Past Experience of Uncertainty Affects Risk Aversion Supplementary Material

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January 2015

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Supplementary Material - Online Appendix

A Details of the Design

Table 1 shows the sequence of lotteries and sure outcomes observed by the participants in periods 17 to 32.

Choice	Lottery				Sure Outcomes Cohort			
	x_1	x_2	p_1	p_2	1	2	3	4
17	4	14	0.6	0.4	7.0	7.5	6.0	6.5
18	4	10	0.33	0.67	6.5	7.5	7.0	6.0
19	5	17	0.75	0.25	7.5	6.5	8.0	7.0
20	2	15	0.54	0.46	6.0	7.0	7.5	6.5
21	5	9	0.25	0.75	7.5	8.0	6.5	7.0
22	3	9	0.17	0.83	8.0	7.0	6.5	7.5
23	2	20	0.67	0.33	6.5	7.5	7.0	8.0
24	5	19	0.79	0.21	7.0	6.0	6.5	7.5
25	3	14	0.55	0.45	6.5	8.0	7.5	7.0
26	4	11	0.43	0.57	6.5	7.0	8.0	7.5
27	4	12	0.5	0.5	7.0	6.5	7.5	8.0
28	2	13	0.45	0.55	8.0	6.5	7.0	7.5
29	3	11	0.38	0.62	6.0	7.0	7.5	6.5
30	3	15	0.58	0.42	7.5	6.0	6.5	7.0
31	2	10	0.25	0.75	7.0	7.5	6.0	6.5
32	5	12	0.57	0.43	7.5	6.5	7.0	6.0

Table 1: Choices 17 to 32.

Participants were divided into 4 cohorts. In each period each cohort faced the same lottery but different sure outcome. The participants were divided into 4 cohorts in order to create more variability in the data.

B Robustness Analyses

In this section we report robustness checks on the econometric specification underlying the logit regressions for our main results. Table 2 reports logit estimations with individual fixed effects, Table 3 shows estimates from an OLS regression and Table 4 shows the logit regressions separately for each main treatment.

	Pr(Lottery)				
	Risk, Ambiguity, Unawareness				
	(1)	(2)	(3)	(4)	(5)
dexp	1.254***	1.240***	1.221***	1.205***	1.189***
	(0.108)	(0.107)	(0.063)	(0.106)	(0.062)
stdv	–0.322***	–0.318***	–0.317***	–0.308***	–0.308***
	(0.038)	(0.038)	(0.037)	(0.037)	(0.037)
per	–0.056***	–0.043***	–0.043***		
	(0.013)	(0.008)	(0.008)		
unawar·stdv	–0.270***	–0.278***	–0.275***	–0.274***	–0.271***
	(0.058)	(0.057)	(0.056)	(0.057)	(0.055)
amb·stdv	–0.158***	–0.162***	–0.168***	–0.161***	–0.166***
	(0.057)	(0.056)	(0.055)	(0.056)	(0.055)
unawar·dexp	–0.006	0.019		0.021	
	(0.154)	(0.153)		(0.152)	
amb·dexp	–0.093	–0.079		–0.074	
	(0.155)	(0.153)		(0.152)	
unawar·per	0.025				
	(0.019)				
amb·per	0.013				
	(0.019)				
N	292	292	292	292	292

Table 2: Fixed effects logit regression of choices between lotteries and sure outcomes in periods 17 to 32 (* – 10% significance; ** – 5%; *** – 1%). 4672 observations, 292 independent. Dummies awar and amb were omitted because of no within-subject variation. 18 subjects were dropped because of no variation in responses.

	Choice Risk, Ambiguity, Unawareness				
	(1)	(2)	(3)	(4)	(5)
dexp	0.210*** (0.016)	0.209*** (0.016)	0.198*** (0.009)	0.206*** (0.016)	0.194*** (0.009)
stdv	–0.053*** (0.006)	–0.053*** (0.006)	–0.053*** (0.006)	–0.052*** (0.006)	–0.052*** (0.006)
per	–0.009*** (0.002)	–0.006*** (0.001)	–0.006*** (0.001)		
unawar	0.133** (0.061)	0.170*** (0.055)	0.158*** (0.050)	0.170*** (0.055)	0.158*** (0.050)
amb	0.085 (0.062)	0.101* (0.056)	0.079 (0.051)	0.102* (0.056)	0.079 (0.051)
unawar·stdv	–0.041*** (0.008)	–0.041*** (0.008)	–0.041*** (0.008)	–0.041*** (0.008)	–0.041*** (0.008)
amb·stdv	–0.024*** (0.008)	–0.024*** (0.008)	–0.024*** (0.008)	–0.024*** (0.008)	–0.024*** (0.008)
unawar·dexp	–0.014 (0.023)	–0.011 (0.023)		–0.011 (0.023)	
amb·dexp	–0.023 (0.023)	–0.022 (0.023)		–0.024 (0.023)	
unawar·per	0.004 (0.003)				
amb·per	0.002 (0.003)				
const	0.710*** (0.043)	0.692*** (0.041)	0.703*** (0.038)	0.637*** (0.039)	0.648*** (0.037)
N	310	310	310	310	310

Table 3: Random effects OLS regression of choices between lotteries and sure outcomes in periods 17 to 32 (* – 10% significance; ** – 5%; *** – 1%). 4960 observations, 310 independent.

