Appendix

A Instructions

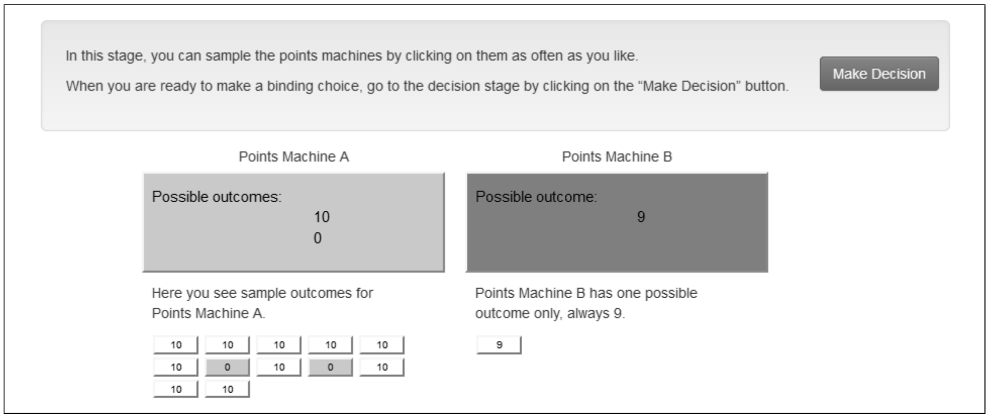


FIGURE A1: Experienced Samples in Experiment 1

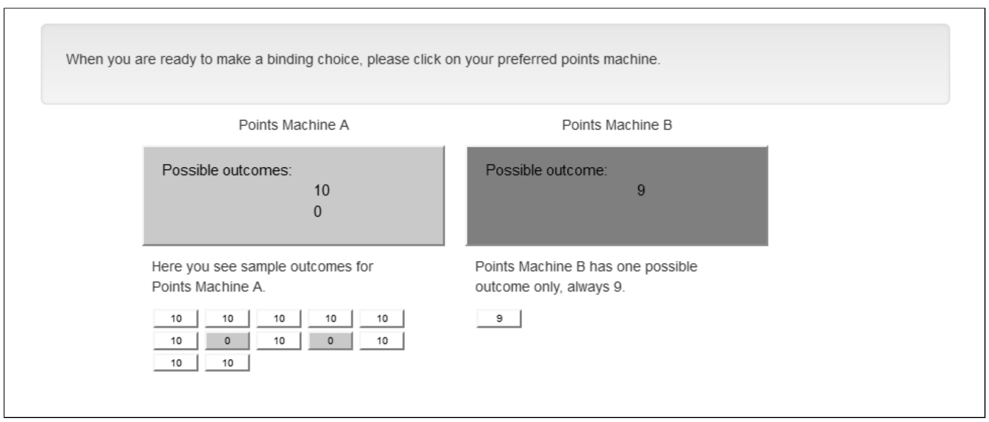


FIGURE A2: Described Samples in Experiment 1

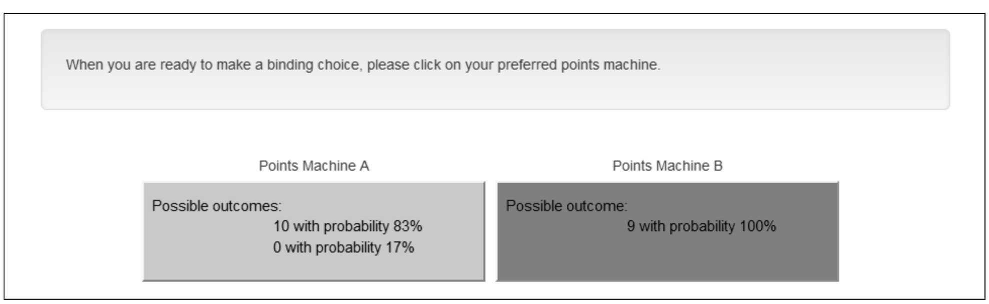


FIGURE A3: Described Probabilities in Experiment 1

