Skewness and Preferences for Non-Instrumental Information

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Current Research Agenda

Belief utility

Intrinsic Information Preferences and Skewness

Motivated Optimism and Workplace Risk

Endogenous Information Feedback and Performance

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Policy-driven Inequities in Access

Impact of School Closures on Mental Health Outcomes

Physician Attention, Congruence and Complex Patient Outcomes

Abortion Center Closures and Contraception Usage

Beliefs matter

- Neoclassical model: Information is valuable to the extent it informs decision-making (instrumental, extrinsic value)
- Information impacts utility also through its impact on expectations (intrinsic value)
  - Anxiety / hope about uncertain future events
  - Disappointment / elation due to realizations vs. beliefs

Intrinsic preferences for timing of uncertainty resolution

- Theory literature characterizes intrinsic preference for the amount (timing) of information
  - Preference for early vs late (Kreps and Porteus, 1978; Caplin and Leahy, 2001)
  - Preference for gradual vs one-shot (Dillenberger, 2010; Kőszegi and Rabin, 2009; Ely et al., 2013)
- Experimental work also focuses on this dimension
  - Chew and Ho, 1994; Arai, 1997; Ahlbrecht and Weber, 1997; Lovallo and Kahneman, 2000; Von Gaudecker et al., 2011; Brown and Kim, 2014; Kocher et al., 2014; Falk and Zimmermann, 2014; Zimmermann, 2014; Ganguly and Tassoff, 2017.
- People may avoid information, even when it is useful

Preference for Skewed Information is Important to Understand

- Many information structures in the real world are inherently skewed
  - Positively skewed: Eliminates more uncertainty about a desired outcome if it generates a good signal, but unlikely to generate a good signal (Paul)
  - Negatively skewed: Eliminates more uncertainty about an undesired outcome if it generates a bad signal, but unlikely to generate a bad signal (Niels)
- Medical tests, bosses, news, earnings guidance...

A complete picture of intrinsic preferences for information

1. Whether people prefer negatively or positively skewed information structures, when they are equally informative
2. Whether people prefer more or less informative structures
3. Whether people tradeoff skewness and informativeness
   - Can providing skewed signals reduce information resistance? (Caplin and Eliaz, 2003; Eliaz and Spiegler, 2006; Schweizer and Szech, 2013; Dillenberger and Segal, 2017)

Contributions

- We provide two novel results
  - Widespread preference for positive $\succ$ negative skewness
  - Providing positively skewed signals can increase both how many people are willing to acquire information and how much they value it
- We explore the implications of these results for
  - Optimal information design policy when information avoidance is a concern
  - Models of intrinsic information preferences

Wide range of investigations

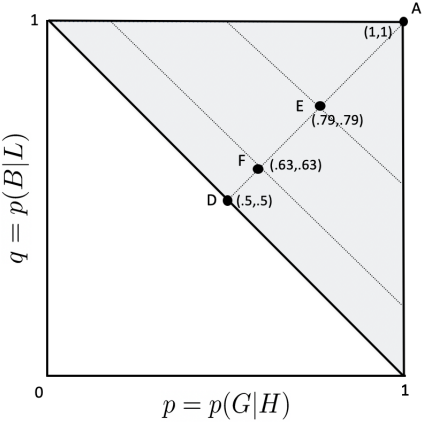
- Three lab experiments (N=1182) in which subjects choose among information structures that reveal clues about whether they won $10 in a lottery (to be revealed in 30 minutes)
  - Experiment 1: Between-subject, informational premia
  - Experiment 2: Within-subject, information-skewness tradeoff
  - Experiment 3: Vary priors
- Two field studies (N=1226) in contexts where skewed information not only possible, but also natural
  - Alzheimer's disease
  - Intelligence test feedback