	Pr(Lottery)					
	Risk	**Risk**	**Amb**	**Amb**	**Unaw**	**Unaw**
dexp	1.250***	1.203***	1.162***	1.130***	1.226***	1.206***
	(0.108)	(0.106)	(0.111)	(0.109)	(0.109)	(0.108)
stdv	–0.321***	–0.308***	–0.481***	–0.470***	–0.585***	–0.576***
	(0.038)	(0.037)	(0.042)	(0.041)	(0.043)	(0.042)
per	–0.055***		–0.044***		–0.031**	
	(0.013)		(0.014)		(0.013)	
const	1.277***	0.784***	1.832***	1.437***	2.151***	1.869***
	(0.264)	(0.230)	(0.287)	(0.255)	(0.278)	(0.245)
N	1664	1664	1600	1600	1696	1696
Independent *N*	104	104	100	100	106	106

Table 4: Random effects logit regressions of choices between lotteries and sure outcomes in periods 17 to 32 (* – 10% significance; ** – 5%; *** – 1%). Each column represents separate regression for one treatment. The numbers in parentheses are standard errors.

Figure 1 shows the same graph as Figure 2 in the main text but with standard errors added. It can be clearly seen that plus/minus one standard error intervals are disjoint for standard deviations in the intervals $[0, 1.5]$ and $[7, 8.5]$ for *all three treatments*. For intermediate levels of standard deviations the standard error intervals are pairwise disjoint for the risk and unawareness as well as risk and ambiguity comparisons.

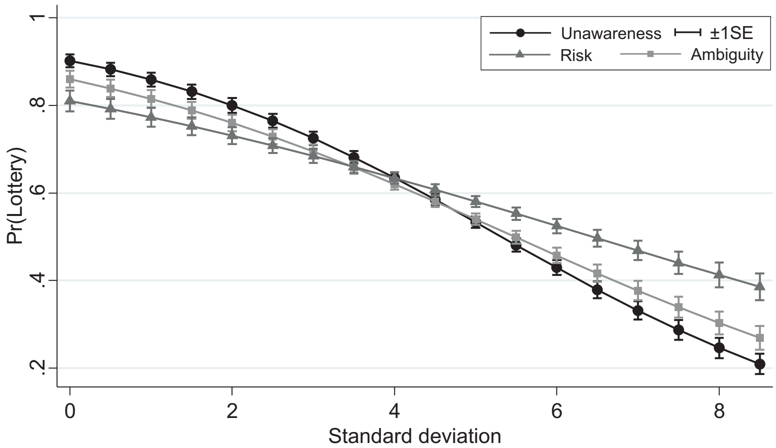

Figure 1: Predicted probabilities of choosing a lottery in periods 17 to 32 as estimated from three separate logit regressions of choice on standard deviation of the lottery with standard errors.

C Additional Analyses of Behavior

We analyze patterns in average behavior as follows: we construct the variable `absc`. For each participant i for periods 1 to 16

$$\text{absc}_i = |\text{average choice}_i - 0.5| \times 2.$$

`absc` ranges from 0 to 1. Participants with `absc`=0 choose the sure outcome and the lottery an equal number of times. Participants with `absc`=1 choose only the sure outcome *or* only the lottery. Thus, `absc` shows how often participants switch between the alternatives.

Figure 2 shows the distributions of `absc` for the three treatments in periods 1 to 16. One can see that on average in the Unawareness treatment participants tend to switch a lot between the lottery and sure outcome whereas in the Ambiguity treatment participants stick more often to the same alternative.

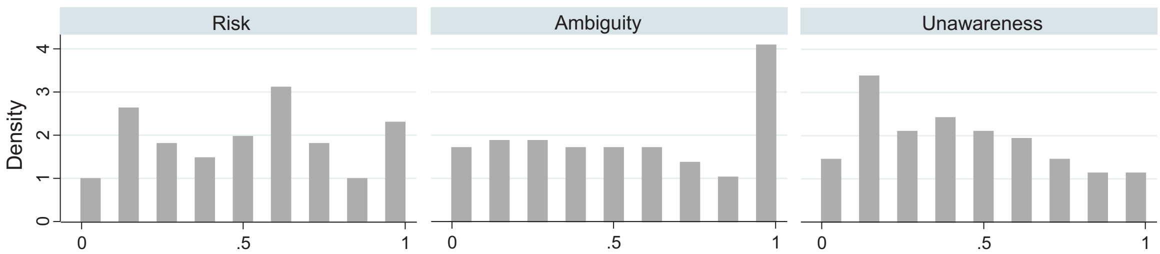

Figure 2: Histograms of absc by treatment in periods 1 to 16.