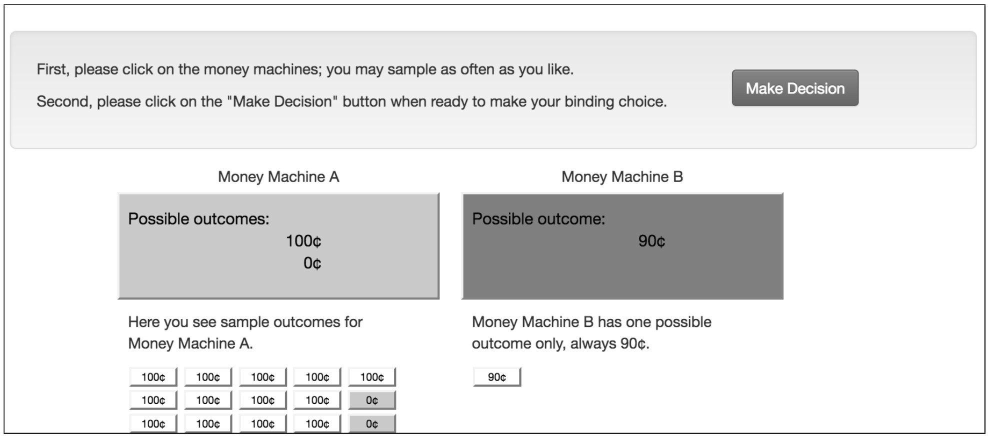


Figure A4: Experienced Samples in Experiment 2

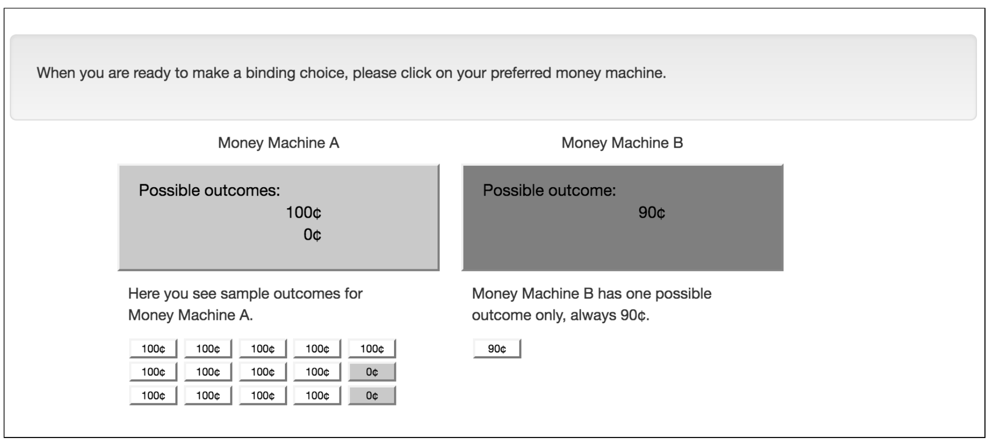


Figure A5: Described Samples in Experiment 2

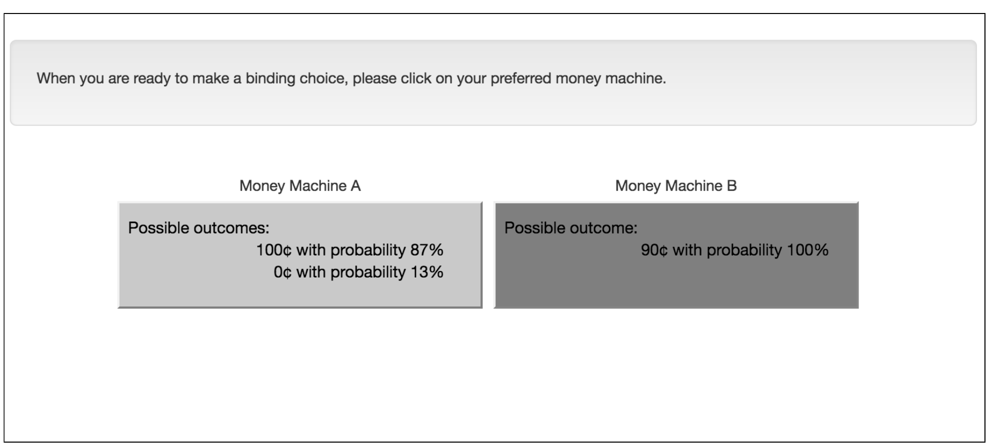
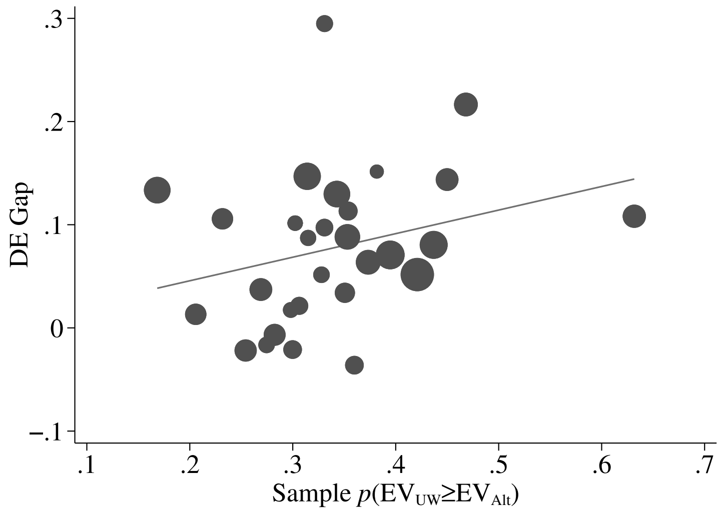


