Likelihoods and Livelihoods: Probability Weighting among Ugandan Farmers*

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Abstract

We investigated the probability weighting habits of farmers from eastern Uganda. We used common consequence effect tests in a lab-in-the-field experiment with a gains condition and a losses condition, in a between-subject design. We find that (a) reference probabilities other than 0 and 1 also influence probability weighting, (b) probability weighting differs between the gains and losses domain, and (c) real-life farming practices meaningfully correlate with lottery choices in the experiment. Some of our findings are at odds with the bulk of the previous evidence, obtained in Western labs, but are plausible in the light of small-scale farmers' livelihoods strategies in hazardous environments.

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Keywords: decision under risk, cumulative prospect theory, common consequence effects, probability weighting, gains, losses, Uganda

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1 Introduction

Nonlinear probability weighting is an important feature of human decision-making under risk. Following Allais (1953), violations of the independence axiom of expected utility theory have been observed in a large number of experimental studies, which points to the prevalence of nonlinear probability weighting.[1] The rationale for probability weighting that is currently most commonly invoked is due to prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992). In prospect theory, so-called "diminishing sensitivity" relative to a reference point is the central organising principle, which governs both the distinct shape of the value function and the shape of the probability weighting function (PWF).

In the realm of probability weighting, diminishing sensitivity means that changes near a reference probability are more acutely felt than equal-sized changes further away from it. Such probability weighting can easily be seen to be plausible. Consider for example a traditional subsistence farmer from our study area in east Uganda, who is contemplating breaking with tradition and investing in modern agricultural inputs such as high-yielding varieties of seed and inorganic fertiliser. Gains from investing being certain is a plausible reference point relative to which actual success probabilities are evaluated. If the farmer's reference probability is 1 and diminishing sensitivity applies, then the attractiveness of the investment prospect of using modern agricultural inputs would be affected more by a rise in the success probability from, for example, .95 to 1 than by a rise from .7 to .75. The intuitively plausible reason that the farmer is less sensitive to the latter increase is that .7 is further away from the reference probability than is .95.

Typically, the reference probabilities 0 and 1 are jointly postulated: the certainty that an outcome will not occur and the certainty that it will occur. Diminishing sensitivity relative to these two reference probabilities produces what Fehr-Duda and Epper (2012, p. 569) call the "famous inverse S": a PWF that is steep near the reference probabilities of zero and 100 percent, and relatively flat in the middle, giving rise to the overweighting of small probabilities and the underweighting of large probabilities (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Wu and Gonzalez, 1996; Gonzalez and Wu, 1999; Starmer, 2000; Takahashi, 2011). The inverse S-shaped PWF has been confirmed in the bulk of the large number of experimental studies of probability weighting.[2] The robustness of this finding suggests that diminishing sensitivity relative to the reference probabilities of 0 and 1 provides a good account of how humans transform probabilities into decision weights.

However, in nonstandard subject pools, an inverse S-shaped PWF seems often not appropriate for organising the data.[3] Humphrey and Verschoor (2004a) in rural Uganda, and Humphrey and Verschoor (2004b) in five rural sites in Ethiopia, Uganda and India find that an S-shaped PWF characterises the probability weighting in their samples more accurately than an inverse S-shaped PWF. The fact that the probability weighting in these rural areas of developing countries is markedly different from that usually found in Western labs casts doubt on the universality of the inverse S-shaped PWF. At the same time it is too early to reach firm conclusions, since the probabilities that are considered in

[1] Examples include the common consequence effect tests cited in Wu and Gonzalez (1998, pp. 131-2) and the common consequence and common ratio effect tests reviewed in Starmer (2000) and in Fehr-Duda and Epper (2012).

[2] See the reviews of these studies in Wu and Gonzalez (1996, 1998); Prelec (1998); Gonzalez and Wu (1999); Starmer (2000); Sugden (2004); Stott (2006); Fehr-Duda and Epper (2012). Studies that report exceptions to the common finding of an inverse S-shaped PWF are listed in Blavatsky (2006).