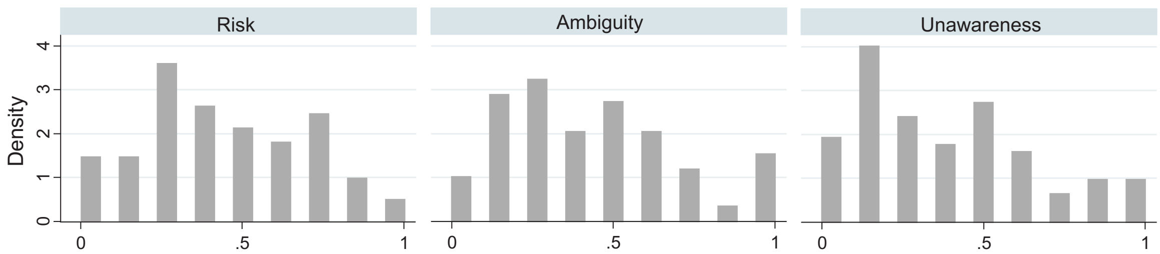

Figure 3: Histograms of absc by treatment in periods 17 to 32.

Mann-Whitney tests reveal significant difference in the distributions of `absc` between Risk and Unawareness ($p < 0.041$) and between Ambiguity and Unawareness ($p < 0.017$) but no significant difference between Risk and Ambiguity ($p > 0.542$). The difference between distributions is only observed in the first 16 periods but not in periods 17 to 32, as can be seen in Figure 3 (Mann-Whitney tests: $p > 0.0677$, $p > 0.1447$ and $p > 0.6464$ respectively).

D Estimation of the CRRA Utility

To check weather our analysis of the mean-variance model is consistent with similar estimation of an expected utility model, we find individual coefficients r of the CRRA expected utility function $u(x) = x^r$. To estimate the coefficient $\hat{r}_i$ for each participant i in periods 17 to 32 we use maximum likelihood method with logistic errors as described in **?**.

We compare the cumulative distribution functions for the three main treatments. Figure 4 displays the results.

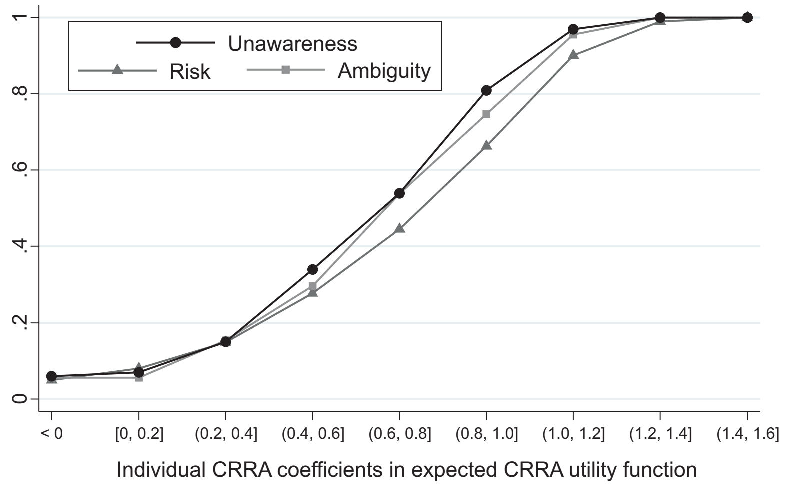

Figure 4: Cumulative distributions of individual r coefficients in Risk, Ambiguity and Unawareness treatments.

One can see that the same pattern as with β coefficients of mean-variance model reappears: the distributions first order stochastically dominate one another:

$$r_{Unawareness} \succ_{FOSD} r_{Ambiguity} \succ_{FOSD} r_{Risk}.$$

This shows that CRRA expected utility and mean-variance models produce similar results. We also look at Spearman's rank correlation between individual β (from the mean variance model) and r (from the CRRA model) coefficients. Overall, for Risk, Ambiguity and Unawareness treatments we obtain Spearman's $\rho = 0.29$ with $p < 0.0001$. For each treatment separately we get $\rho = 0.41$ with $p < 0.0001$ for the Risk treatment; $\rho = 0.08$ with $p < 0.49$ for the Ambiguity treatment; and $\rho = 0.24$ with $p < 0.023$ for the Unawareness treatment.[1]

[1]The Spearman's correlation was very sensitive to the outliers in the data. All the estimates above are done only for participants who had $r > 0$, and $|\beta| < 6$.