Preliminaries of experimental design

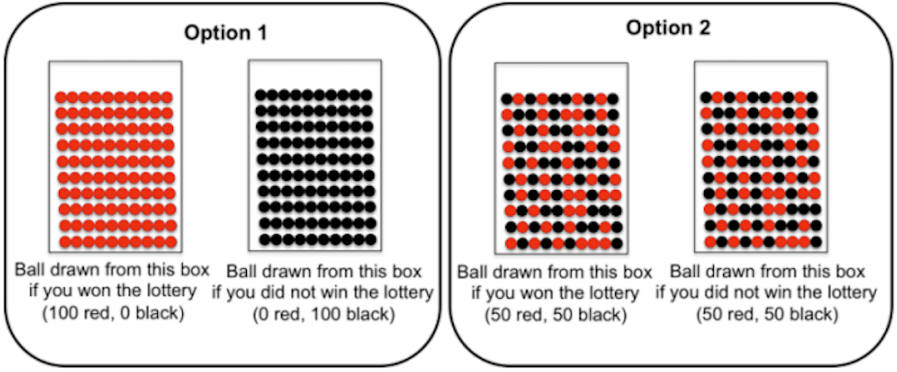
- Binary outcomes with utilities $u(H)$, $u(L)$
  - Period 0: Prior f on H.
  - Period 1: Receive a signal. Realizations are G (good) or B (bad). Update beliefs.
  - Period 2: Outcome realized (H or L).
- Presume individuals have preferences for information structures (p, q) given the prior f, denoted by $\succsim_f$.
  - Probability of good signal conditional on high outcome: $p = p(G|H)$
  - Probability of bad signal conditional on low outcome: $q = p(B|L)$

Late, early, gradual signals

WLOG, consider $\mathbb{S} := \{(p,q)|\ p+q>1\} \cup (.5,.5)$, minimal set that captures all possible posterior distributions



Choice between (1, 1) and (.5, .5)



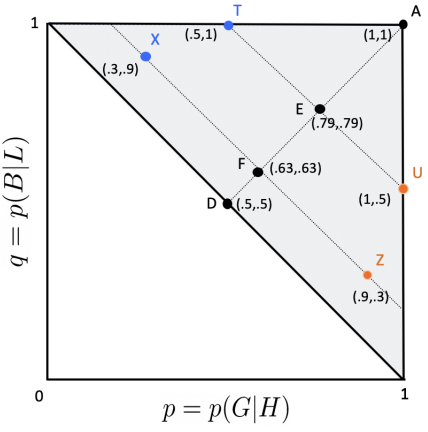
50% red, 50% black
Black: 0% win
Red: 100% win

50% red, 50% black
Black: 50% win
Red: 50% win

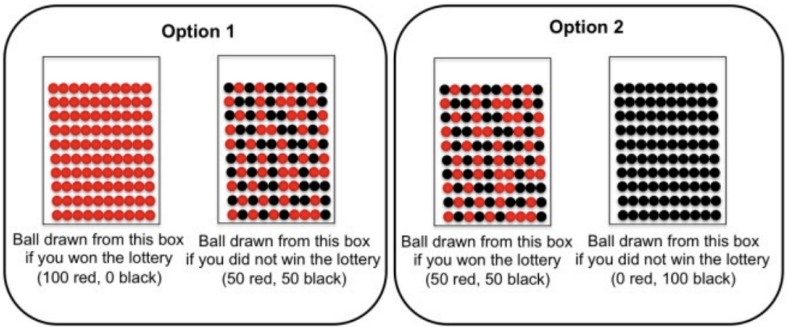
Skewed signals

Information is negatively skewed if $p > q$.

It is positively skewed if $p < q$.



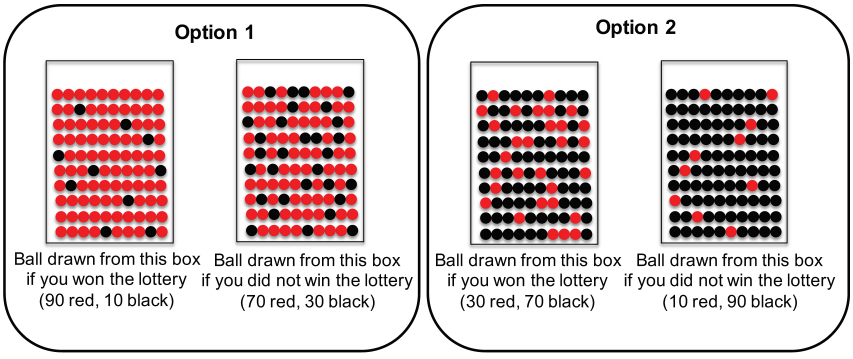
Choice between (1, .5) and (.5, 1)