Figure A6: Described Probabilities in Experiment 2

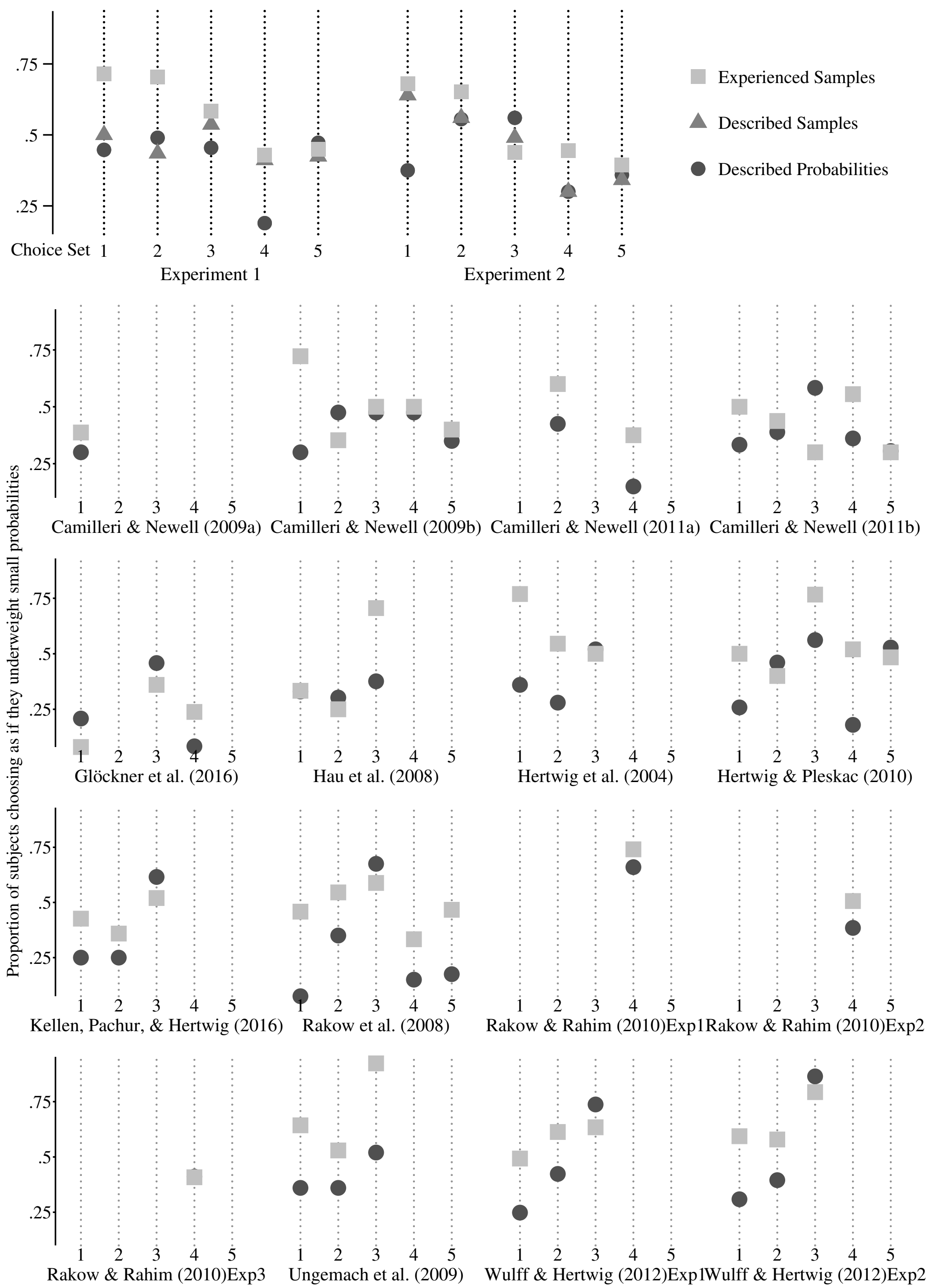
B Statistical Confidence in Prior Work



Notes. The Y axis charts differences in the proportion of underweighting choices in experience and description treatments. The X axis charts mean values for statistical confidence in the experience treatments. Data are from 30 experiments identified by the integer id in the Wulff et al. (2018) dataset. The 30 markers in the chart are weighted by the number of experimental subjects. In total, 2,471 subjects made 11,137 