Nonstandard Framing Effects with Somewhat Risky Options: Explorations and Theory Comparisons

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RESEARCH QUESTION

How well do current theories predict risky-choice framing effects involving "somewhat risky" options?

ANSWER

Not too well.

More details

- We broadened the scope of the standard risky-choice framing effect to include four types of somewhat risky options in addition to the usual sure and risky options.
- We considered nine different theories to explain the resulting choices. None of the theories was very accurate. Differences between the theories were small.
- A text-based account, Sentiment Analysis, performed best overall, according to AIC and BIC. Interestingly, Prospect Theory improved slightly when it did not include loss aversion or probability weighting.

Zoom link: https://osu.zoom.us/j/98647600575?pwd=WngwUzdZd0RrUEoxUk8vTnRwcjFkUT09 (Passcode: 54321)

MOTIVATION AND METHOD

- In choices between a sure option and a risky option, people usually prefer the sure option in the gain frame and the risky option in the loss frame. This pattern is called the risky-choice framing effect.[1][7]
- Almost every study of risky-choice framing effects has involved choices between a sure option and an "all or none" risky option. Numerous theories have been proposed to explain the effect.
- Very few studies[2][4][5][8] have used "somewhat risky" options that are riskier than the sure option but less risky than the usual risky option. Results are varied. Sometimes the framing effect is eliminated.
- We conducted a large, systematic study involving choices between a sure option, a risky option, and four types of somewhat risky options.

Option construction

We constructed a set of six option types, ranging from the least risky (top) to the most risky (bottom). This riskiness order is the same for any utility function of the form $U(x) = x^{\alpha}$ with $0 < \alpha < 1$.[4]

Option Type	Example from the Cancer domain (gain frame)	Description
1. Sure	3,600 patients will be saved.	Standard sure option.
2. Somewhat Risky (Mismatched)	There is a 1/4 probability that 7,500 patients will be saved and a 3/4 probability that 2,300 patients will be saved.	Probabilities are ***not matched with the risky option (below)*** and a zero outcome is not present.
3. Somewhat Risky (Matched)	There is a 2/5 probability that 6,300 patients will be saved and a 3/5 probability that 1,800 patients will be saved.	Probabilities are ***matched with the risky option (below)*** and a zero outcome is not present.
4. Somewhat Risky (Zero in Losses)	There is a 1/4 probability that 9,000 patients will be saved and a 3/4 probability that 1,800 patients will be saved.	In gains, the better outcome is the same as in the risky option (below). Hence, the corresponding option has a zero outcome in the loss frame.
5. Somewhat Risky (Zero in Gains)	There is a 3/5 probability that 6,000 patients will be saved and a 2/5 probability that no patients will be saved.	In gains, the worse outcome is zero. The corresponding option in the loss frame lacks a zero outcome.
6. Risky	There is a 2/5 probability that 9,000 patients will be saved and a 3/5 probability that no patients will be saved.	Standard risky option.

We combined these 6 option types to yield 15 option pairs in the gain frame and the loss frame, for a total of 30 conditions. In each of these 30 conditions, we created options for 4 domains (wildfire, drought, investment, cancer) with different probabilities and outcomes.

We considered nine theories or accounts to explain variations in framing effects.

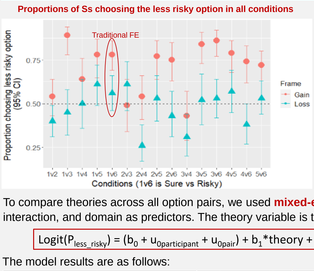
Theory or Account	Description [Higher preference scores favor the less risky option]
Prospect Theory (PT) Versions[7]	PT has a value function that is concave in gains and convex in losses. For two outcomes, PT and Cumulative PT (CPT) give identical scores to options.
Full PT	We computed the PT value for each option, calculated the difference in favor of the less risky option, PT(less risky) – PT(more risky), and standardized these differences across domains. Parameter values are from [7]: $\alpha = \beta = 0.88$, $\lambda = 2.25$, $\gamma = 0.61$, $\delta = 0.69$.
No loss aversion	As above, but with $\lambda = 1$.
No probability weighting	As above, but with $\gamma = 1$, $\delta = 1$
No loss aversion or probability weighting	As above, but with $\lambda = 1$, $\gamma = 1$, $\delta = 1$
Gist-Based Accounts	
Fuzzy-Trace Theory (FTT)[3]	FTT's categorical gist representation distinguishes outcomes as "some" vs. "none." In the sure vs. risky comparison above (1 vs. 6), the sure option has "some" and the risky option has some chance of "none," so the sure option is preferred. [Scores are –1,0,1]
Fuzzy-Trace Theory+ (FTT+)	A modified version of FTT. When some pairs have matched probabilities, a zero vs. non-zero outcome difference is highlighted, yielding a greater preference difference. E.g., the Somewhat Risky (Matched) vs. Risky comparison (3 vs. 6) is assigned a score of 2 instead of 1 in gains. [Scores are –2,–1,0,1,2]
Explicated Valence Account (EVA)[5]	In this account, people choose the option with the better valence (positive, mixed, negative). [Scores are –1,0,1]
Good Bad Count (GBC)	A modified version of EVA. Two positive outcomes make the option twice as positive and two negative outcome make it twice as negative. E.g., the somewhat risky options 2, 3, and 4 above are coded as 2. [Scores are –2,–1,0,1,2].
Sentiment Analysis (SA)	We used the sentimentr package in R, a text-based program that considers negators, intensifiers, de-amplifiers, etc. while calculating the sentiment of the sentence. We computed the SA value for each option, computed the difference in favor of the less risky option, SA(less risky) – SA(more risky), and standardized these differences across domains.

