Willingness-to-pay for Warnings: Revision Discussion

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Sample(s) Structure

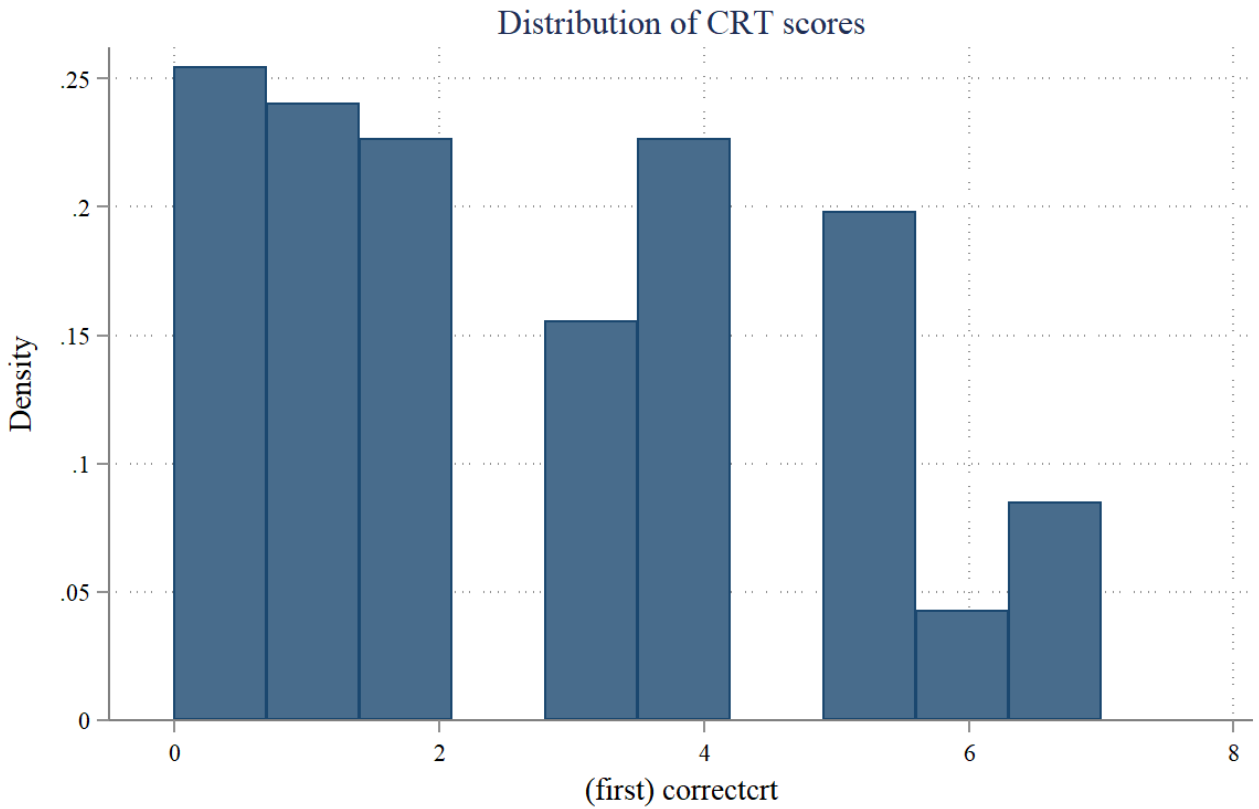
	All		$p \in \{0.1, 0.3\}$		$p \in \{0.2, 0.5\}$	
	N	%	N	%	N	%
All waves						
Male	96	47	49	46	47	47
Age>23yrs old	16	8	8	7	8	8
Students	174	84	90	84	84	85
Had statistics classes	128	62	71	66	57	58
First waves						
Male	43	21	22	21	21	21
Age>23yrs old	14	7	6	6	8	8
Students	88	43	46	43	42	42
Had statistics classes	63	31	37	35	26	26
Second wave						
Male	53	26	27	25	26	26
Age>23yrs old	2	1	2	2	0	0
Students	86	42	44	41	42	42
Had statistics classes	65	32	34	32	31	31

Treatments

	Gremlins composition				
Prop. of black balls (p)	Honest	Black-eyed	White-eyed	FP rate	FN rate
0.1, 0.2, 0.3, 0.5	2	0	0	0	0
0.1, 0.2, 0.3, 0.5	1	1	0	0.5	0
0.1, 0.2, 0.3, 0.5	1	0	1	0	0.5
0.1, 0.2, 0.3, 0.5	3	1	0	0.33	0
0.1, 0.2, 0.3, 0.5	3	0	1	0	0.33
0.1, 0.2, 0.3, 0.5	3	1	1	0.33	0.33
0.1, 0.2, 0.3, 0.5	5	1	0	0.2	0
0.1, 0.2, 0.3, 0.5	5	0	1	0	0.2
0.1, 0.2, 0.3, 0.5	5	1	1	0.2	0.2
New treatments					
0.1, 0.2, 0.3, 0.5	1	1	0	0.5	0
0.1, 0.2, 0.3, 0.5	1	0	1	0	0.5
0.1, 0.2, 0.3, 0.5	5	2	0	0.29	0
0.1, 0.2, 0.3, 0.5	5	0	2	0	0.29
0.1, 0.2, 0.3, 0.5	5	1	1	0.14	0.14