E A Theoretical Explanation

In this section we propose a theoretical explanation of the spillover effects observed in the experiments. Our explanation is based on Prospect theory (Tversky and Kahneman, 1992) and includes three key steps.

1. In periods 1 to 16 participants estimate possible probability distribution over lotteries.

2. The uncertainty from periods 1 to 16 is carried over to periods 17 to 32. Upon observing lottery ℓ with mean and standard deviation (μ_ℓ, σ_ℓ), participants attach small probabilities to lotteries with mean/standard deviation pairs (μ, σ) which are one (estimated) standard deviation away from the actual mean and standard deviation (μ_ℓ, σ_ℓ)

3. In accordance with Prospect theory participants overweigh probabilities far away from the reference point, where the reference point is given by $(\mu, \sigma) = (8, 3.8)$, the mean and standard deviation of the lottery in periods 1 to 16

We now describe each of these steps in detail:

E.1 Estimation in Periods 1 to 16

First we illustrate one possible manner of estimating a distribution over lotteries that the agent deems possible in periods 1 to 16 which works for our theoretical explanation. This method is built on the framework of DeGroot (1970). Other methods, such as variants of bootstrapping, will be consistent with our explanation as well.

Types of Possible Outcomes

Let us start with some notation. There is a set of possible outcomes X with typical elements x and y. Suppose that the agent observes a random sample $q = (q_x \, ; \, x \in X)$, where $q_x \in \mathbb{N}$ stands for the frequency of x in the sample. Let $\alpha_x > 0$ denote the prior weight that the agent assigns to $x \in X$. Then, the posterior expected probability assigned to x by the agent, given the sample q is equal to

$$p_x = \frac{\alpha_x + q_x}{\sum_{y \in X}(\alpha_y + q_y)}. \tag{E.1}$$

We distinguish three types of outcomes:

X_s : The outcomes that are realized in the sample, i.e., $x \in X_s$ if and only if $q_x > 0$.

X_a : The outcomes that the agent *knows* are possible (even if $q_x = 0$). This is the case for instance, when the participant in our experiment has been informed (e.g. in the Ambiguity treatment) that -20 is possible, even if it was never drawn. Notice that, $X_s \subseteq X_a$.

X_u : The outcomes that the agent deems possible, without having been explicitly informed that they belong to X. Obviously, if $x \in X_u$ then $q_x = 0$. This is for instance the case when the subject (in the Unawareness treatment) deems -10 possible, without having ever observed it.

To reduce the number of degrees of freedom and make our analysis less arbitrary, we impose some assumptions that restrict the agent's *ex ante* probabilistic assessments.

Assumption 1. Elements of X that cannot be distinguished *a priori* share the same α:

- $\alpha_x = \alpha_a$ for all $x \in X_a$,
- $\alpha_x = \alpha_u$ for all $x \in X_u$.

Observe that if $x \in X_s$ and $y \in X_a$ then $\alpha_x = \alpha_y$. $\triangleleft$

Assumption 2. $\alpha_a \gg \alpha_u$. $\triangleleft$

Assumption 2 says that the agent deems the outcomes in X_a (much) more likely than the ones in X_u.

In our experiment, we consider $X_a = \{-20, -1, 1, 6, 8, 10, 14\}$.[2] In the Ambiguity treatment $X_u = \emptyset$, whereas in the Unawareness treatment we assume that $X_a \cup X_u$ is sufficiently rich containing all outcomes between -50 and 50. In the Risk treatment participants don't need to estimate distributions over lotteries since the lottery is known (i.e. they have a degenerate estimate over the lottery which places probability one on the objective lottery.)

Distribution over the Lotteries

We assume that the agent believes that α_u is distributed uniformly in $[0, \alpha_0]$, and α_a is uniformly distributed in $[\alpha_1, \alpha_2]$, where $\alpha_0 \ll \alpha_1$. This is consistent with Assumption 2 in that the probability that the agent attaches to α_a being much larger than α_u is equal to 1. Clearly, if $\alpha_0 = 0$, which implies that the agent is certain that X_u is empty, the unawareness case degenerates to the ambiguity case. For every $(\alpha_u, \alpha_a) \in [0, \alpha_0] \times [\alpha_1, \alpha_2]$, the agent estimates a p_x for every $x \in X$, and therefore estimates the expected value $E_p(X)$ and standard deviation $SD_p(X)$.

