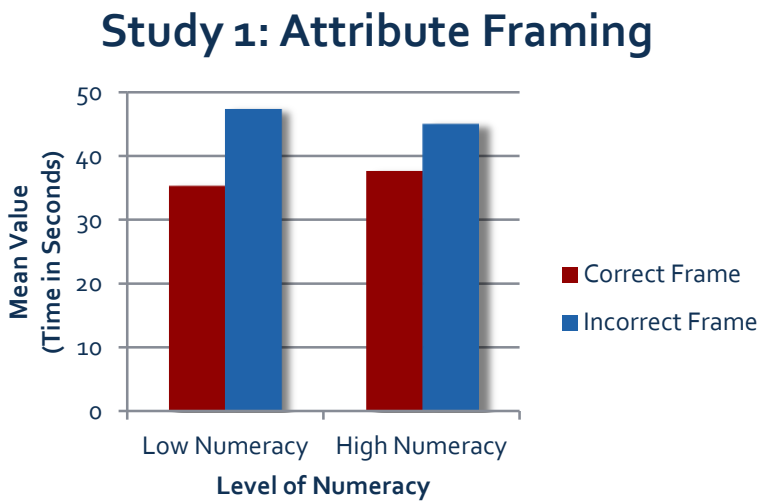
- There will be an interaction between numeracy and the manipulations
- High numerate participants responses will depend on their logical thinking (replicated results/interaction)
- Low numerate participants responses will depend on affective information(replicated results/interaction)
- High numerate people will answer faster(new results)

Study 1-Attribute Framing

- Participants rated the performance of a students test grades
- Rating scale ran from “very poor” to “very good”
- Participants given the percent correct or incorrect of the students test score

Study 1-Attribute Framing





Results:

- High numerate participants rated the students' grades significantly lower than did the low numerate people
- Participants took longer to respond with the the incorrect frame
- Interaction was not significant

Study 2-Risk Representation

- Participants given a vignette of a mental health patient
- Participants were to rate the level of risk of the patient committing an act of violence
- Rating scale ran from “very low risk” to “very high risk”
- Participants given the level of risk as a percent or a frequency

Vignette of Mental Health Patient

- **History of Present Illness**

  This is a 52-year old divorced Hispanic female with a history of psychiatric illness, including bipolar and schizo-affective disorders. She has a low level of cognitive functioning, and is borderline mentally retarded. Her sister states that the patient struck her several times on the day of admission because the sister opened the window to let some smoke out. The sister had to grab onto the patient's shoulder and bring her to her room. The patient complained "My sister grabbed my face and hurt me." The patient has been paranoid of her sister, and has had auditory hallucinations. She has also had illusions of a man at her window and sitting in her living room, as well as illusions of lice in her hair. She has been scratching and picking at her head, and washing herself excessively. The patient denies homicidality and suicidality, and has been compliant with medications.

- **Family and Social History**

  The patient is divorced with four children. Her ex-husband is an alcoholic. She currently lives in her sister's house with her sister's husband, sister's father, and the patient's brother. The brother carries a diagnosis of schizophrenia. The sister also cares for a grandson who has severe mental retardation. The patient lived in an orphanage as a child, and has a history of being sexually abused. She was taken out of school in the first grade because of an inability to perform.