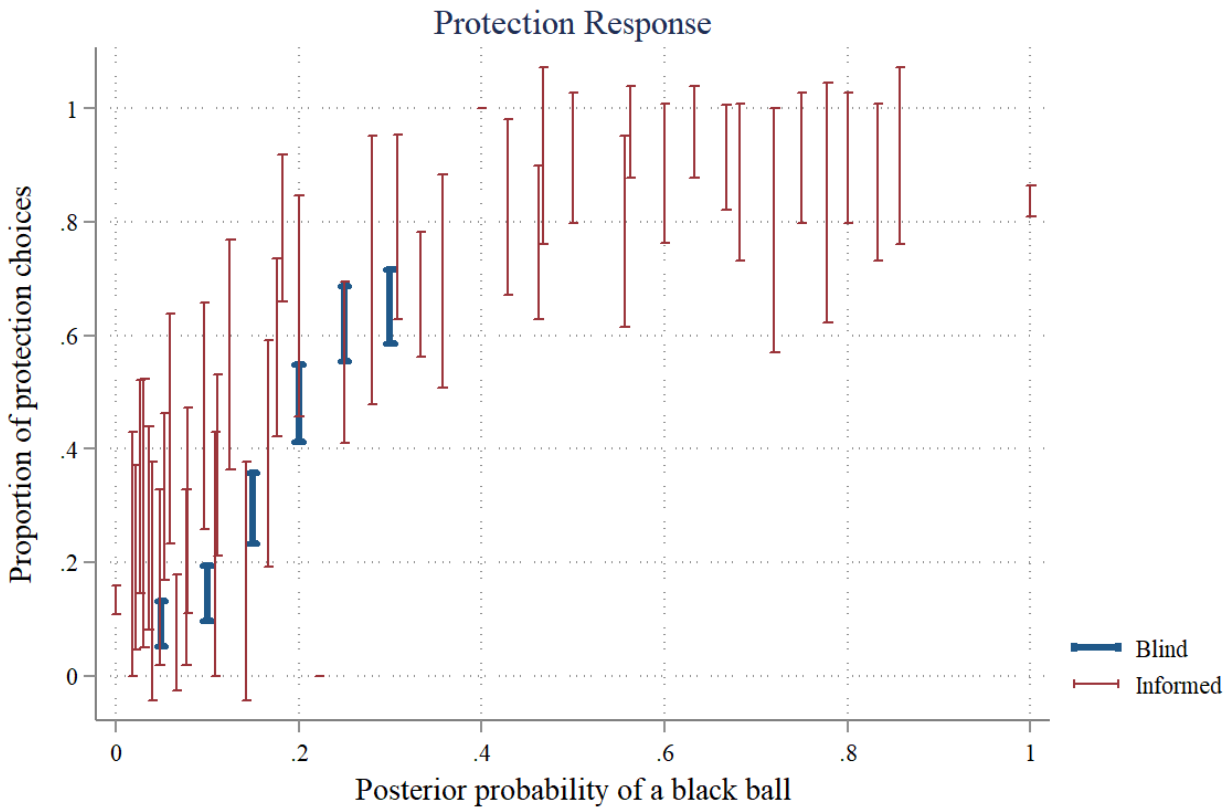
CRT scores: just for the reference

- Extended CRT scores are lower than I expected (2 out of 7 median), slightly higher for college graduates (4 median). But this beats some previous studies (Toplak et al, 2014) finding about 1.5 items answered correctly on average.



Blind and Informed Protection

- Tighter confidence intervals for blind protection (BP) as expected
- More points in IP, narrower confidence intervals for existing points, still roughly correlates with BP



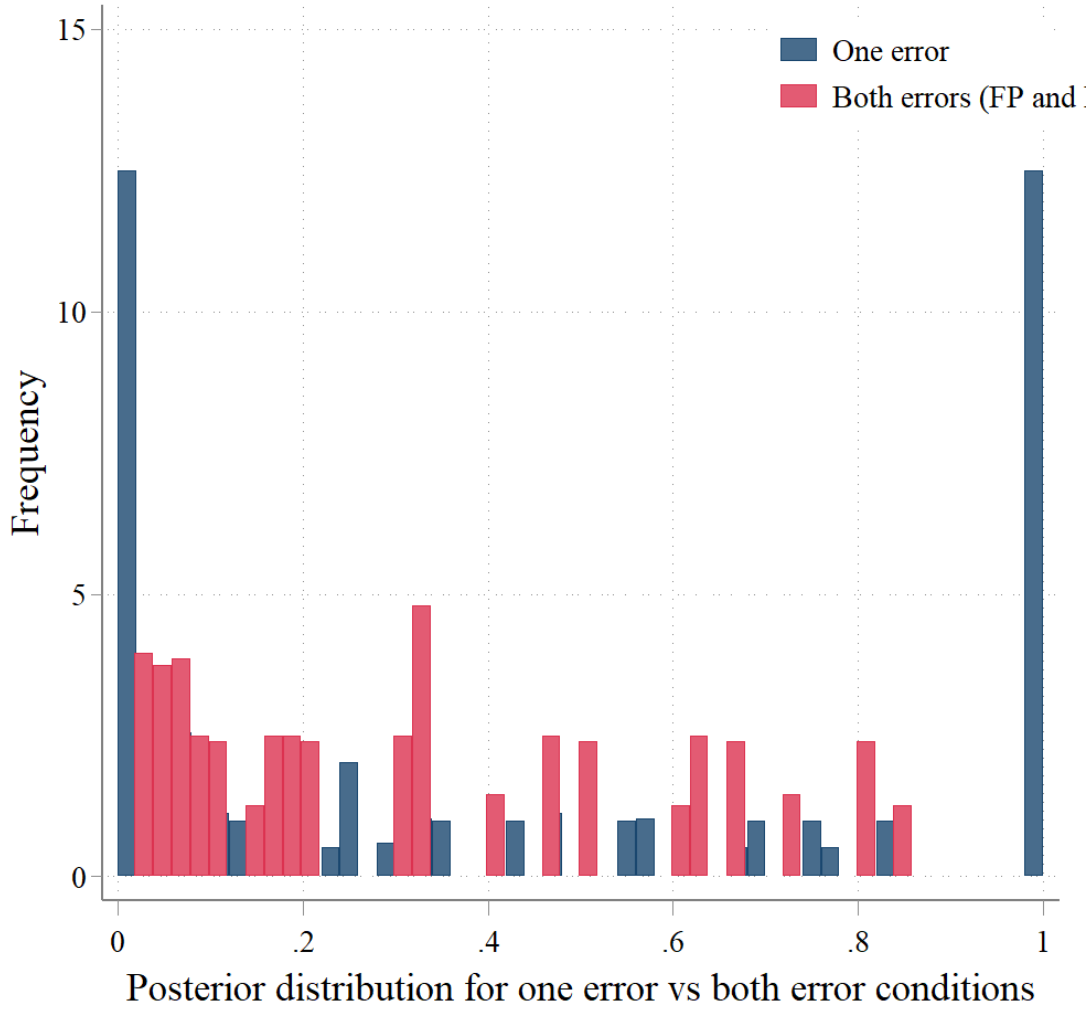
Comment: intermediate priors with both conditions