decisions, involving subsets of 132 classic choice problems. Classic choices are always between a safe and a risky money machine such that the outcome from the safe machine falls in between the two outcomes from the risky machine. Inclusion criteria are those of our main analyses (one risky outcome rare and sample size of five or greater). The linear relationship displayed in the chart has a slope of 0.228, 95% CI [0.218, 0.239].

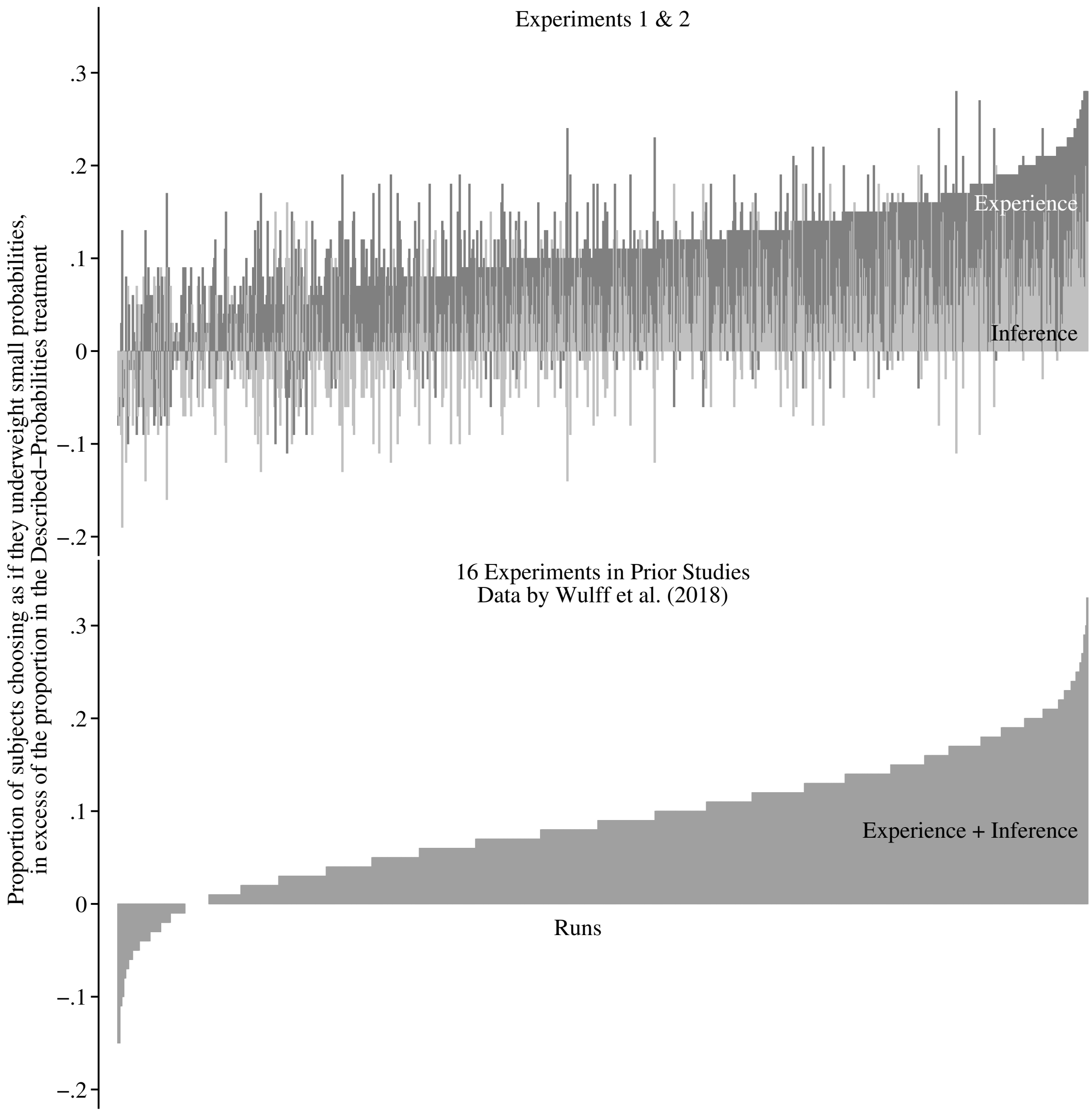
FIGURE B1: Simultaneous Variation in Underweighting and Statistical Confidence in the Literature