75% red, 25% black
Black: 0% win
Red: 67% win

25% red, 75% black
Black: 33% win
Red: 100% win

Choice between (.9, .3) and (.3, .9)



80% red, 20% black
Black: 25% win
Red: 56% win

20% red, 80% black
Black: 44% win
Red: 75% win

Experimental Protocol

- 60 minutes, $7 participation, computerized lab experiment
- Practice preference elicitation tools (different task)
- Period 0: Receive raffle ticket 50% chance of paying additional $10. Winning tickets announced at end, but decided at beginning of experiment (die roll, last digit)
- Period 1: Make pairwise choice(s) between information structures regarding whether they have a winning ticket
  - Information structure implemented, subjects observe signal
  - While waiting, answer questions about demographics, complete (hypothetical) preference elicitations, and provide reasons for information choice
- Period 2: Approximately 30 minutes after making choice, observe whether ticket won; receive payment

After information choice

- Indicate preference intensity: Scale, 0 - indifferent between two options, 10 - very strong preference for Option 2 (chosen one)
- In Experiment 1, also decide whether for $x \in [0, 50]$ cents, they would accept to see a ball drawn from Option 1 instead of Option 2
- Computer draws a ball from the appropriate option and displays the color on the screen
- After observing signal realization, subjects confirm posteriors

Identification of intrinsic preferences

This design addresses important challenges in identifying intrinsic preferences for information

1. Presents entirely non-instrumental information
2. Exogenously sets common priors
3. Separately identifies preferences for skewness, by pairing positively and negatively skewed structures that have the same variance (and absolute value of skewness)
4. Eliminates confounds that arise from cognitive constraints or flaws in Bayesian updating, by providing the posteriors they should hold after each type of signal

Experiment 1: Between subject evidence for preferences of timing and skewness

Treatment	N	Preferences	Percentage	p-value
Early vs. Late				
T1	79	$(1,1) \succ (.5,.5)$	70%	.000
Positively Skewed vs. Negatively Skewed				
T2	78	$(.5,1) \succ (1,.5)$	80%	.000
T3	83	$(.3,.9) \succ (.9,.3)$	67%	.001
T4	78	$(.6,.9) \succ (.9,.6)$	74%	.000
Positively Skewed vs. Late				
T5	75	$(.5,1) \succ (.5,.5)$	87%	.000
T6	68	$(.3,.9) \succ (.5,.5)$	82%	.000
Negatively Skewed vs. Late				
T7	57	$(1,.5) \succ (.5,.5)$	72%	.000
T8	60	$(.9,.3) \succ (.5,.5)$	77%	.000
(Symmetric) Gradual vs. Late				
T9	63	$(.79,.79) \succ (.5,.5)$	81%	.000
T10	59	$(.63,.63) \succ (.5,.5)$	75%	.000

Takeaways from Choice Results

Across 700 participants in the Ross Behavioral Lab,

1. Typical participant prefers positive $\succ$ negative skew (T2-T4)
2. Typical participant likes information (T1, T9, T10). But, a substantial minority (30%) avoid fully revealing signals.
3. Information avoidance reduces in the aggregate with positive skew: T1 vs. T5 ($p = .01$) and T1 vs. T6 ($p = .07$).
   - Not explained by a preference for gradual resolution (T1 vs. T7 or T8 are insignificant).

How strong are these preferences?

- Define informational premia given prior f as the minimum amount of money an individual would need to move from (p, q) to (p', q')
- This definition corresponds to (and generalizes)
  - Gradual resolution premium in Dillenberger (2010). WTP/WTA to replace the compound lottery with its single-stage counterpart.
- Allows for a simple experimental elicitation (list method, amounts between 1 cent and 50 cents) for each pairwise choice in T1-T10

Three lenses to assess informational premia

Paying for 30-minute duration, for a $5 expected value

1. Average premia conditional on choice
   - Generally large averages, over 20 cents for 18 out of 20 cases
   - At least as high for skewness as for full vs. late

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2. Unconditional average premium
   - Premia for positively skewed options vs. (.5, .5) is 2x - 3x as large as (1, 1) vs. (.5, .5)
   - Premia ordering reflects choice ordering among equivariant signals: pos skew $\succ$ symmetric $\succ$ neg skew