"For instance, on page 16, Result 1 shows that both-error conditions have systematically lowest WTP. This pattern might be suspicious since single-error conditions often produce extreme posteriors (0 or 1) while both-error conditions tend to produce intermediate posteriors. The complexity level is different. Likelihood insensitivity, rather than belief updating, might also explain the valuation. In addition, almost all the both-error conditions generate very low WTPs, thus the apparent overvaluation for them might "simply be due to reversion to the mean.""

Response: We added new treatments with both error (technically one extra combination of gremlins but for different priors). The distribution of WTP for both errors doesn't concentrate near zero.

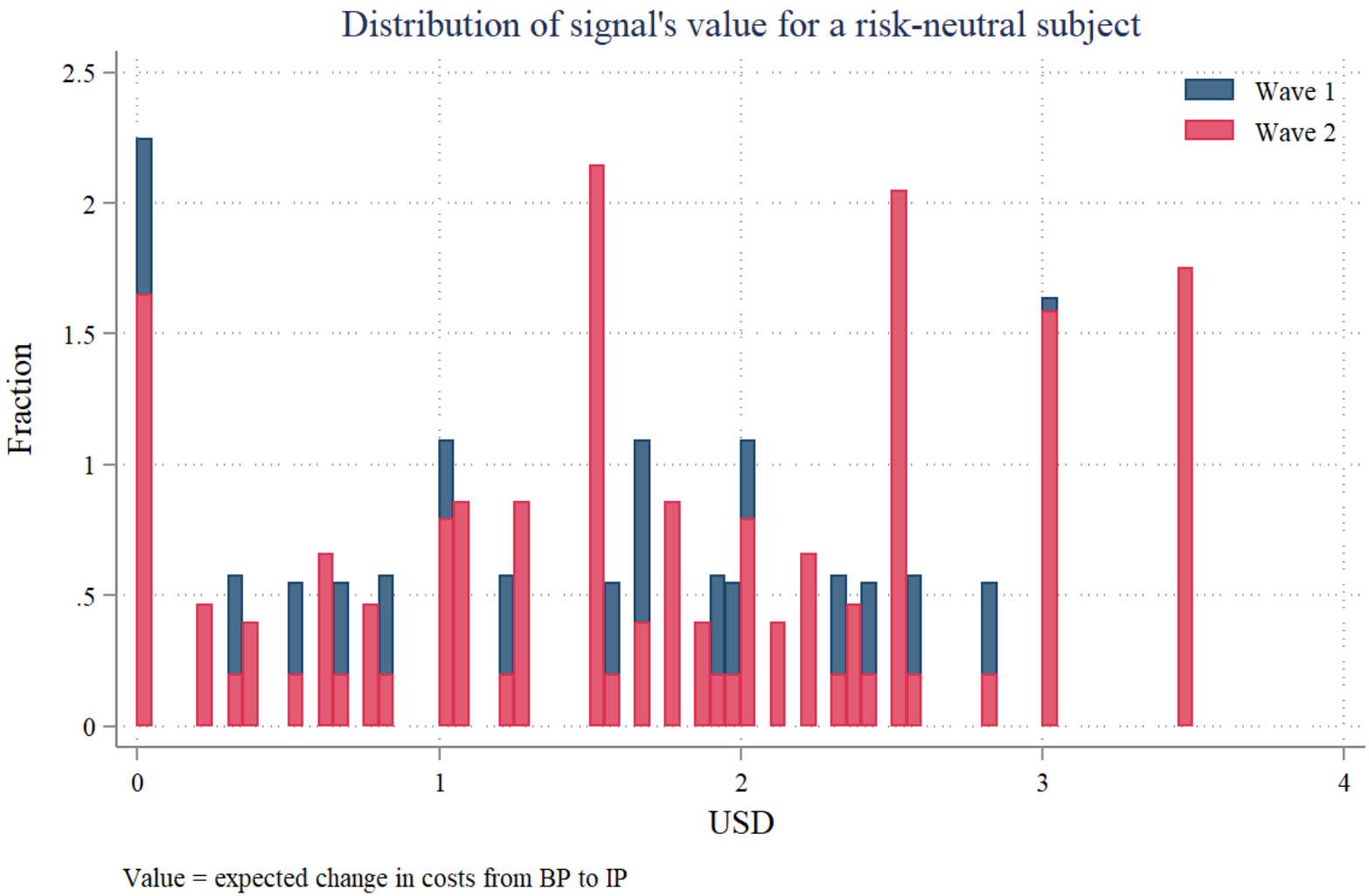
Distribution of posteriors (both errors vs one error)

- The majority of uncertain cases has both errors and they are not concentrated near zeros/edges