Expected Value

The agent estimates from the sample the probability of each outcome she deems possible

[2]Here we assume Twix has value 1.

through equation (E.1). Throughout this section we assume that the sample size is equal to 10.[3]

In the Ambiguity treatment this yields an expected value as follows:

$$\begin{aligned} E_a X &= \sum_{x \in X_a} \frac{\alpha_x + q_x}{\sum_{y \in X_a} (\alpha_y + q_y)} x \\ &= \frac{\alpha_a}{10 + \alpha_a |X_a|} \sum_{x \in X_a} x + \frac{10}{10 + \alpha_a |X_a|} \sum_{x \in X_s} \frac{q_x}{10} x. \end{aligned}$$

Since the sample mean is an unbiased estimator of EX, it follows that

$$E_a X \approx \frac{80 + 18\alpha_a}{10 + 7\alpha_a}.$$

Recall that this is a random variable, yielding one value for each $\alpha_a \in [0, \alpha_0]$.

Likewise, the agent estimates the expected value of X for (α_a, α_u) in the Unawareness treatment:

$$\begin{aligned} E_u X &= \sum_{x \in X_a \cup X_u} \frac{\alpha_x + q_x}{\sum_{y \in X_a \cup X_u} (\alpha_y + q_y)} x \\ &= \frac{1}{10 + \alpha_a |X_a| + \alpha_u |X_u|} \left(\alpha_a \sum_{x \in X_a} x + \alpha_u \sum_{x \in X_u} x \right) + \\ & \quad \frac{10}{10 + \alpha_a |X_a| + \alpha_u |X_u|} \sum_{x \in X_s} \frac{q_x}{10} x \\ &\approx \frac{80 + 18(\alpha_a - \alpha_u)}{10 + 7\alpha_a + 94\alpha_u} \end{aligned}$$

Observe that for every (α_a, α_u), $E_u X < E_a X$. However, since α_u is assumed to be very small (sufficiently close to 0), they will typically lie very close together as we will see below.

Standard Deviation

Likewise, for every α_a the agent estimates the variance of X in the Ambiguity treatment

[3]If an agent chooses the lottery each time the sample size would be 16. A sample size of 10 corresponds roughly to what we observe.

as follows:

$$
\begin{aligned}
V_a X &= E_a X^2 - (E_a X)^2 \\
&\approx \sum_{x \in X_a} \frac{\alpha_x + q_x}{\sum_{y \in X_a} (\alpha_y + q_y)} x^2 - \left(\frac{80 + 18\alpha_a}{10 + 7\alpha_a} \right)^2 \\
&\approx \frac{750 + 798\alpha_a}{10 + 7\alpha_a} - \left(\frac{80 + 18\alpha_a}{10 + 7\alpha_a} \right)^2,
\end{aligned}
$$

implying that the estimated standard deviation given α_a is equal to

$$
SD_a X \approx \sqrt{\frac{750 + 798\alpha_a}{10 + 7\alpha_a} - \left(\frac{80 + 18\alpha_a}{10 + 7\alpha_a} \right)^2}.
$$

On the other hand, the estimated variance in the Unawareness treatment for some (α_a, α_u) is equal to

$$
\begin{aligned}
V_u X &= E_u X^2 - (E_u X)^2 \\
&\approx \sum_{x \in X_A \cup X_u} \frac{\alpha_x + q_x}{\sum_{y \in X_a \cup X_u} (\alpha_y + q_y)} x^2 - \left(\frac{80 + 18(\alpha_a - \alpha_u)}{10 + 7\alpha_a + 94\alpha_u} \right)^2 \\
&\approx \frac{750 + 798\alpha_a + 85,850\alpha_u}{10 + 7\alpha_a + 94\alpha_u} - \left(\frac{80 + 18(\alpha_a - \alpha_u)}{10 + 7\alpha_a + 94\alpha_u} \right)^2,
\end{aligned}
$$

implying that the estimated SD given (α_a, α_u) is equal to

$$
SD_u X \approx \sqrt{\frac{750 + 798\alpha_a + 85,850\alpha_u}{10 + 7\alpha_a + 94\alpha_u} - \left(\frac{80 + 18(\alpha_a - \alpha_u)}{10 + 7\alpha_a + 94\alpha_u} \right)^2}.
$$

Uncertainty over Means and Standard Deviations

Using $\alpha_a \in [0.1, 0.2]$ and $\alpha_u \in [0, 0.01]$ we obtain numerically that $SD(E_a X) = 0.09$ and $SD(E_u X) = 0.19$ for the expected values and $SD(SD_a X) = 0.21$ and $SD(SD_u X) = 1.79$. Therefore, there is much more uncertainty in periods 1 to 16 regarding the standard deviation of the lottery than regarding its expected value. Hence, even if agents carried over the uncertainty regarding both expected value and standard deviation, the latter would have a much stronger impact on choices. This may be a reason why we do not see a treatment effect on expected value in our main regression.