C Discrete Group-Mean Differences in the Weighting of Small Probabilities



Notes. The graphs display the proportion of underweighting choices for experimental treatments and choice sets 1-5. The analysis is for decision problems with a sample size of 5 or greater and at least one sample outcome for the rare event.

FIGURE C1: Detailed Underweighting Means



Notes. The graphs display gaps for 1000 data runs each. Each run compares the proportion of underweighting choices among 100 randomly selected decisions from each experimental treatment. The analysis is for choice sets 1-5 with a sample size of 5 or greater and at least one sample outcome for the rare event. The total DE-Gap is positive, indicating underweighting of small probabilities, in 95.7% of runs on our data, and 90.6% of runs on the data consolidated by Wulff et al. (2018).

FIGURE C2: Robustness of the Total DE-Gap and its Components

D Estimation Model: Cumulative Prospect Theory

Prospect A with ordered outcomes $x_1 \geq x_2 \geq \ldots \geq x_k \geq 0 \geq x_{k+1} \geq \ldots \geq x_n$ and respective probabilities $p_1, \ldots, p_n$ has a subjective value $V(A)$ given by

$$V(A) = \sum_{i=1}^{n} \pi_i v(x_i)$$

with

$$v(x_i) = \begin{cases} x_i^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x_i)^{\alpha} & \text{if } x < 0 \end{cases}$$

(relative to a neutral reference point 0) and

$$\begin{aligned}
\pi_1 &= w^{+}(p_1), \\
\pi_n &= w^{-}(p_n), \\
\pi_i &= w^{+}(p_1 + \ldots + p_i) - w^{+}(p_1 + \ldots + p_{i-1}), i = 2, \ldots, k, \\
\pi_i &= w^{-}(p_i + \ldots + p_n) - w^{-}(p_{i+1} + \ldots + p_n), i = k+1, \ldots, n-1.
\end{aligned}$$

The parameter α captures the outcome sensitivity; the bigger α is, the more sensitive the subjective value is to the magnitude of the outcome. The parameter λ captures loss aversion; with $\lambda > 1$, the value function is steeper in the loss domain than in the gain domain. Tversky and Kahneman (1992) suggested a probability weighting function

$$w^{+}(p) = w^{-}(p) = \frac{p^{\gamma}}{(p^{\gamma} + (1-p)^{\gamma})^{\frac{1}{\gamma}}}.$$

The parameter γ captures the shape of the weighting function. With $\gamma < 1$, the weighting function has an inverted S-shape. With $\gamma = 1$, the weighting function is the identity line. With $\gamma > 1$, the weighting function is S-shaped.