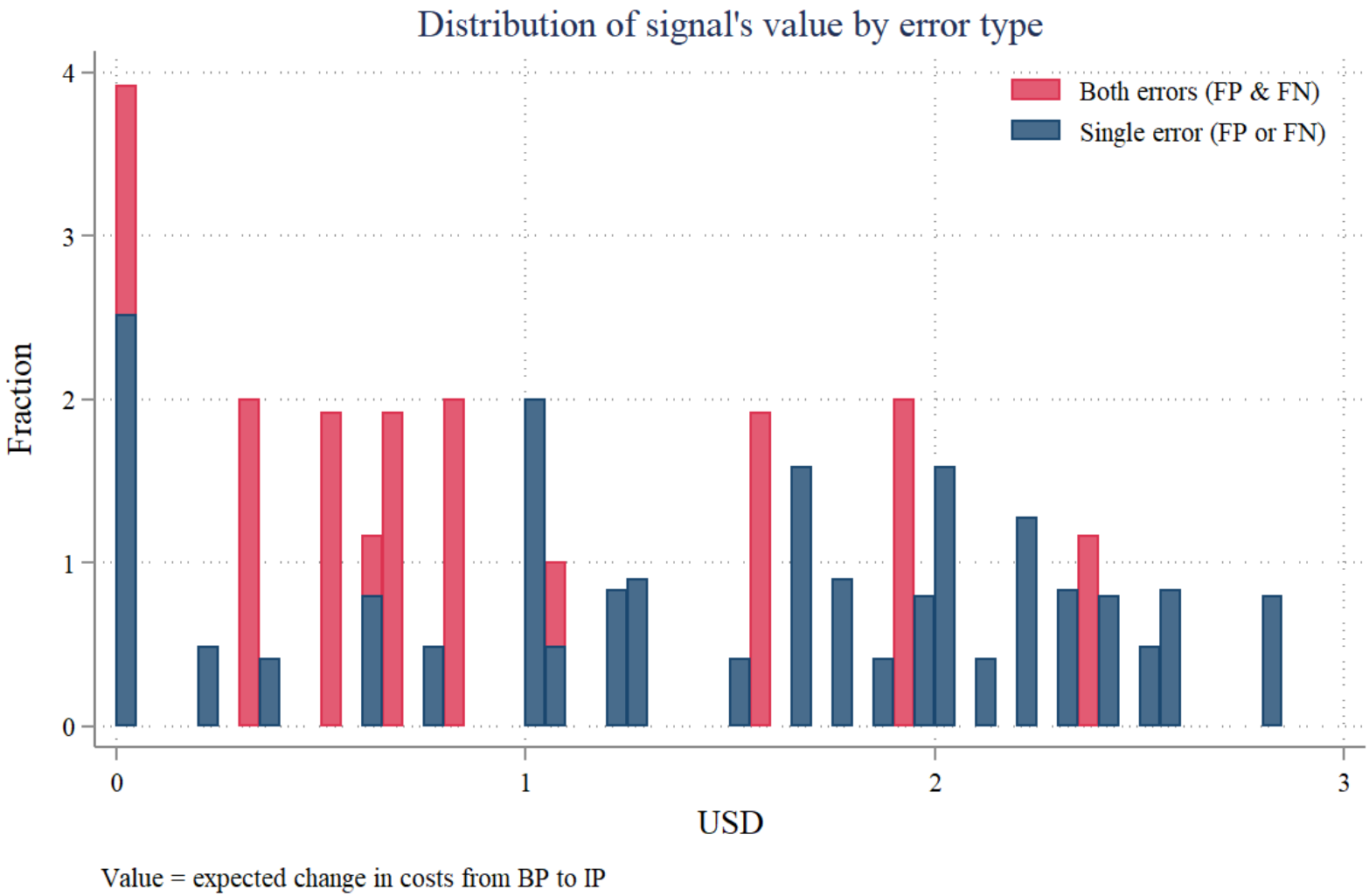
Distribution of theoretical values

- New wave significanly beefs up treatments with intermediate value



Distribution of theoretical values

- Both error conditions often result in significant WTP



Comments: pooling in summary tables

1) More importantly, their approach contradicts their own theory since they average responses across all subjects and conditions, but their theory predicts that different types of people (risk-averse versus risk-neutral) should show different patterns of FP/FN sensitivity. ""

2) I hope the authors can revise Tables 2 and 3 accordingly since the pooling of priors and FN and FP structures may be uninformative. Given that, it will be more straightforward to check how the elicited posteriors, protection actions and WTPs change for different priors and error types.

Response: Split it by prior too? Could be two tables. The danger is that readers would take a more detailed table too seriously, its original purpose was just a rough first impression.

Protection Summary

- Similar: overprotection for white hints, underprotection for black hints with no FP; new - slight underprotection for FP$>$0,FP$=$0

Row	Signal Characteristics		Hint	Posterior	Share Protect	Share Optimal	p
	False Positive	False Negative					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	No	No	White	0.000	0.049	0.000	0.000
(2)	No	Yes	White	0.112	0.262	0.041	0.000
(3)	Yes	No	White	0.000	0.255	0.000	0.000
(4)	Yes	Yes	White	0.117	0.454	0.096	0.000
(5)	No	No	Black	1.000	0.824	1.000	0.000
(6)	No	Yes	Black	1.000	0.855	1.000	0.000
(7)	Yes	No	Black	0.520	0.810	0.869	0.043
(8)	Yes	Yes	Black	0.517	0.875	0.900	0.367

Notes: The p-value in column 7 is for the test of equality between the theoretical prediction (column 6) and the observed share of protection (column 5).

Belief Errrors Summary

- Overestimation for white hints, black hints with FP, underestimation if there are FN or no error. Very similar.

Row	Signal Characteristics		Hint	Posterior	Updating Error*	p
	False Positive	False Negative				
	(1)	(2)	(3)	(4)	(5)	(6)
(1)	No	No	White	0.000	0.047	0.000
(2)	No	Yes	White	0.112	0.061	0.000
(3)	Yes	No	White	0.000	0.189	0.000
(4)	Yes	Yes	White	0.117	0.201	0.000
(5)	No	No	Black	1.000	-0.145	0.000
(6)	No	Yes	Black	1.000	-0.362	0.000
(7)	Yes	No	Black	0.520	0.139	0.000
(8)	Yes	Yes	Black	0.517	0.036	0.043

WTP Summary

- Overpaying: low priors - if there are FP, high priors - if there are FN; overpaying if both errors.

