



# Exploring the Relationship Between Verbal Probability Translations and Objective Numeracy



THE UNIVERSITY OF  
**TOLEDO**  
1872

Stephen Prunier and J. D. Jasper  
University of Toledo

## Abstract

When communicating information about risks, most people use different probability words or phrases (e.g. highly likely, certain, doubtful, etc.) to describe the situation instead of giving numerical probabilities. Despite these verbal probability phrases being common in the English language, most of these words do not have a precise value attached to their definitions leaving them open to interpretation by the individual. The goal of this research is to better understand what numerical values people place on these verbal probability phrases by exploring individual differences in verbal probability interpretations that arise based on GPA, objective numeracy, and verbal intelligence.

## Background

How people communicate and understand risks has become a very important topic across many domains of study. When a doctor gives a patient a diagnosis and recommendation for treatment they use expressions like “highly likely” the medicine will work or “very low chance” of negative side effects. The problem with expressing risk verbally is it makes the probability of a given outcome open for interpretation. Several studies have already shown that not everyone interprets a given verbal expression in the same way (Honda & Yamagishi, 2006; Karelitz & Budescu, 2004).

The problem with previous studies is twofold. First, previous studies have used a large variety of methods for translating verbal probabilities to numerical values and as a result the same verbal expression show widely different numerical translations. Teigen and Brun (2003) showed the framing of a verbal probability expression can significantly influence what probabilities a given word or phrase represents. Second, despite the variation in results across and within studies, nobody has attempted to explain this variance by looking at individual differences in translating verbal probabilities.

The purpose of this study is to address these two short comings by:

1. Removing context from the verbal to numerical translation process
2. Assessing individual differences in verbal probability translation.

## Methods

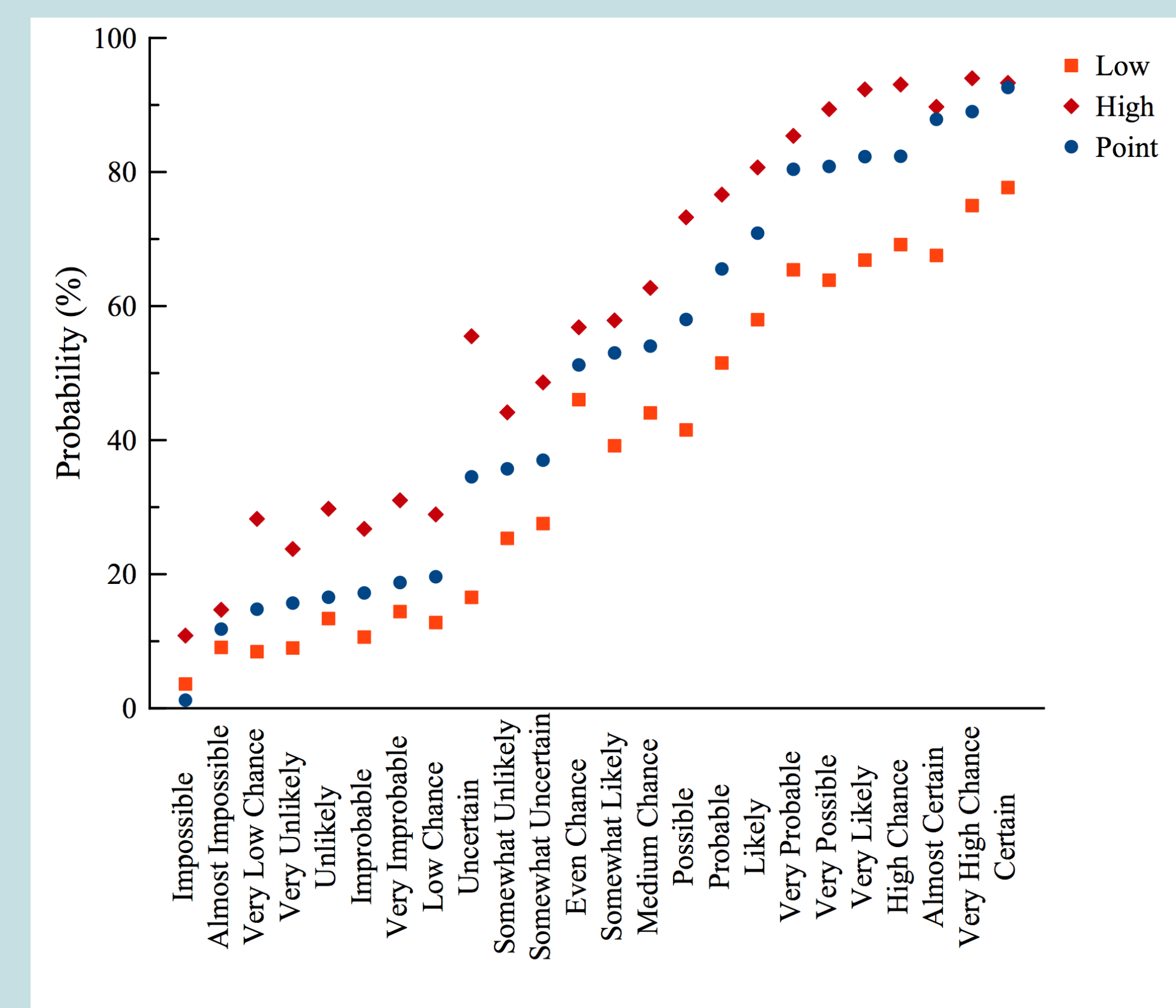
### Participants:

- 171 undergraduate students from the University of Toledo

### Procedure:

- Translated 24 verbal probability expressions
- First set of 12 questions, participants were asked to assign a range of values from 0 to 100%
- Second set of 12 questions, participants were asked to assign a single value from 0 to 100%
- The 24 verbal probabilities counterbalanced between the first and second block of 12 questions
- Completed objective numeracy, Hartford-Shipley Vocabulary Subtest, and Edinburgh Handedness Inventory (EHI)

## Overall Means



## Discussion

### Individual Variation

• GPA and Numeracy were the strongest predictors of translation differences, however, so few data points are explained that additional research is needed

### Mean Range size

- The size of the ranges given for each verbal probability expression were significantly impacted by the participant's Numeracy
- The higher a participant's Numeracy, the smaller the average range size was for the verbal probability translation
- Suggests people with higher Numeracy may discriminate between verbal expressions more

## Results 1: Individual Variation

### Multiple Linear Regression

#### DV:

- 72 distinct data points
- 24 verbal expressions each with a low and high end of the range and a single point estimate

#### IV:

- Grade Point Average (GPA), Strength of Handedness (EHI), Objective Numeracy, Verbal Intelligence (Hartford-Shipley)

### Results:

- GPA and Numeracy explain the most variation amongst the individual data points explaining 13 and 10 data points, respectively

	Words	b (unstandardized)	t	p
EHI	Even Chance (low)	0.107	1.988	0.05
	Certain (single)	1.167	3.131	0.002
	High Chance (high)	0.354	1.943	0.056
Hartford-Shipley	Very Probable (high)	1.055	2.501	0.014
	Probable (high)	1.176	2.56	0.013
	Very Improbable (single)	-1.121	-2.057	0.044
	Almost Impossible (single)	-1.254	-2.414	0.018
	Very Likely (low)	3.791	2.573	0.012
Numeracy	Low Chance (high)	-1.855	-2.018	0.048
	Very Possible (low)	3.433	2.365	0.021
	Certain (low)	4.441	2.435	0.018
	High Chance (high)	-0.99	-2.127	0.037
	Medium Chance (low)	1.994	2.519	0.014
	Almost Certain (single)	1.537	1.984	0.052
	Very Unlikely (single)	-1.687	-2.457	0.016
	Almost Certain (low)	3.674	2.404	0.018
	Very Probable (low)	2.966	2.139	0.035
	Very Likely (low)	11.521	2.03	0.047
GPA	Low Chance (low)	-9.833	-2.075	0.042
	Improbable (high)	-14.533	-2.632	0.011
	Almost Impossible (low)	-10.11	-1.88	0.065
	Very Probable (single)	5.944	1.99	0.051
	Improbable (single)	-7.106	-1.972	0.052
	High Chance (single)	5.204	2.255	0.027
	Almost Certain (low)	10.318	1.918	0.059
	Almost Certain (high)	5.984	1.923	0.058
	Very Low Chance (low)	-14.305	-4.928	<.001
	Unlikely (low)	-8.498	-2.307	0.024
	Impossible (low)	-14.53	-4.827	<.001
Very Improbable (low)	-10.374	-2.061	0.043	