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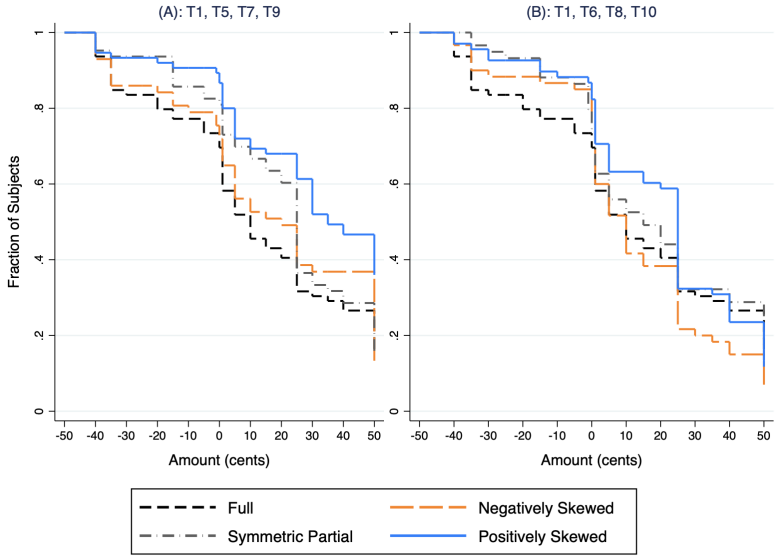
3. Inverse demand curves
   - Maximum info price for 1/2 of population to acquire information: 5c for full info, 30c for positively skewed info
   - At 0c, 72% vs 88% willing to get full vs. positively skewed info, at a price of 50c, it is 15% vs. 36%

Inverse Demand Curves of (p, q) vs (.5, .5)



Experiment 1: Summary

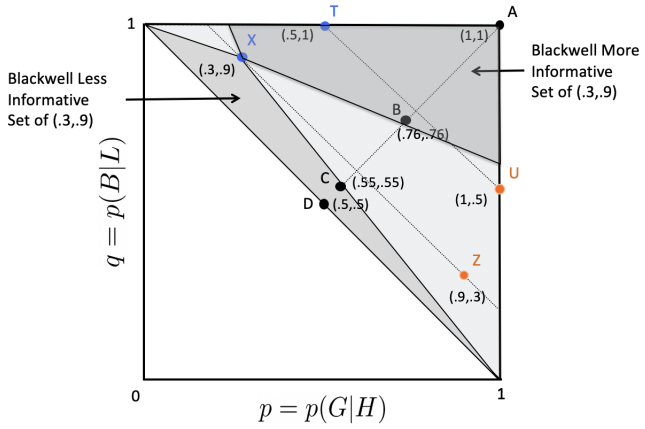
- Strong preference for positive skew vs. negative skew
- Monotonicity in preferences for skewness. Conditional on the variance, subjects prefer more positively skewed structures more (reflected in choice % and in informational premia)
- Suggestive of a tradeoff between skewness and informativeness (non-monotonicity in informativeness)
- Open-ended reasons for choice: desire to preserve hope as the main motivator

Experiment 2

- Each subjects made 5 pairwise choices (one randomly chosen, order varied)
- Repeats treatments from Experiment 1 for Q1-Q3
- Design tested whether preferences for skewness interact with preferences for timing (within-person)

Informativeness versus Skewness

Intuitively, posteriors under BW more-informative structures are mean preserving spread of those under BW less-informative ones



Experiment 2: Conditions and Results

Cond. 1	Cond. 2	N	Preferences	Percentage	p-value
Early vs. Late					
Q1	Q1	250	$(1,1) \succ (.5,.5)$	78%	.000
Positively Skewed vs. Negatively Skewed					
Q2	Q2	250	$(.5,1) \succ (1,.5)$	67%	.000
Q3	Q5a	183	$(.3,.9) \succ (.9,.3)$	81%	.000
Q5a	Q3	196	$(.6,.9) \succ (.9,.6)$	74%	.000
(Symmetric) Gradual vs. Positively Skewed					
Q4a		92	$(.76,.76) \succ (.3,.9)$	71%	.000
	Q4a	104	$(.67,.67) \succ (.1,.95)$	64%	.002
Q4b		27	$(.55,.55) \succ (.3,.9)$	33%	.061
	Q4b	27	$(.66,.66) \succ (.5,1)$	56%	.701
(Symmetric) Gradual vs. Late					
Q5b	Q5b	121	$(.55,.55) \succ (.5,.5)$	75%	.000