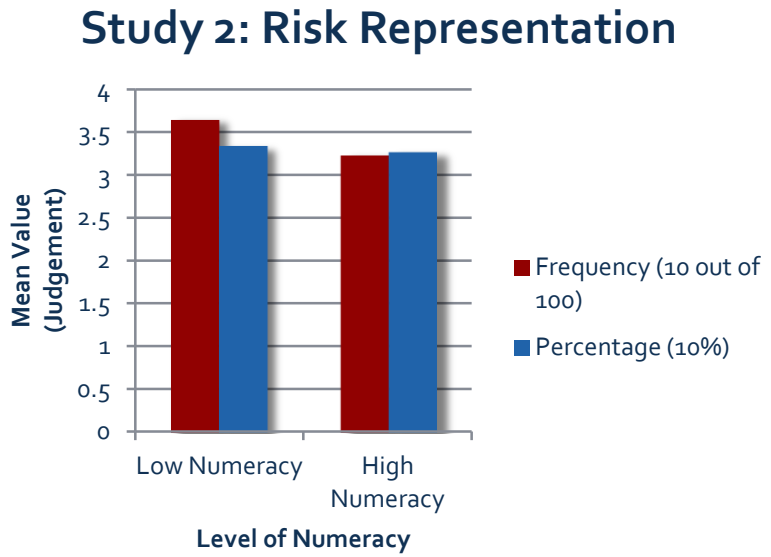
- **Mental Status Examination**

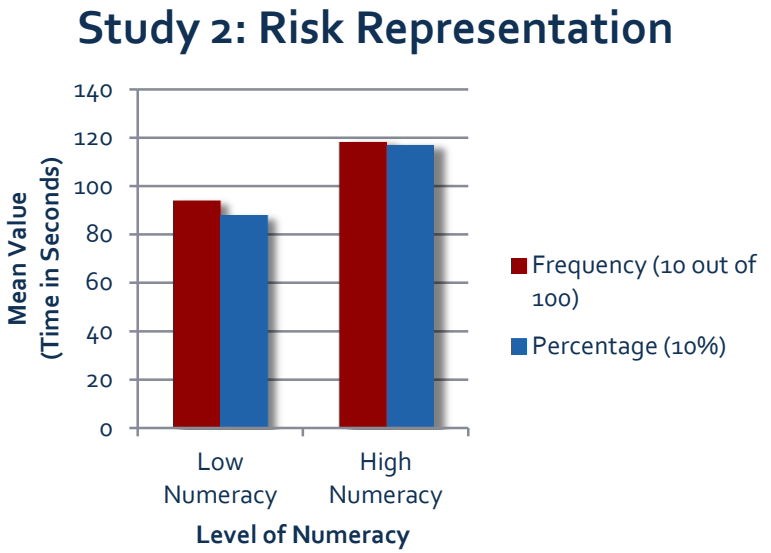
  The patient was casually dressed, appearing older than her stated age (52 years). Her eye contact was good and she was cooperative to interview. Speech was variable, sometimes loud and fast. She was restless and her mood was anxious. Her affect was extremely labile with anger, inappropriate laughter and crying. There was some looseness of association with mild flight of ideas. She denied wanting to hurt her sister or anyone else. She admitted auditory and visual hallucinations. She was alert and oriented only to the fact that she was in a hospital. She believed the date was 1957. Her concentration and insight were poor. Her judgment was poor to fair.

- **Hospital Course**

  The patient was continued on same medication regime as that while she was an outpatient. She gradually showed general improvement over the course of two weeks. Sleeping patterns improved and her thoughts became more organized. Her delusions dissipated and she did not appear to be responding to any internal stimuli. A family meeting was held prior to discharge to discuss a discharge plan and to review the patient's medication plan. The patient's sister and brother seemed very supportive and were anxious to have the patient return home, feeling that she was at baseline. Prior to discharge the patient was referred for case management and follow-up. On discharge, there was no evidence of psychosis or mania. She was in good behavioral control, eating and sleeping well, and anxious for discharge.

Study 2-Risk Representation





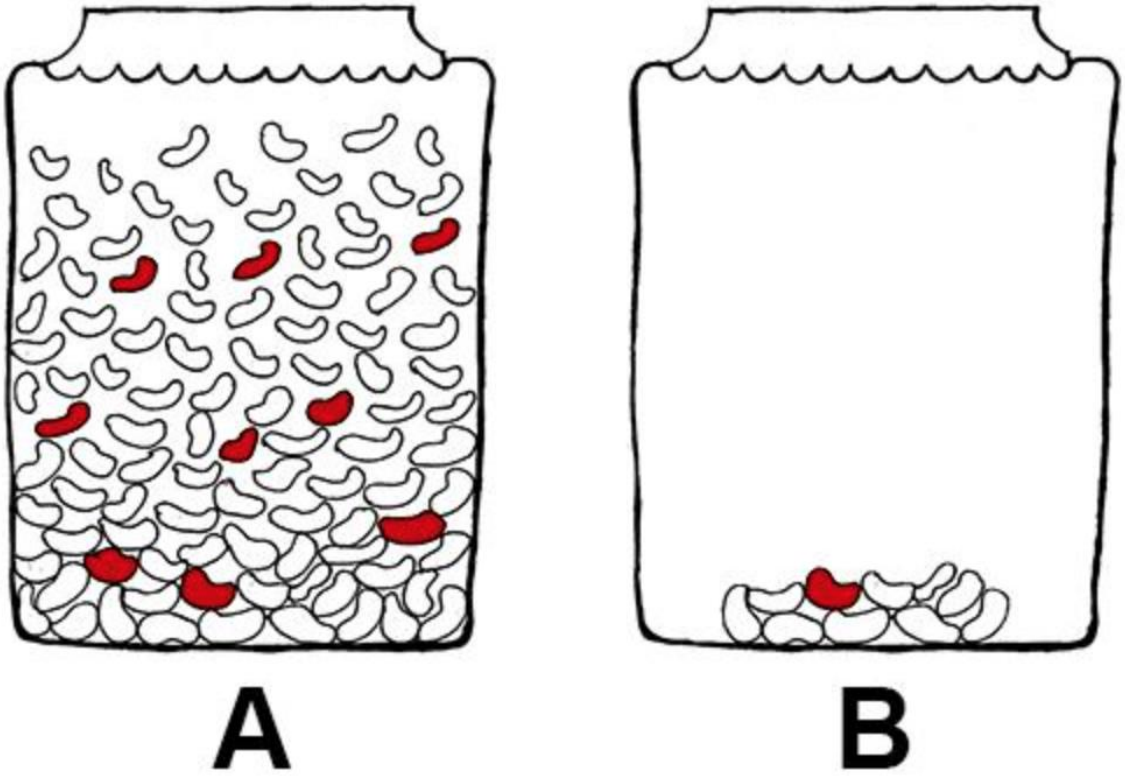
Results:

- Reaction time for high numerate was higher (opposite of expectation)
- Interaction was not significant

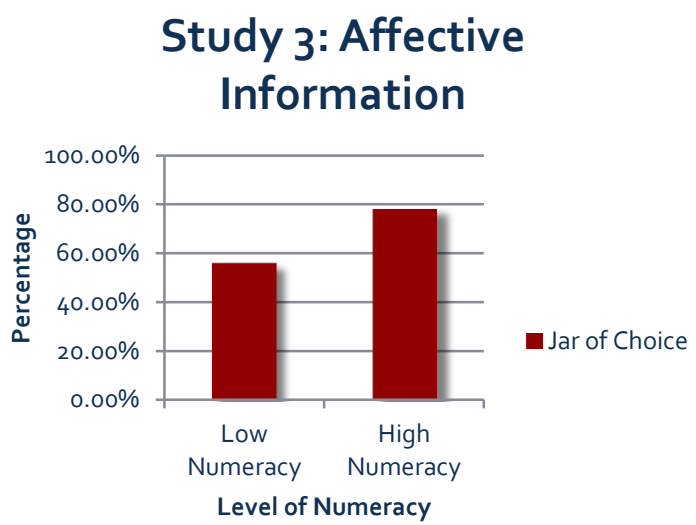
Study 3-Affective Information

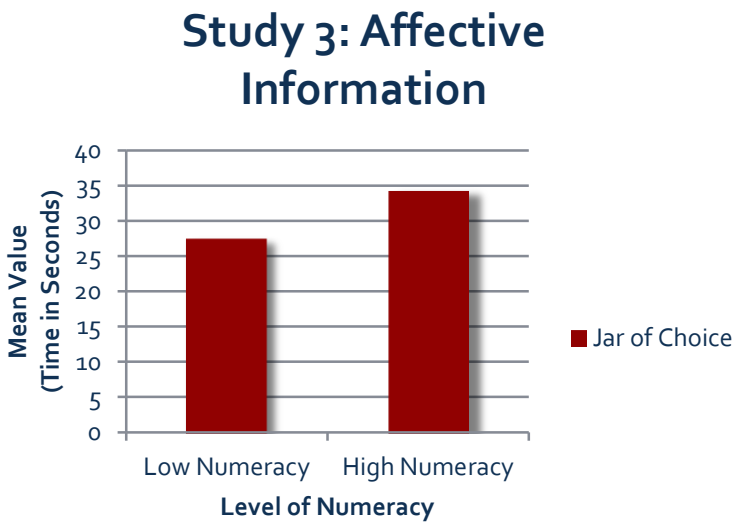
- Participants given two jars of jellybeans
- Jar A
  - 9 red jellybeans out of 100
- Jar B
  - 1 red jellybean out of 10
- Participants chose which jar they believed had the higher chance of them picking a red jellybean