Table: Average WTP discrepancy (WTP-Value) by Signal Type

Priors	**Honest**	**FN only**	**FP only**	**FP and FN**
All priors	-0.261**	0.183*	0.099	0.434***
Low priors	-0.039	-0.033	0.593***	0.451***
High priors (>0.2)	-0.483***	0.399**	-0.394***	0.417**

*The number of stars represents statistical significance (0.05, 0.01, 0.001)

Just IP responses regression for review

- Previous insights hold: FP/FN rates affect protection controlling on posteriors and beliefs

Table: Informed Protection Response

	(1)	(2)	(3)	(4)
FP rate x (S=White)	0.895***	0.943***	0.525***	0.571***
	(10.011)	(10.145)	(5.518)	(5.850)
FN rate x (S=White)	0.537***	0.532***	0.307**	0.299**
	(3.709)	(3.631)	(2.139)	(2.048)
p>0.2	0.039**	0.041**	0.024	0.029
	(2.408)	(1.965)	(1.558)	(1.457)
S=Black	0.531***	0.542***	0.383***	0.374***
	(5.161)	(4.758)	(3.653)	(3.268)
FP rate x (S=Black)	-0.032	0.025	-0.065	-0.000
	(-0.158)	(0.123)	(-0.330)	(-0.001)
FN rate x (S=Black)	0.103	0.069	-0.005	-0.021
	(1.398)	(0.860)	(-0.055)	(-0.229)
FP rate x (p>0.2)		-0.081		-0.085
		(-1.066)		(-1.081)
FN rate x (p>0.2)		0.088		0.048
		(0.891)		(0.521)
N	2424	2424	2424	2424
Pseudo R-squared	0.505	0.505	0.538	0.539
Log-likelihood	-830.188	-829.168	-773.731	-773.018
Subject FE	Yes	Yes	Yes	Yes
Flexible controls for:				
Posterior	Yes	Yes	Yes	Yes
Beliefs	No	No	Yes	Yes

Comment: coefficients interpretation

The authors write: "subjects tend to overvalue false-negative costs for low probability events and overvalue false-positive costs for high probability events." Where do we see that in Table 5? The coefficients of FP costs, FN costs on column 4 and 5 are all positive. Should it be "subjects tend to overvalue more false-positive costs (coeff:0.800 vs 0.204) for low probability events and overvalue more false-negative (coeff: 0.407 vs 0.150) costs for high probability events."? When comparing coefficients, the authors should also report results in statistical tests.

The coefficients had changed, still underreacting to FP for low priors, no real difference for high priors on average. Should be reframed+tests when needed.

Main WTP regression

Table: Deviations from Signal Value (WTP - Value) and Signal Characteristics

	All			Prior	
				$\{.1, .2\}$	$\{.3, .5\}$
	(1)	(2)	(3)	(4)	(5)
FP costs	0.421	0.487	0.643	0.577	0.303
	(0.081)***	(0.126)***	(0.158)***	(0.180)***	(0.308)
FN costs	0.287	0.327	0.357	0.016	0.367
	(0.046)***	(0.084)***	(0.088)***	(0.216)	(0.085)***
Risk-averse × FP costs		-0.329	-0.415	-0.243	-0.576
		(0.225)	(0.257)	(0.285)	(0.427)
Risk-averse × FN costs		-0.355	-0.361	-0.352	-0.288
		(0.124)***	(0.135)***	(0.292)	(0.128)**
Risk-loving × FP costs		0.048	0.018	0.008	0.318
		(0.179)	(0.213)	(0.290)	(0.408)
Risk-loving × FN costs		0.080	0.110	0.361	0.119
		(0.107)	(0.117)	(0.341)	(0.118)
Obs	1230	1230	1230	615	615
Subject FE	Yes	Yes	Yes	Yes	Yes
Inaccurate Belief Interactions	No	No	Yes	Yes	Yes
Prior Probability FE	No	No	No	Yes	Yes

Accounting for WTP bounds (Tobit), WTP as dependent variable, in theory sensitivity=-1

	All			Prior	
				$\{.1, .2\}$	$\{.3, .5\}$
	(1)	(2)	(3)	(4)	(5)
model					
FP costs	-0.804	-0.653	-0.262	-0.389	0.101
	(0.121)***	(0.012)***	(0.016)***	(0.015)***	(0.019)***
FN costs	-0.321	-0.329	-0.211	-0.791	0.386
	(0.061)***	(0.007)***	(0.009)***	(0.017)***	(0.006)***
Risk-averse × FP costs		-0.346	-0.360	-0.069	-0.796
		(0.013)***	(0.023)***	(0.021)***	(0.027)***
Risk-averse × FN costs		-0.342	-0.276	-0.307	-0.441
		(0.008)***	(0.013)***	(0.028)***	(0.009)***
Risk-loving × FP costs		0.114	0.058	0.046	0.251
		(0.012)***	(0.017)***	(0.015)***	(0.025)***
Risk-loving × FN costs		0.102	0.143	0.463	0.141
		(0.008)***	(0.010)***	(0.020)***	(0.008)***
Constant	2.233	-7.971	-13.035	-5.754	-9.871
	(0.154)***	(0.008)***	(0.003)***	(0.004)***	(0.004)***
sigma					
Constant	1.990	1.302	1.270	0.994	0.835
	(0.077)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
*.subject_id	No	Yes	Yes	Yes	Yes
Prob(FP=FN)	0.000	0.000	0.000	0.000	0.000
Obs	1230	1230	1230	615	615
Risk-Averse Subjects:					
False Positive		-1.999	-1.622	-1.458	-1.694
se		(0.024)	(0.037)	(0.034)	(0.044)
p-value		[0.000]	[0.000]	[0.000]	[0.000]
False Negative		-1.671	-1.487	-2.098	-1.055
se		(0.014)	(0.020)	(0.042)	(0.014)
p-value		[0.000]	[0.000]	[0.000]	[0.000]
Risk-Loving Subjects:					
False Positive		-1.538	-1.203	-1.343	-0.647
se		(0.022)	(0.031)	(0.028)	(0.042)
p-value		[0.000]	[0.000]	[0.000]	[0.000]
False Negative		-1.227	-1.068	-1.328	-0.473
se		(0.013)	(0.018)	(0.036)	(0.013)
p-value		[0.000]	[0.000]	[0.000]	[0.000]

Cognitive determinants of WTP

- No significant effects of CRT scores either on the level or on sensitivity of WTP