Summary of Results from the Lab

- A large proportion of subjects prefer positively to negatively skewed information, and preferences for skewness tend to be monotonic
- Those who prefer early to late resolution tend to monotonically prefer more informative structures, and tend not to trade off skewness and informativeness.
- Those who prefer full late resolution to full early resolution are sometimes willing to take positively skewed information.

Field Studies: Medical test, Intelligence test

Context choices guided by:

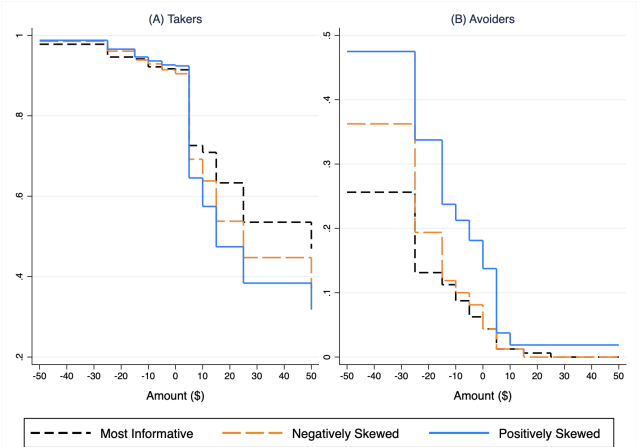
- Can provide simple information structures that are natural: (1) no information, (2) very informative signal, (3) positively skewed and less informative signal, (4) negatively skewed and less informative signal
- Minimize confounding preferences for skewness vs. informativess that arise in the field due to lack of control over exact properties of information structures (prior, variance, instrumentality)
- Prior information avoidance documented as a concern, evaluating policies is of interest (medical: Oster et al 2013; Ganguly and Tasoff, 2017, intelligence: Eil and Rao, 2011; Mobius et al, 2022)

Alzheimer's Disease Study

- 626 MTurkers, 40 years or older (avg. 53 yo)
- APOE gene pairs (exogenous, common priors)
  - Neutral variant (APOE3): 70% of population, Protective variant (APOE2): 5-10% of population, Risky variant (APOE4): 20-25% of population
  - People with APOE2/APOE2 have lowest risk, APOE4/APOE4 have highest risk, others are in between
- Natural context for partially informative skewed signals
  - Neg. Skew: Carry (at least one copy of) APOE4
  - Pos. Skew: Carry (at least one copy of) APOE2
  - Most Info: Exact combination of genes
- Willingness to pay $X, X ranging -50 and 50

Alzheimer's Disease: Results

- Those who want to learn about exact combination of genes do not tradeoff information and skewness
- Among avoiders, 19% indicate demand for APOE2 test (only 4% do so for APOE4) and 9.25% would even pay for it



IQ Test Study

- 600 MTurkers first take a test (fluid intelligence: verbal and visual reasoning)
- We elicit individual priors μ regarding their rank among 100 randomly chosen participants
- Personalized information structures, with $topcut_\mu = \mu - \delta_\mu$ and $bottomcut_\mu = \mu + \delta_\mu$ where $\delta_\mu = \frac{1}{4} min\{\mu, 100 - \mu\}$

NoInfo	Receive no information about how your score ranks you relative to other people
MostInfo	Learn whether your score ranked $topcut$ or better, ranked between $topcut + 1$ and $bottomcut - 1$, or ranked $bottomcut$ or worse
PosSkew	Learn whether your score ranked $topcut$ or better
NegSkew	Learn whether your score ranked $bottomcut$ or worse

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  - If expect to rank 20th: topcut is 15, bottomcut is 25
  - If expect to rank 40th: topcut 30, bottomcut is 50