The estimated probability distributions in Step 1 induce a joint probability distribution over means and variances. This distribution (as well as the marginals) will have the highest variance in the Unawareness treatment compared to the Ambiguity treatment and will have zero variance under the Risk treatment (this is formalized in Appendix

E). Any estimation procedure that will create a higher standard deviation of μ and σ in the Unawareness treatment compared to the Ambiguity treatment will be consistent with our explanation.[4] It is important to note that we do not believe that participants actually do estimate probability distributions. Rather we maintain that making choices in these environments creates a feeling of uncertainty that can be captured by a model where decision makers act *as if* they reasoned in this manner.

E.2 Carrying over Uncertainty

We assume that the agent uses reference points estimated in periods 1 to 16. These are 8 and 3.8 corresponding to the mean and standard deviation of the lottery in periods 1 to 16. Denote by $p(\mu_\mu, \sigma_\mu)$ the marginal distribution of means and by $r(\mu_\sigma, \sigma_\sigma)$ the marginal distribution of standard deviations resulting from the estimation procedure described above. Since these estimations are unbiased their means correspond to $\mu_\mu = 8$ and $\mu_\sigma = 3.8$, i.e. to the reference points.[5] The two standard deviations σ_μ and σ_σ represent the fundamental uncertainty of the environment for a decision maker who cares about mean and variance. Note that in the case of the Risk treatment $\sigma_\mu = \sigma_\sigma = 0$ since the estimated distribution is degenerate.

When participants make decisions in periods 17 to 32, they evaluate the mean and variance of the lottery faced $(\mu_\ell, \sigma_\ell)_{\ell=17..32}$ by attaching weight λ to μ_ℓ (and σ_ℓ) and weight $1-\lambda$ to the (normalized) restriction of the estimated distribution to $[\mu_\ell - \sigma_\mu, \mu_\ell + \sigma_\mu]$ ($[\sigma_\ell - \sigma_\sigma, \sigma_\ell + \sigma_\sigma]$), where $\lambda \in [0,1]$. This is the second crucial assumption of this theoretical explanation. Denote the resulting distributions by π and ρ respectively.

E.3 Decisions

Participants then evaluate lotteries, as in Prospect theory (Tversky and Kahneman, 1992), as follows:

$$U_\ell = \alpha \left(\int_{\mu>8} d\pi^+ \left(\pi^+ v_\mu(\mu)\right) + \int_{\mu<8} d\pi^- \left(\pi^- v_\mu(\mu)\right) \right)$$
$$+\beta \left(\int_{\sigma<3.8} d\rho^+ \left(\rho^+ v_\sigma(\sigma)\right) + \int_{\sigma>3.8} d\rho^- \left(\rho^- v_\sigma(\sigma)\right) \right).$$

[4]Since in the Risk treatment the lottery is known, the estimated standard deviation of μ and σ will be zero.

[5]We treat $\mu_\mu = 8$ and $\mu_\sigma = 3.8$ as two reference points and assume additive separability. Alternatively one could have one reference point (μ_μ, μ_σ). This complicates matters since this does not induce a complete order on the (μ, σ)-space. In other words it is unclear how to define gains and losses with respect to such a reference point.

Prospect theory makes the following assumptions on the probability weighting functions π^+, π^- and ρ^+, ρ^- and the value functions v_μ and v_σ.[6] (i) v is concave above the reference point and convex below, (ii) v is steeper for gains than for losses and (iii) the weighting functions are concave near the reference point and convex away from the reference point. Now assuming that v is linear, overweighing of probabilities away from the reference point and underweighing of probabilities near the reference point can explain our results. The reason is that if $\sigma_\ell < 3.8$ in the Unawareness treatment, then participants attach some probability to good outcomes $\sigma < \sigma_\ell$ which are far from the reference point and are, hence, overweighed and some probability to bad outcomes $\sigma > \sigma_\ell$, which are underweighed. This effect is strongest in the Unawareness treatment. Hence participants are more likely to choose a lottery if $\sigma_\ell < 3.8$ in the Unawareness treatment and less likely if $\sigma_\ell > 3.8$ compared to other treatments. The shape of the value function (as assumed by prospect theory) however works in the opposite direction. Concavity for $\sigma_\ell < 3.8$ will mean that a degenerate lottery is preferred to a mean preserving spread and hence would imply that lotteries with $\sigma_\ell < 3.8$ are least likely to be chosen in the Unawareness treatment. Hence for prospect theory to work here the value function should be "close enough" to linear.