	(1)	(2)	(3)	(4)	(5)	(6)
GPA>3.5=1	.131	-.451				
	(0.4)	(0.5)				
FP costs	.367*	.352*	.55***	.515***	.423***	.435***
	(0.2)	(0.2)	(0.1)	(0.1)	(0.1)	(0.1)
GPA>3.5=1 × FP costs	-.0409	-.0279				
	(0.2)	(0.2)				
FN costs	.341***	.442***	.318***	.417***	.342***	.321***
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
GPA>3.5=1 × FN costs	-.158	-.228*				
	(0.1)	(0.1)				
GPA>3.5	0	0				
	(.)	(.)				
<4 CRT errors=1			.434	-.0602		
			(0.5)	(0.5)		
<4 CRT errors=1 × FP costs			-.363	-.326		
			(0.2)	(0.2)		
<4 CRT errors=1 × FN costs			-.134	-.225*		
			(0.1)	(0.1)		
crt_errors			.00699	.0212		
			(0.1)	(0.1)		
Stat. class					.218	.306
					(0.2)	(0.3)
Stat. class × FP costs					-.122	-.152
					(0.2)	(0.2)
Stat. class × FN costs					-.0727	-.0204
					(0.1)	(0.1)
Constant	-.345	.868**	-.556	.47	-.418**	.222
	(0.3)	(0.4)	(0.7)	(0.7)	(0.2)	(0.2)
Prior dummies	No	Yes	No	Yes	No	Yes
Observations	492	492	606	606	1230	1230
Adjusted R^2	0.02	0.18	0.04	0.20	0.04	0.20

Demographic determinants of WTP

- Males and subjects with good quiz have slightly lower WTP. Sensitivities are higher only for subjects with the good quiz (though it is endogenous obv)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	b	b	b	b	b	b	b
model							
Male	-.388*	-.341	-.567*	-.381*	-.401**	-.32	-.341
Stat. class	.191	.433	.171	.145	.289	.466	.456
ncorrect	.211***	.315***	.202***	.334***	.202***	.318***	.315***
correctcrt		-.0287				-.0333	.00519
gpa		-.66				-.423	-.572
FP costs			-.859***	-.431***	-.633***	-.692***	-.581***
FN costs			-.457***	-.28***	-.375***	-.279**	-.366***
Male × FP costs			.264				
Male × FN costs			.0869				
Good quiz × FP costs				-.686***			
Good quiz × FN costs				-.285***			
Stat. class × FP costs					-.17		
Stat. class × FN costs					-.0752		
GPA>3.5=1 × FP costs						.00127	
GPA>3.5=1 × FN costs						-.21	
<4 CRT errors=1 × FP costs							-.305
<4 CRT errors=1 × FN costs							-.0989
Constant	-.348	1.37	.333	-.808	.178	1	1.46
sigma							
Constant	2.01***	2.05***	1.92***	1.91***	1.92***	1.96***	1.96***
Prior dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1230	492	1230	1230	1230	492	492
Adjusted R^2							