[3] Lab experiments with a nonstandard subject pool are called "artefactual field experiments" in Harrison and List (2004, pp. 1013-14)'s taxonomy of field experiments. They are also known as "lab-in-the-field experiments", which take place in venues known as "field labs". We have a slight preference for the more evocative latter terminology, which we adopt in this paper.

these studies are limited to one quarter, one half and three quarters.[4]

In this study, we investigated as thoroughly as we deemed feasible, the probability-weighting habits of small-scale farmers in a poor country. We were motivated by the intriguing possibility that in nonstandard subject pools, probability weighting could be very different from that typically found in Western labs. In particular, we wondered whether the all-pervasive nature of risk in the rural areas of developing countries (Fafchamps, 2003) would lead to the emergence of reference probabilities not equal to but somewhere between 0 and 1. If certainty is at best an abstract concept for a population, then perhaps more realistic (historically informed) probabilities would act as referents. If so, then the PWF may no longer resemble an inverse S.

For investigating probability weighting, we designed and implemented common consequence effect tests (Wu and Gonzalez, 1998).[5] Each subject faced ten choices between two three-outcome lotteries. A pair of lotteries may be thought of as representing a "rung" on a "common consequence ladder". The rungs are related to each other through an identical manipulation of both lotteries, a so-called common consequence shift. In our case, the manipulation consists in shifting identical probability mass from the worst outcome to the intermediate outcome of both lotteries on one rung, which yields the lotteries on another rung. A preference reversal violates the independence axiom of expected utility theory. Assuming cumulative prospect theory (Tversky and Kahneman, 1992), preference reversals permit pronouncements on the relative steepness of the PWF in precisely defined probability intervals.[6]

Importantly, we implemented two game conditions, in a between-subject design. One condition is in the gains domain, the other in the losses domain. In the gains version of the experiment, the worst outcome of the three-outcome lotteries is equal to the neutral outcome, so that the intermediate outcome and best outcome represent gains. In the losses version, the best outcome is equal to the neutral outcome, so that the intermediate outcome and worst outcome represent losses. We established the neutral outcome by giving each subject a voucher three weeks before the day of the experimental session in which that subject would participate. The voucher showed the name, address and portrait photo of the face of the subject, as well as the figure of 8,000 shillings prominently displayed. 8,000

[4]Moreover, Tanaka et al. (2010) and Liu (2013) find evidence for an inverse S-shaped PWF in rural Vietnam and rural China, respectively. As we explain below in footnote 5, the methodology that these studies deploy is limited in its tracking ability of the PWF.

[5]There are two reasons that we decided to choose this method. The first is that we needed a simple method for a subject pool with low levels of literacy and numeracy (Dave et al., 2010). Humphrey and Verschoor (2004a,b) had previously successfully implemented common consequence effect tests in similar subject pools to ours. Based on extensive piloting, we found that we could considerably increase the refinement of these tests while maintaining excellent subject comprehension. Conceptually attractive alternatives such as Van de Kuilen and Wakker (2011)'s midweight method were deemed to be cognitively too demanding for our subject pool. The second is that we needed a method with sufficient tracking ability of the PWF to answer our research questions. The main alternative for subject pools with low levels of literacy and numeracy is the design of Tanaka et al. (2010), which they used in rural Vietnam and Liu (2013) used in rural China. In that design, the parameter α of Prelec (1998)'s one-parameter functional form of the PWF, $w(p) = (-(-\ln p)^{\alpha})$, is obtained directly based on a series of paired lottery choices. This functional form can produce an inverse S ($\alpha < 1$) as well as (unintended by Prelec, since he rules out $\alpha > 1$ axiomatically) an S ($\alpha > 1$), but no shapes with more than one convex or more than one concave area. For that reason, it cannot capture shapes influenced by reference probabilities at the extremes as well as in between those extremes of the domain of the PWF. We deem such shapes plausible in our subject pool; see subsection 2.2 for further discussion. More generally on the limitations of proposed functional forms of the PWF for capturing experimentally observed behaviour, see Neilson and Stowe (2002).