Note that a simpler model built on Prospect theory, which does not include Step 1 above, cannot explain our results. In particular, a theory which assumes simply that the mean and standard deviation of the lottery in periods 1 to 16 are reference points in periods 17 to 32 will fail to accommodate most of our results. Such a theory would, for example, predict differences between the treatments Risk and Risk-high (which have different standard deviations). But this is not what we observe. In addition, since the lottery in periods 1 to 16 has the same standard deviation in all three treatments (Risk, Ambiguity, Unawareness), such a theory would lead to the same reference points in our three main treatments and hence as such would *not* predict a difference between them.[7] Again this is clearly against empirical observation. Hence it is not the estimated standard deviation but the standard deviation of the estimated (μ, σ) that matters, i.e. the fundamental uncertainty by which the environment is characterized.

[6]Note that there is no unique way in prospect theory to rank prospects (μ_i, σ_i) and (μ_j, σ_j) where $\mu_i > \mu_j$ and $\sigma_i > \sigma_j$. Hence we assume additive separability.

[7]One way out of this would be to assume that the mean and variance of the lottery in periods 1 to 16 are estimated in a *biased* way, which seems ad hoc. In addition, even if we did assume this such a theory would still predict a difference between the Risk and Risk-high treatments, which is not what we observe.

F Instructions

F.1 Risk Treatment

General Explanations for Participants

You are participating in a choice experiment that is financed by the Marie Curie grant. You will receive 4 Euro for your participation. You can earn additional money with the decisions you make. Your earnings may also depend on random events. The exact way your earnings are calculated is explained in this document and during the experiment. It is, therefore, very important that you carefully read the following explanations. At the end of the experiment you will be instantly and confidentially paid in cash all the money you have earned.

During the experiment you are not allowed to communicate. If you have any questions please raise your hand. An experimenter will come to answer your questions.

Information on the Exact Procedure of the Experiment

The experiment consists of a main part and a questionnaire. The main part consists of a sequence of 32 periods. In the questionnaire we will ask you to provide some general information about yourself. In each period in the main part of the experiment you will have a chance to earn money. At the end of the experiment you will be paid for one period only that will be determined randomly.

Instructions for the Main Part of the Experiment

Typical Choice

The main part of the experiment consists of 32 different periods. In each period you can choose between a lottery and a sure outcome. Here is an example of one period:

Outcomes (Euro)				Sure Outcome (Euro)
	2	5	7	4.5
	0.2	0.5	0.3	
Probabilities				

In this example, if you choose sure outcome then in case this period is selected for your payment you will receive 4.5 Euro in addition to the 4 Euro you receive for your participation. If you choose the lottery then you might receive 2 Euro, 5 Euro, or 7 Euro (also in addition to the 4 Euro you receive for your participation). Each of these three possible outcomes can happen with the probabilities described below each number. For example here there is a 20% chance that you receive 2 Euro; a 50% chance that you receive 5 Euro; and a 30% chance that you receive 7 Euro. In case you choose the lottery you will be informed after your choice about which outcome of the lottery has occurred.

Also keep in mind that irrespective of whether you choose the sure outcome or the lottery you receive this amount of money only if this period is selected for your payment.

Non-Monetary Outcomes

The outcomes of the lottery might also be represented by the objects other than monetary outcomes. For example, you might have a Twix candy as one of the outcomes of the lottery. If this is the case, instead of the monetary amount you will see a picture like this:

In case you choose a lottery, Twix occurs as the outcome and the period in which you received Twix is randomly selected for your payment you will receive the candy from the experimenters in the end of the experiment (plus the show up payment).

F.2 Ambiguity Treatment

General Explanations for Participants

You are participating in a choice experiment that is financed by the Marie Curie grant. You will receive 4 Euro for your participation. You can earn additional money with the decisions you make. Your earnings may also depend on random events. The exact way your earnings are calculated is explained in this document and during the experiment. It is, therefore, very important that you carefully read the following explanations. At the end of the experiment you will be instantly and confidentially paid in cash all the money you have earned.

During the experiment you are not allowed to communicate. If you have any questions please raise your hand. An experimenter will come to answer your questions.

Information on the Exact Procedure of the Experiment

The experiment consists of a main part and a questionnaire. The main part consists of a sequence of 32 periods. In the questionnaire we will ask you to provide some general information about yourself. In each period in the main part of the experiment you will have a chance to earn money. At the end of the experiment you will be paid for one period only that will be determined randomly.

Instructions for the Main Part of the Experiment

Typical Choice

The main part of the experiment consists of 32 different periods. In each period you can choose between a lottery and a sure outcome. Here is an example of one period:

Outcomes (Euro)				Sure Outcome (Euro)
	2	5	7	4.5
	0.2	0.5	0.3	
Probabilities				

In this example, if you choose sure outcome then in case this period is selected for your payment you will receive 4.5 Euro in addition to the 4 Euro you receive for your participation. If you choose the lottery then you might receive 2 Euro, 5 Euro, or 7 Euro (also in addition to the 4 Euro you receive for your participation). Each of these three possible outcomes can happen with the probabilities described below each number. For example here there is a 20% chance that you receive 2 Euro; a 50% chance that you receive 5 Euro; and a 30% chance that you receive 7 Euro. In case you choose the lottery you will be informed after your choice about which outcome of the lottery has occurred.