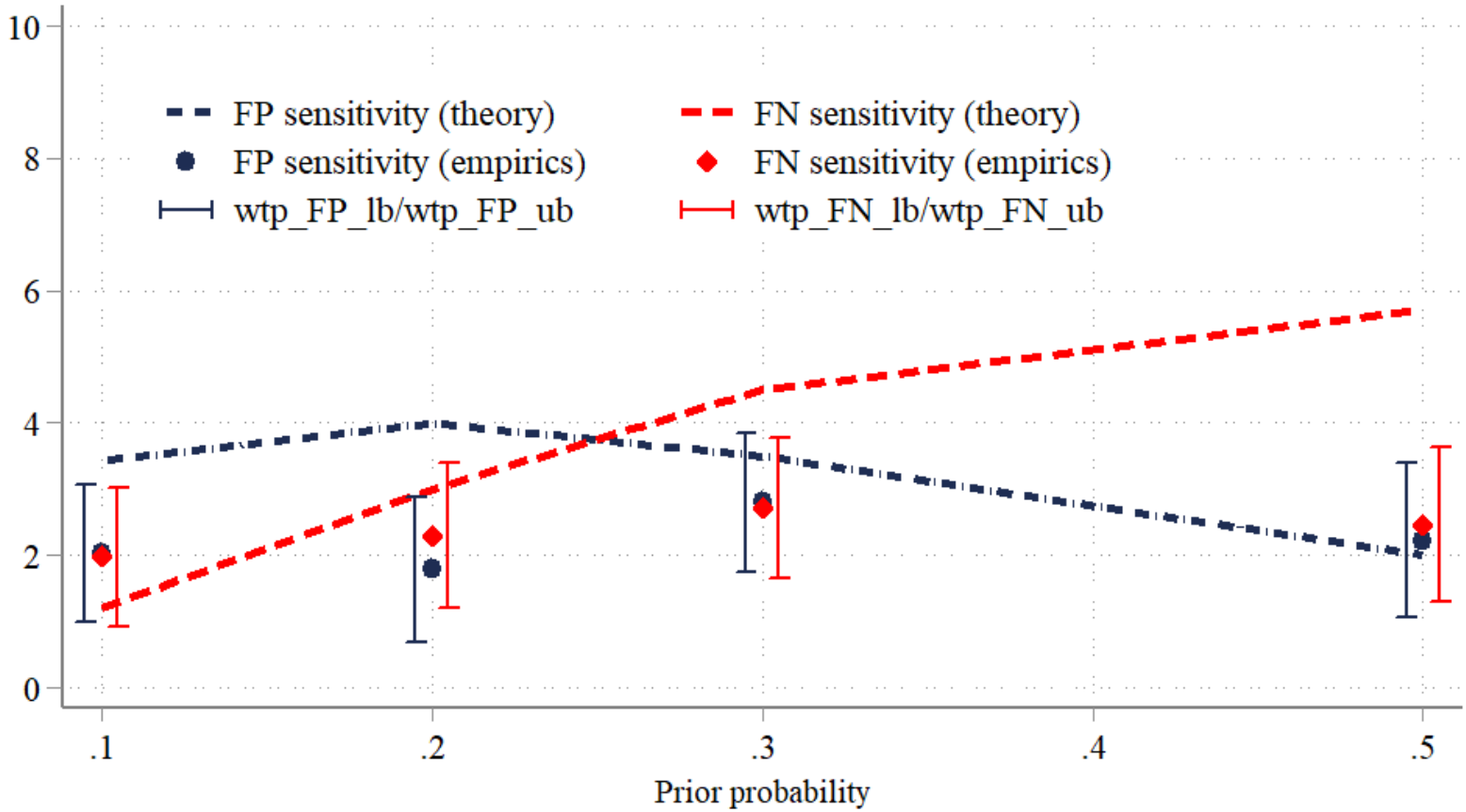
Comment: coefficients interpretation

"Similarly, given the importance of Figure 5, it would be nice if the authors could include confidence interval of the regression coefficients, and present in more details the regression specification."

See the graph with confidence intervals added. And also the same graph using Tobit to estimate sensitivities. Will add regression specification either into the figurenotes or into the text.

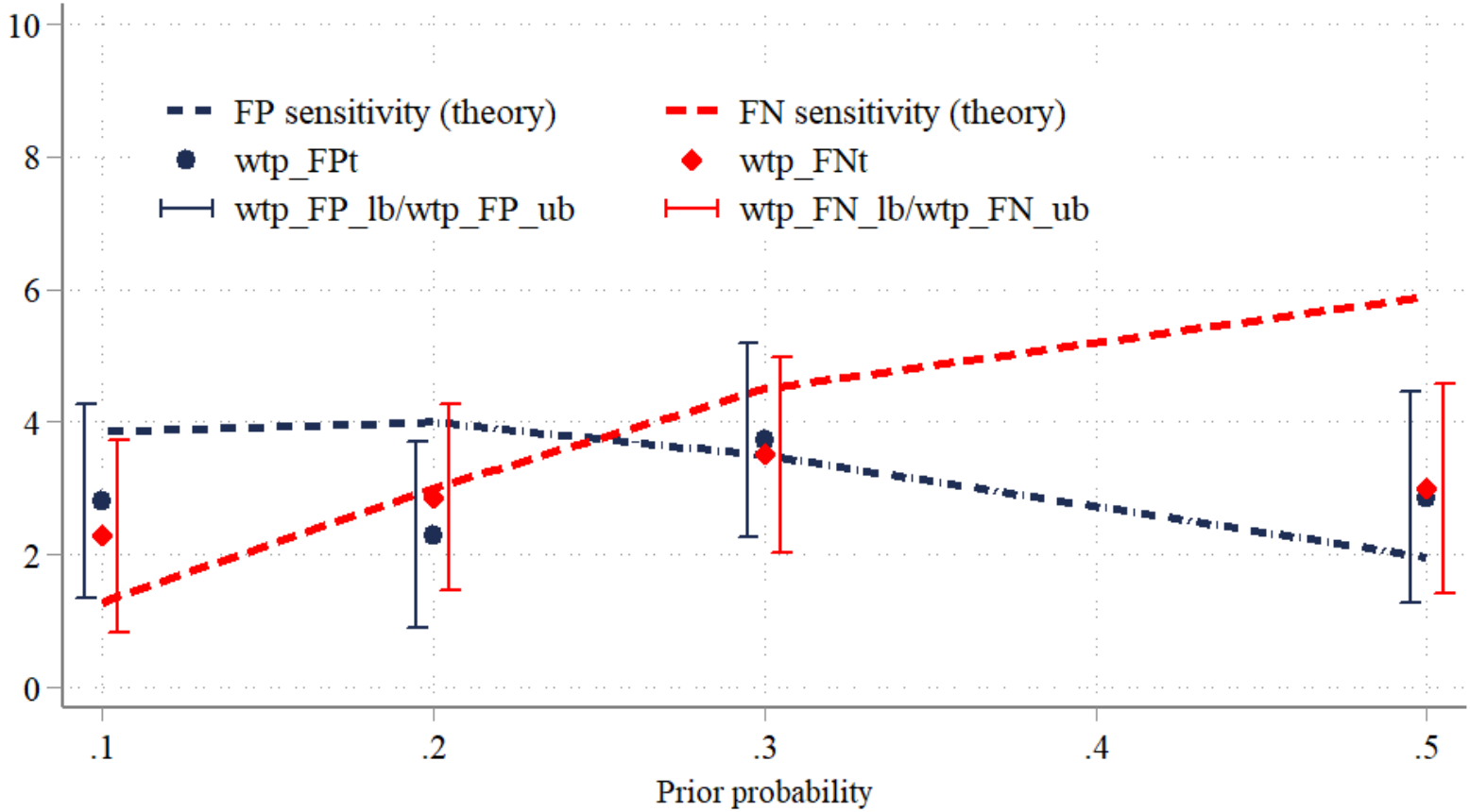
WTP Sensitivity

- We can never reject the hypothesis that empirical FP/FN sensitivities are the same, but in 1/2 cases cannot reject that they are equal to theoretical ones.



OLS estimates of sensitivity to FP and FN rates by prior probability of a black ball.

WTP Sensitivity (Tobit)



Estimates of sensitivity to FP and FN rates by prior probability of a black ball (tobit)

Comments (Reviewer 1): Task cross-consistency

1) "For instance, a BE-IP consistency check could examine whether, given a threshold posterior of 0.25, a consistent decision maker who reports posterior $>$ 0.25 in the BE task also chooses Protect" in the IP task. Across the six tasks generating 12 posteriors, the authors could identify decision thresholds for different subjects and inconsistency measures at the individual level."

2) "Similarly, an IP-WTP consistency check could examine whether participants who chose to protect or not protect regardless of possible signals assign zero WTP to information structures, as predicted by the assumption that access to a signal can increase expected utility if the signal affects her protection decisions." These analyses would likely reveal that high-consistency subjects show clearer false positive/false negative sensitivity patterns, while low-consistency subjects drive the null aggregate results, explaining why their current pooled analysis fails to detect the theoretically predicted effects."