[6]The vast majority of experimental studies of probability weighting assume either cumulative prospect theory (Tversky and Kahneman, 1992) or rank-dependent utility theory (Quiggin, 1982). If all outcomes are neutral or gains, then the two theories are indistinguishable. However, rank-dependent utility theory has no place for losses relative to a neutral outcome, which is why we assume cumulative prospect theory. Compared to Kahneman and Tversky (1979)'s original prospect theory it is an improvement because it corrects the original theory's problem that stochastically dominated lotteries may be sometimes preferred. See Wakker (2010) for more elaborate discussion of these theories. The more recent influential theoretical development of reference-dependent preferences of Koszegi and Rabin (2006, 2007) abstracts from probability weighting, which makes it unsuitable for our purposes.

Ugandan shillings is about twice the median daily wage in the study area, in which waged labour is moreover hard to come by. In a scripted, orally delivered message when the vouchers were handed over, subjects were informed that, depending on the decisions they would be asked to take in three weeks' time, their final earnings could be higher or lower than 8,000 shillings.

By making the figure of 8,000 shillings salient in this way, we aimed to establish this amount as a reference point, so that higher amounts would be thought of as gains, and lower amounts as losses. The reason we handed over the vouchers three weeks before experimental days was to alleviate concerns about a house-money effect (Thaler and Johnson, 1990) through inducing sense of entitlement to the 8,000 shillings through the passage of time.

Our findings may be summarised as follows. In the gains domain, we investigated the curvature of the PWF for probabilities between .35 and 1. We find that convexity between .35 and .65, concavity from .65 to .85 and convexity from .85 to 1 organises aggregate patterns in the data. This is consistent with diminishing sensitivity relative to two reference probabilities: .65 and 1. The former on its own would produce an S-shape, but the latter adds curvature that (on its own) is consistent with an inverse S. In the losses domain, our investigations were restricted to probabilities between 0 and .8. The aggregate patterns in the data for losses are best organised by a PWF that is concave from 0 to .15, convex from .15 to .3, concave from .3 to .6, and convex from .6 to .8. Diminishing sensitivity relative to the reference probabilities of 0 and .3 would produce this pattern. Again, the former on its own is consistent with an inverse S, the latter on its own would produce an S, while together they produce more twists and turns than commonly postulated.

As we explain in the paper, the pronounced concavity of the PWF near zero in the losses domain and convexity near unity in the gains domain suggest the presence of a safety-first survival algorithm. Such a livelihoods strategy has long been deemed plausible in development economics for people whose average income is near the subsistence threshold and who operate in hazardous environments (Lipton, 1968; Roumasset, 1976; Scott, 1976). We obtain further support for this interpretation when we examine heterogeneity on observable subject characteristics through regression analysis. The probability weighting consistent with a safety-first algorithm is significantly more pronounced among traditional subsistence farmers, who would be expected more than others in the sample to practise such a survival algorithm. Such plausible consistency with observable subject characteristics provides important evidence of the external validity of our experimental findings.

We see the contribution of our study as follows. First, we contribute to the large experimental literature on probability weighting referred to above. Of relevance to this literature, we show that findings robust in standard subject pools may not hold in nonstandard subject pools. In particular, we find that an inverse S does not organise the aggregate data well. Instead, multiple reference probabilities including 0, 1 and probabilities in between these two extremes need to be postulated to organise the data.

Second, we contribute to the fairly small literature on probability weighting in the losses domain (Tversky and Kahneman, 1992; Abdellaoui, 2000; Abdellaoui et al., 2005; Etchart-Vincent, 2004; Abdellaoui et al., 2011). We make a theoretical contribution by spelling out common consequence conditions for probability weighting in the losses domaing, make a methodological contribution by providing real incentives in the losses domain without practising deception (cf. Etchart-Vincent and l'Haridon, 2011) and show that probability weighting is different in the losses domain to that in the gains domain.