Also keep in mind that irrespective of whether you choose the sure outcome or the lottery you receive this amount of money only if this period is selected for your payment.

Non-Monetary Outcomes

The outcomes of the lottery might also be represented by the objects other than monetary outcomes. For example, you might have a Twix candy as one of the outcomes of the lottery. If this is the case, instead of the monetary amount you will see a picture like this:

In case you choose a lottery, Twix occurs as the outcome and the period in which you received Twix is randomly selected for your payment you will receive the candy from the experimenters in the end of the experiment (plus the show up payment).

Hidden Information

It is also possible that you will not observe all the information about the lottery. For example you might see a choice represented like this:

Outcomes (Euro)				Sure Outcome (Euro)
	2	5	7	4.5
Probabilities				

Here you are still choosing between a sure outcome and some fixed lottery (for example, this could be the exact same lottery as in the previous example above). The only difference is that you do not know the probabilities with which the outcomes of the lottery occur. In case you choose the lottery you will observe the realized outcome immediately.

IMPORTANT NOTE: in ALL periods in which you do not observe the probabilities of the lottery outcomes, the actual lottery is EXACTLY THE SAME, both in terms of the outcomes and the unobserved probabilities.

F.3 Unawareness Treatment

General Explanations for Participants

You are participating in a choice experiment that is financed by the Marie Curie grant. You will receive 4 Euro for your participation. You can earn additional money with the decisions you make. Your earnings may also depend on random events. The exact way your earnings are calculated is explained in this document and during the experiment. It is, therefore, very important that you carefully read the following explanations. At the end of the experiment you will be instantly and confidentially paid in cash all the money you have earned.

During the experiment you are not allowed to communicate. If you have any questions please raise your hand. An experimenter will come to answer your questions.

Information on the Exact Procedure of the Experiment

The experiment consists of a main part and a questionnaire. The main part consists of a sequence of 32 periods. In the questionnaire we will ask you to provide some general information about yourself. In each period in the main part of the experiment you will have a chance to earn money. At the end of the experiment you will be paid for one period only that will be determined randomly.

Instructions for the Main Part of the Experiment

Typical Choice

The main part of the experiment consists of 32 different periods. In each period you can choose between a lottery and a sure outcome. Here is an example of one period:

Outcomes (Euro)				Sure Outcome (Euro)
	2	5	7	4.5
	0.2	0.5	0.3	
Probabilities				

In this example, if you choose sure outcome then in case this period is selected for your payment you will receive 4.5 Euro in addition to the 4 Euro you receive for your participation. If you choose the lottery then you might receive 2 Euro, 5 Euro, or 7 Euro (also in addition to the 4 Euro you receive for your participation). Each of these three possible outcomes can happen with the probabilities described below each number. For example here there is a 20% chance that you receive 2 Euro; a 50% chance that you receive 5 Euro; and a 30% chance that you receive 7 Euro. In case you choose the lottery you will be informed after your choice about which outcome of the lottery has occurred.

Also keep in mind that irrespective of whether you choose the sure outcome or the lottery you receive this amount of money only if this period is selected for your payment.

Hidden Information

It is also possible that you will not observe all the information about the lottery. For example you might see a choice represented like this:

Outcomes (Euro)			Sure Outcome (Euro)
	2	5	4.5
Probabilities			

Here you are still choosing between a sure outcome and some fixed lottery (for example, this could be the exact same lottery as in the previous example above). The only difference is that you do not know the probabilities with which the outcomes of the lottery occur. It may also be the case that you do not know some of the outcomes. For example, if the lottery here is the same as in the example on the previous page, you do not know that the outcome 7 Euro can occur. Note that outcomes can occur also if you don't observe them. If you choose the lottery and the previously unobserved outcome 7 Euro occurs, then you will observe it as a possibility afterwards:

Outcomes (Euro)				Sure Outcome (Euro)
	2	5	7	6.5
Probabilities				

Not all the lotteries you are about to see will have hidden information. For some lotteries you will observe the probabilities of the outcomes. To check that there are no hidden outcomes you may sum up the probabilities and verify that they add up to 1.

IMPORTANT NOTE: in ALL periods in which you do NOT observe the probabilities and/or the outcomes, the actual lottery is EXACTLY THE SAME, both in terms of the outcomes and the unobserved probabilities. In addition, some unobserved outcomes will be revealed to you over time. When this happens you will observe them on your screen.

References

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