## Results 2: Mean Range Size

### Linear Regression

#### DV:

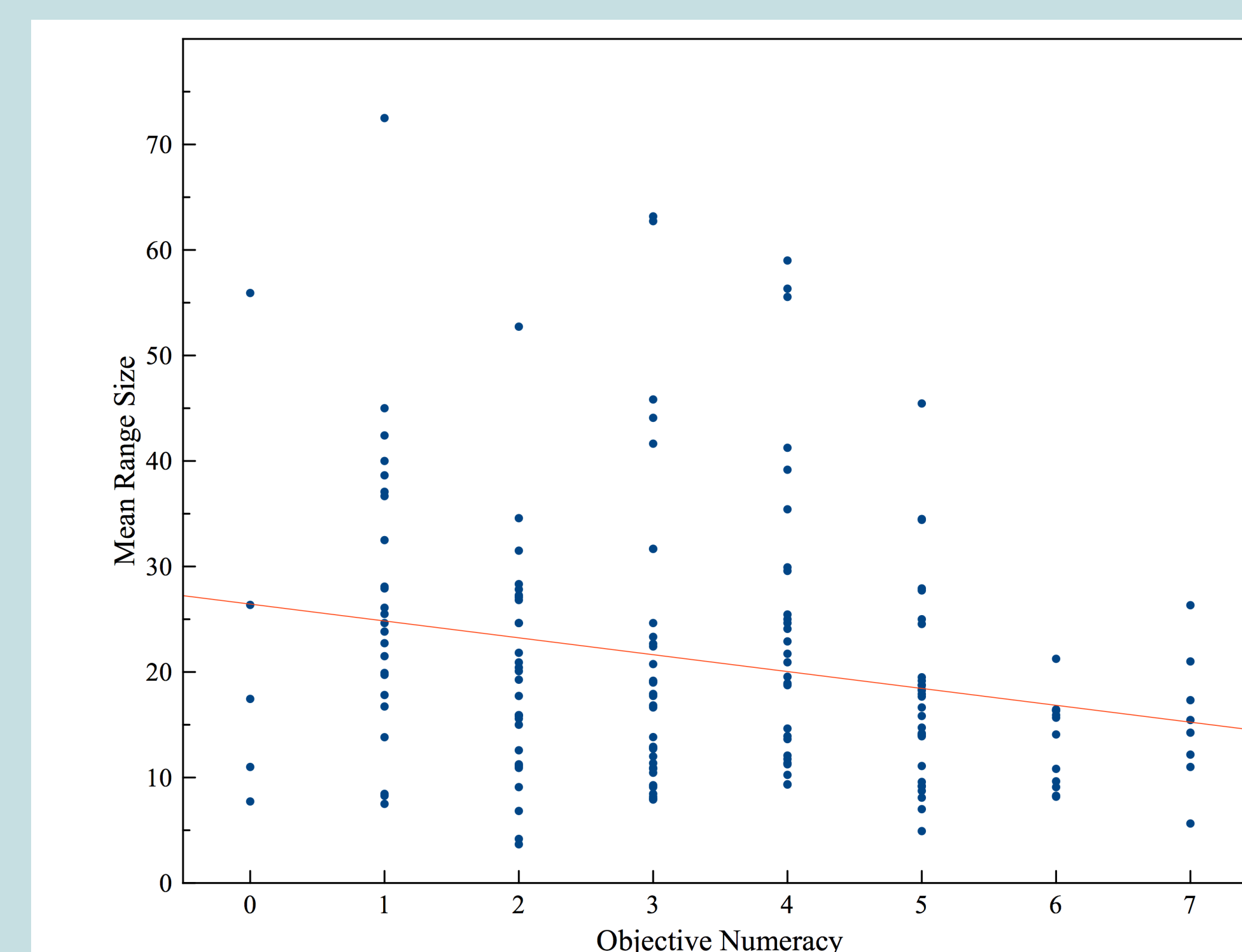
- Mean size of the ranges given to the 24 verbal probability expressions

#### IV:

- Grade Point Average (GPA), Strength of Handedness (EHI), Objective Numeracy, Verbal Intelligence (Hartford-Shipley)

### Results:

- Numeracy was significantly related to the size of the range participants assigned,  $b = -1.699$ ,  $t(4) = -2.957$ ,  $p = .004$
- GPA, EHI, and Verbal Intelligence were not significant



## References

- Honda, H., & Yamagishi, K. (2006). Directional verbal probabilities: Inconsistencies between preferential judgments and numerical meanings. *Experimental Psychology*, 53(3), 161-170.
- Karelitz, T. M., & Budescu, D.V. (2004). You say “Probable” and I say “Likely”: Improving interpersonal communication with verbal probability phrases. *Journal of Experimental Psychology: Applied*, 10(1), 25-41.
- Teigen, K.H., & Brun, W. (2003). Verbal probabilities: A question of frame? *Journal of Behavioral Decision Making*, 16, 53-72.

Name: Stephen Prunier  
Department of Psychology  
University of Toledo  
Email: stephen.prunier@rockets.utoledo.edu