Because the Tversky and Kahneman (1992) weighting function creates shapes with varying elevation, we additionally estimate a constrained variant for robustness checks. The Karmarkar (1979) weighting function sets elevation to 0.5. The interpretation of the γ parameter remains unchanged.

$$w(p) = \frac{p^{\gamma}}{p^{\gamma} + (1-p)^{\gamma}}.$$

We then apply the exponential Luce choice rule (**?**). The probability of choosing Option A over Option B is

$$p(A, B) = \frac{e^{\phi V(A)}}{e^{\phi V(A)} + e^{\phi V(B)}}$$

where the parameter ϕ captures the choice sensitivity. The bigger ϕ is, the more sensitive the decision maker is to the differences between $V(A)$ and $V(B)$.

Table D1: CPT Parameter Estimation - Main Analysis

Variable	Experiments 1 and 2		Wulff et al. (2018)	
	Estimate	95% CI	Estimate	95% CI
α				
Described Probabilities	0.908	0.778 - 1.220	0.706	0.647 - 1.374
Described Samples	0.976	0.809 - 1.322		
Experienced Samples	1.196	0.975 - 1.568	0.712	0.662 - 0.762
γ				
Described Probabilities	0.782	0.629 - 1.131	0.735	0.630 - 0.840
Described Samples	0.938	0.754 - 1.336		
Experienced Samples	1.224	0.974 - 1.643	1.037	0.935 - 1.140
λ				
Described Probabilities	1.728	0.797 - 3.761	1.081	0.370 - 1.793
Described Samples	1.900	0.843 - 4.174		
Experienced Samples	2.099	1.002 - 5.183	1.203	0.724 - 1.682
ϕ				
Described Probabilities	0.497	0.170 - 0.871	0.796	0.568 - 1.023
Described Samples	0.371	0.133 - 0.665		
Experienced Samples	0.389	0.154 - 0.731	0.598	0.441 - 0.754
Decisions	2, 178		7, 658	

Notes. The estimation is with observations yoked to sample sizes of 5 or greater and at least one sample outcome for each outcome possibility. For the model with our data, we use all choice sets 1-10 (see Table 2). The model for extant data of Wulff et al. (2018) includes 27 choice sets that are between a safe and a risky money machine and where one risky outcome is zero. The structure of these 27 choice sets most closely correspond to the structure of choice sets 1-10 in our study. The γ parameters reported here are used to generate Figure 5 and Table 4 in the main document. For comparison, a robustness check with elevation set to 0.5 (Karmarkar, 1979) and utility parameters set to the point estimates of Tversky and Kahneman (1992) yields gamma values $\gamma_{DP} = 0.856$, $\gamma_{DS} = 0.891$, and $\gamma_{ES} = 1.082$ for Experiments 1 and 2, and $\gamma_{DP} = 0.876$ and $\gamma_{ES} = 1.172$ for the extant data of Wulff et al. (2018).

Table D2: CPT Parameter Estimation - All Observations

Variable	Experiment 1		Experiment 2	
	Estimate	95% CI	Estimate	95% CI
α				
Experienced Samples	0.743	0.678 - 0.804	0.661	0.580 - 0.743
Described Samples	0.664	0.055 - 1.011	0.715	0.479 - 0.951
Described Probabilities	0.952	0.714 - 1.234	0.779	0.669 - 0.901
γ				
Experienced Samples	0.746	0.679 - 0.825	0.809	0.699 - 0.958
Described Samples	1.389	0.735 - 2.873	1.132	0.712 - 2.253
Described Probabilities	1.413	1.007 - 2.151	1.071	0.874 - 1.367
λ				
Experienced Samples	0.498	0.246 - 0.785	0.623	0.330 - 0.969
Described Samples	0.070	0.001 - 1.026	0.574	0.006 - 1.820
Described Probabilities	0.053	0.001 - 0.623	0.706	0.233 - 1.284
ϕ				
Experienced Samples	1.651	1.332 - 2.003	1.209	0.964 - 1.474
Described Samples	0.192	0.070 - 0.377	0.321	0.166 - 0.514
Described Probabilities	0.364	0.174 - 0.633	0.423	0.302 - 0.553
Decisions	2, 140		2, 990	

Notes. The estimation is for all observations, including decisions without risk. Note that the estimation of parameters suffers when choices are between two safe outcomes (see **??**, for the effect on the λ parameter in particular). For comparisons with the γ parameters estimated in prior DE-Gap work, see Table 9 in Wulff et al. (2018).