Jar of Choice



Study 3-Affective Information





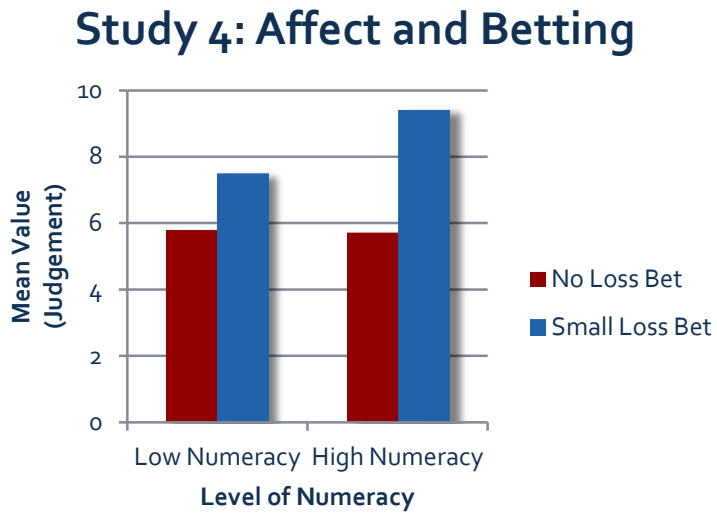
Results:

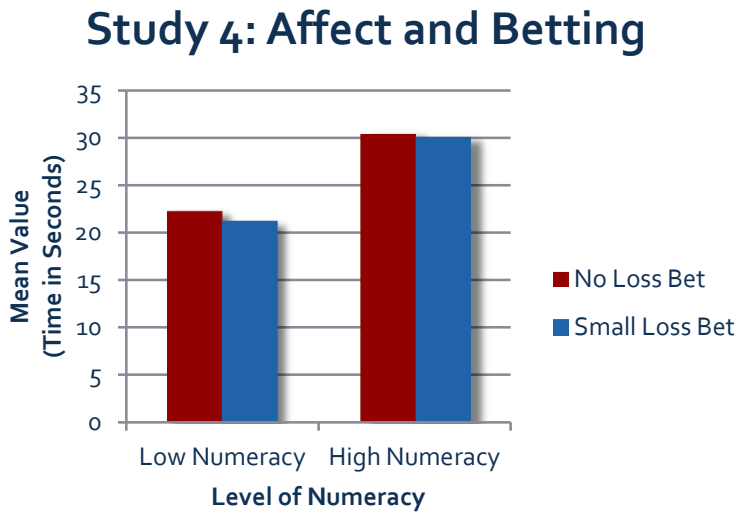
- High numerate participants were more likely to choose the jar with fewer jelly beans (greater chance of winning) than were the low numerate participants
- High numerate took longer to respond (opposite of expectation)
- Interaction was not significant

Study 4-Affect and Betting
Loss vs. No Loss Bet

- Participants given a small loss or no loss bet
- No loss bet
  - 7/36 chance to win $9 or 29/36 chance to win nothing
- Small loss bet
  - 7/36 chance to win $9 or 29/36 chance to lose $0.05
- Participants rated the attractiveness of the bet on a scale from "0- not attractive at all" to "20-extremely attractive"

Study 4-Affect and Betting





Results:

- High numerate we affected by affective information
- Participants rated a bet involving a small potential loss as more attractive than a bet involving no chance of a loss
- Reaction time was higher and more significant for high numerate
- Replication of loss bet over no loss bet

Conclusion

- The interactions were not there but the main affects were replicated
  - Using a the split halves and tertiary split did not come out correct
  - Data was evenly distributed
  - Distribution was not wide enough
  - Low numerate were not low enough

Conclusion (cont.)

- The response times were more significant for high numerate participants (opposite expectation)
- High numerate participants had more time thinking over the questions
- Solutions
  - Continuous analysis
  - Younger participants
  - Lower education level

Acknowledgements

- Dr. Michael Serra for guiding and assisting me on my ongoing research process
- Principal investigator Dr. Pat DeLucia and the co-principal investigator Dr. James Yang for providing me with the funding and opportunity for my research experience
- TTU staff and presenters for their knowledge and resources essential for my research

References

- Peters, E., Västfjäll, D., Slovic, P., Mertz, C., Mazzocco, K. and Dickert, S. (2006). Numeracy and Decision Making. *Psychological Science*, 17(5), pp.407-413.
- Peters, E. (2012). Beyond Comprehension. *Current Directions in Psychological Science*, 21(1), pp.31-35.
- McGraw, A., Larsen, J., Kahneman, D. and Schkade, D. (2010). Comparing Gains and Losses. *Psychological Science*, 21(10), pp.1438-1445.
- Slovic, P., Monahan, J. and MacGregor, D. (2000). Violence risk assessment and risk communication: The effects of using actual cases, providing instruction, and employing probability versus frequency formats. *Law and Human Behavior*, 24(3), pp.271-296.
- Cokely, E., Galesic, M., Schulz., Ghazal S., and Garcia-Retamero, R. (2012). Measuring Risk Literacy: The Berlin Numeracy Test. *Judgement and Decision Making*, 7(1), pp. 25-47.

QUESTIONS ?