Procedure

Participants ($N = 1001$, undergraduate psych students) were assigned to one of the 30 conditions. All participants made choices in all four domains.

RESULTS

Proportions of Ss choosing the less risky option in all conditions



- Framing effects were in the usual direction for 14 of 15 option pairs and significant for 11 of 15 option pairs.
- The reversed framing effect for the 2v3 option pair, Somewhat Risky (Mismatched) vs. Somewhat Risky (Matched), was not significant.
- None of the 9 theories exactly predict these framing effects. E.g., for the 1v3 option pair, FTT, FTT+, and EVA predict no framing effect, but the observed framing effect was large and significant.

To compare theories across all option pairs, we used **mixed-effects logistic regression modeling** with theory, frame, their interaction, and domain as predictors. The theory variable is the prediction of a specific theory such as full PT.

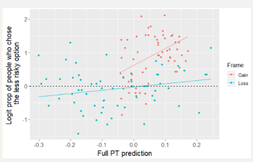
$$\text{Logit}(P_{\text{less\_risky}}) = (b_0 + u_{0\text{participant}} + u_{0\text{pair}}) + b_1{*}\text{theory} + (b_2 + u_{1\text{pair}}){*}\text{frame} + b_3{*}\text{theory}{*}\text{frame} + b_{4\text{-}6}{*}\text{domains}$$

The model results are as follows:

Theory/Account	Theory coeff.	Frame coeff.	Interaction coeff.	AIC	BIC
Prospect Theory Versions					
Full PT	2.98**	0.65***	4.02*	4512.2	4580.1
No Loss aversion	0.43	0.86***	6.72*	4510.7	4578.6
No probability weighting	13.49**	0.43†	18.23†	4510.4	4578.3
No loss aversion or probability weighing	16.23**	0.43†	12.76	4510.4	4578.3
Gist-Based Accounts					
Fuzzy-Trace Theory	0.46**	0.53**	0.51†	4510.7	4578.6
Fuzzy-Trace Theory+	0.35**	0.55**	0.43*	4509.2	4577.1
Explicated Valence Account	0.46**	0.53**	0.51†	4510.7	4578.6
Good Bad Count	0.16	0.90***	0.18	4516.1	4583.9
Sentiment Analysis	0.92**	0.83***	-1.45*	4496.7	4564.6

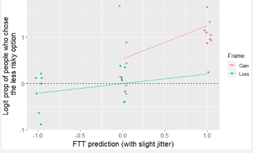
- The theory variable coefficients are all positive, though not all are significant.
- However, there is always a significant or nearly significant residual framing effect.
- In almost every case, the interaction is positive, which means that most theories made better predictions in the gain frame.
- The Sentiment Analysis model performed the best among all the models under consideration (based on AIC and BIC).
- Interestingly, the simplest version of PT performed slightly better than the full version (smaller framing effect, better fit).
- Results for four illustrative theories are shown below.

Full Prospect Theory



Simplest Prospect Theory

Fuzzy-Trace Theory (Same for all domains)



Sentiment Analysis (Best)

CONCLUSION

- Most of the theories predict some of the variation in framing effects in choices with somewhat risky options.
- However, none of the theories (not even Prospect Theory!) predicts framing effects very accurately. There is almost always a significant residual framing effect and substantial unexplained variation in choice proportions.
- The next steps are to (a) replicate these results with non-student participants and (b) ask similar questions in a within-participants design, where one would expect more consistency.

References

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The study was preregistered at AsPredicted.org: https://aspredicted.org/blind.php?x=m5pk97

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