Protection-Beliefs consistency

- Measure the consistency of beliefs and protection decisions using subject-level Mann-Whitney U-statistic:
  - Isomorphic to N of cases in which a subjects protects for belief μ_1 but doesn't protect for belief $\mu_2 \geq \mu_1$
  - Should be 1 for any rational subject regardless of risk preferences
- Median U is 0.925 (pretty good, 1-2 discrepancies), 35% of subjects are fully consistent, but 25% of subjects has U$<$0.71
- Inconsistent subjects have significantly lower belief accuracy ($+$60% mean absolute error, p$<$0.001), and quiz (-1 question).
- Seems to indicate that they are not confident in their answers and either do not take their beliefs into account or recalculate them when making protection decisions

Protection-WTP consistency

- In most cases, subjects both react to a signal and indicate positive WTP, or do neither
- However, in about 1/3 of cases their actions are misaligned for the task:

	WTP = 0		WTP > 0	
	Freq	Mean WTP	Freq	Mean WTP
React to a signal	128	0	706	2.32
Don't react to a signal	101	0	295	1.97

Consistent subjects are more sensitive to FN/FN costs

- Consistent subjects do not show significant biases in either FP or FN sensitivity both an average and for low/high priors!

	All		Prior	
			$\{.1, .2\}$	$\{.3, .5\}$
FP costs	0.442	0.593	0.605	0.543
	(0.081)***	(0.125)***	(0.127)***	(0.196)***
FN costs	0.300	0.545	0.012	0.592
	(0.046)***	(0.074)***	(0.161)	(0.076)***
Consistent WTP	0.256			
	(0.119)**			
Consistent WTP=1 × FP costs		-0.249	-0.199	-0.502
		(0.149)*	(0.161)	(0.248)**
Consistent WTP=1 × FN costs		-0.412	0.030	-0.365
		(0.091)***	(0.208)	(0.095)***
Consistent WTP=1		0.685	0.314	0.932
		(0.186)***	(0.203)	(0.238)***
R^2	0.484	0.496	0.723	0.743
Obs	1230	1230	615	615
Consistent Subjects:				
False Positive		0.344	0.406	0.041
se		(0.096)	(0.100)	(0.144)
p-value		[0.000]	[0.000]	[0.779]
False Negative		0.133	0.042	0.227
se		(0.054)	(0.117)	(0.048)
p-value		[0.014]	[0.720]	

Potential implications for framing our results

- The observed WTP biases we observe mostly come a large group of subjects making inconsistent choices
- Indicates that biases have cognitive origins - paying for a signals and not using it is hard to explain just from preferences
- Supported by the observed high correlations between protection-belief inconsistency, WTP-protection inconsistency, belief accuracy, and quiz results

Comments: Does WTP bias follows from IP bias?

Reviewer 2 also wants more cross-task analysis but with a deeper question:

1) "However, the current version of the paper does not explore much of the relationship between protection actions and WTP. Therefore, I encourage the authors to investigate how the protection actions observed in the experiment affect WTP, which sets the paper apart from the existing literature. The analysis would also lead to new implications. Intuitively, WTP for signals is roughly affected by two factors: 1) the understanding/preference (etc.) over information 2) anticipated protection action taken by the subject's future self. As shown in Table 7, subjects exhibit failure to distinguish FP and FN even when choosing their protection actions. Is the equal sensitivity of WTP w.r.t. FP and FN driven by rational anticipation of the "bias" in protective choice? Or Is it driven by the heuristic when subjects compute the expected benefit of getting the signal? Depending on the answer, the result will have different policy implications for encouraging the acquisition of warning signals."

What the Expected Bias Entails?

- We can imagine three ways to be aware of your biases:
  1. I know my bias direction and magnitude give a signal ("Cannot resist hiding for that tornado siren test on Wednesday").
  2. I know that I do not account for certain information when making a decision (eg.: failing to distinguish FP and FN rates).
  3. I know that I poorly understand particular signal structures, so expect to make more errors and extract less value from these signals
- Reviewer's point: Subjects do not differentiate FP and FN costs in WTP $\Longrightarrow$ What if they are aware of that bias in the IP too and pay less for signal structures known to suffer from this bias?

Narrowing on Beliefs

- Biases of the first type are internally inconsistent and a priori implausible:
  - Why not adjust the protection decision if knowing the bias direction?
  - Also, if a person is aware of equal sensitivity to FP/FN in the IP task, they would still have non-equal sensitivty in WTP task as long as they differentiate two errors there
- Both types 2 and 3 imply poor use of signals. Possible test: do they pay less for signals in which they have large BE errors?
- We can also write a simple model for type 2 bias by rewriting the signal purchase problem in terms of variables they do account for: π, proportion of dishonest gremlins.
  - Still not clear how we test it? Bias correction significance is one option, but inconclusive because as a function of signal characteristics it can proxy for something else (preference non-linearity).

Do errors correlate with discounting WTP?

- Belief error in round indeed strongly correlates with WTP (with subject and prior FE) if controlling for FP/FN costs $\Longrightarrow$ Consistent with bias awareness of type 2 or 3

Table: WTP minus Value of Information: subject-round BE error

	(1)	(2)	(3)
Subject-round-specific belief error	.294	-.795***	-.723**
	(0.3)	(0.3)	(0.3)
FP costs		.482***	.571***
		(0.1)	(0.1)
FN costs		.342***	.129
		(0.0)	(0.1)
p>0.2 × FN costs			.234***
			(0.1)
p>0.2 × FP costs			-.321***
			(0.1)
Prior dummies	Yes	Yes	Yes
Observations	1230	1230	1230
Adjusted R^2	0.50	0.56	0.56

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Some thoughts on bias awareness

- There is an indication that subjects might be aware that they do not use some signals well and pay less for those
- Being aware of your biases cannot explain paying for unused signals which we observe, and which is more consistent with reasoning problems
- Given that the average WTP roughly equals the risk-neutral value, either the bias awareness has to be small, or risk preferences increase baseline WTP