Exploring the Relationship Between Verbal Probability Translations and Objective Numeracy

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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

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-Shipleys Vocabulary Subtest, and Edinburgh Handedness Inventory (EHI)

Results 1: Individual Variation

<table>
<thead>
<tr>
<th>IV</th>
<th>DV</th>
<th>Multiple Linear Regression</th>
<th>F</th>
<th>p</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>Numeracy</td>
<td>2.957, p = .004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPA</td>
<td>Objective Numeracy</td>
<td>1.699, t(4) = -2.957, p = .004</td>
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<td></td>
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<tr>
<td>GPA</td>
<td>Verbal Intelligence (Hartford-Shipleys)</td>
<td>2.058, t(4) = 1.619, p = .131</td>
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<tr>
<td>GPA</td>
<td>Handedness</td>
<td>0.518, t(4) = 0.518, p = .619</td>
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<tr>
<td>GPA</td>
<td>Numeracy</td>
<td>7.226, t(4) = 2.226, p = .05</td>
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<tr>
<td>GPA</td>
<td>Objective Numeracy</td>
<td>7.894, t(4) = 2.894, p = .05</td>
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<tr>
<td>GPA</td>
<td>Verbal Intelligence (Hartford-Shipleys)</td>
<td>7.323, t(4) = 2.323, p = .05</td>
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<tr>
<td>GPA</td>
<td>Handedness</td>
<td>0.333, t(4) = 0.333, p = .333</td>
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</table>

Results 2: Mean Range Size

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<th>DV</th>
<th>Linear Regression</th>
<th>F</th>
<th>p</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>Mean size of the ranges given to the 24 verbal probability expressions</td>
<td>2.957, p = .004</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

References

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