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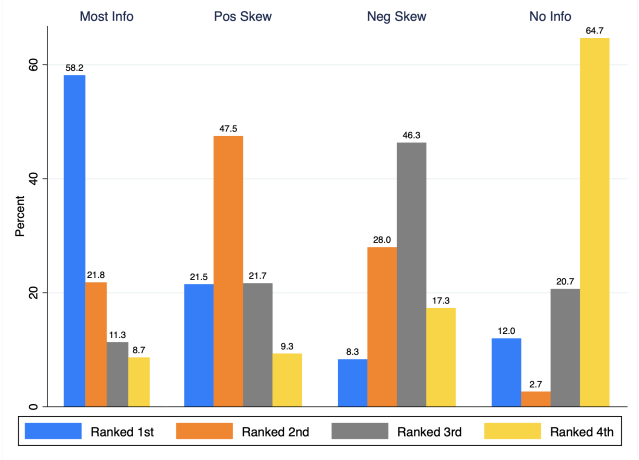
- Elicit (incentivized) ranking of information structures
  - 1st ranked 60%, 2nd ranked 30%, 3rd ranked 10%, 4th ranked 0% chance of being implemented

IQ Test: Ranking of Information Structures

- 82% most info $\succ$ no info, 81% pos. skew $\succ$ no info (insig.)
- 75% neg. skew $\succ$ no info (vs. pos, $p < .001$)



IQ Test: Within-Person Tradeoffs

	Avoiders	Takers
Most Info. Ranked 1st	0%	70.8%
Pos. Skew Ranked 1st	24.3%	20.9%
Neg. Skew Ranked 1st	8.4%	8.3%
No Info. Ranked 1st	67.3%	0%

Avoiders (N=107) / Takers (N=493) refer to the group of people who rank no information better/worse than the most informative option.

- Positively skewed option is more likely to be ranked first than the negatively skewed option, by both groups

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- Among 32.7% of avoiders who do not rank no info as 1st choice, big majority (74%) ranks pos. skew 1st
- Providing pos. skew in addition to the most info. one would increase information uptake from 82.2% to 86.5%

IQ Test: Within-Person Tradeoffs

Aggregating over all possible rankings for each group, preference for positively skewed information is still stronger

	Avoiders	Takers
Pos. Skew $\succ$ Neg. Skew	67.3%	68.6%
Pos. Skew $\succ$ Most Info	71.0%	23.9%
Neg. Skew $\succ$ Most Info	56.1%	12.6%

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Theoretical Implications

- Typical individual prefers more information to less and (even more so) positive skew to negative skew
  - Local utility functions convex, and their first derivatives convex
  - Consistent with well-known parameterizations of Epstein-Zin-Weil preferences

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- Typical individual prefers more information to less and (even more so) positive skew to negative skew
  - Local utility functions convex, and their first derivatives convex
  - Consistent with well-known parameterizations of Epstein-Zin-Weil preferences
- Providing positively skewed information may decrease information resistance, as some individuals take positively skewed information but avoid more informative signals (symmetric or neg. skewed)
  - Local utility functions goes from concave below the prior to convex above.
  - Implies increasing preference for information as prior increases, which we also confirm in Experiment 3
  - Consistent with Kreps-Porteus preferences where $u_1 \circ u_2^{-1}$ is inverse S-shaped

Optimal Information Design

1. When accuracy is achieved at a cost, maximize positive skew for any given level of accuracy
2. When multiple signals can be offered, adding a positively skewed information structure to a fully revealing option increases number of individuals acquiring information

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1. When accuracy is achieved at a cost, maximize positive skew for any given level of accuracy
2. When multiple signals can be offered, adding a positively skewed information structure to a fully revealing option increases number of individuals acquiring information
   - Nuance: Cannibalization from most informative option to the (less informative) positively skewed option can occur
   - Solution 1: Sequential provision by intermediary, if consumers are unaware of all options (doctors)
   - Solution 2: Pricing positively skewed option higher

Avenues for Future Research

- Information premia very large for 30 minutes, consistent with arguments of Epstein et al.(2014). Not much empirical evidence out there.
  - More nuanced estimation of informational premia across a wider set of contexts is needed
- Experiments use binary state - binary signal realization. Simplest domain. Definition of skewness more involved when space of posteriors has dimensionality larger than 2.
  - Trinary lotteries: How does the preference for skewness depend on probability mass changes across different subsets of the support
  - Sharper test of models of non-expected utility
- Future field work on optimal information provision for policy-guidance in particular contexts