Third, we contribute to the literature on individual risky choice in developing countries.[7] Only some of the studies have investigated probability weighting (Humphrey and Verschoor, 2004a,b; Tanaka et al., 2010; Liu, 2013), but none of these have tracked the PWF with the refinement offered here, nor have they considered probability weighting in the losses domain. Our contribution here is to show that probability weighting is consistent with plausible livelihoods strategies, both in the gains and in the losses domain.

The paper proceeds as follows. In Section 2, we derive our hypotheses in the context of cumulative prospect theory and develop common consequence conditions for testing these hypotheses. Section 3 shows how we implemented these common consequence conditions in our experimental design, and contains details of auxiliary data collection as well as the study area, sampling and other fieldwork implementation. Section 4 presents descriptive statistics, a balancing test across game conditions, and the univariate and multivariate analysis for testing our hypotheses. Section 5 discusses our main results in terms of the theoretical expectations and the related empirical literature. Section 6 contains a brief conclusion.

2 Theory and Hypotheses

In this section, we derive from theory the hypotheses to be tested in our experiments, as well as the vehicle for hypothesis testing, so-called common consequence ladders. Our theoretical framework is cumulative prospect theory (CPT) (Tversky and Kahneman, 1992), one of the most influential theories of decision making under uncertainty, which allows precise tests of probability weighting separately in the gains and losses domains. The tests we derive from CPT consist of a series of choices between paired lotteries, each pair containing a relatively safe lottery and a relatively risky lottery. Each pair in the series is related to every other one through a single manipulation: an identical shift of probability mass between two outcomes, both in the safe lottery and in the risky lottery, a so-called common consequence shift. When a common consequence shift leads to a preference reversal (in one pair of lotteries the safe lottery is preferred, in another pair the risky lottery), then evidence has been obtained about the curvature of the probability weighting function (PWF) in a precisely defined interval of probabilities. In what follows, we first present decision weights in cumulative prospect theory, which make use of weighted cumulative probabilities. We next present S-shaped and inverse S-shaped PWFs, as well as the pyschological intuitions that underpin them, and the hypotheses for our experimental tests that these give rise to. In the last two subsections, we present common consequence effects, in the gains and losses domains, respectively. The common consequence conditions for probability weighting obtained in these two subsections form the basis for our experimental design, which constructs common consequence ladders separately in the gains and losses domains, in a between-subject design.

[7] Lab-in-the-field-experiments on individual risky choice in developing countries we could find are experiments in Chile (Henrich and McElreath, 2002), China (Liu, 2013), Ethiopia (Humphrey and Verschoor, 2004b; Yesuf and Bluffstone, 2009; Harrison et al., 2010), six Latin American cities (Cardenas and Carpenter, 2013), India (Binswanger, 1980, 1981; Humphrey and Verschoor, 2004b; Harrison et al., 2010), Indonesia (Cameron and Shah, 2015), Nepal (Carvalho et al., 2016), Tanzania (Henrich and McElreath, 2002), Thailand (Hardeweg et al., 2013), Uganda (Humphrey and Verschoor, 2004a; Harrison et al., 2010; Tanaka and Munro, 2014; Verschoor et al., 2016), and Vietnam (Tanaka et al., 2010). There are some experiments on risk sharing too, which elicit individual risk preferences as part of their design, in Colombia (Attanasio et al., 2012), Uganda (D'Exelle and Verschoor, 2015) and Zimbabwe (Barr and Genicot, 2008).

2.1 Decision weights in Cumulative Prospect Theory

In CPT, individuals maximise a strictly increasing value function $v : X \to \mathbb{R}$, where X is a set of monetary outcomes, with the neutral outcome denoted as 0, so that gains relative to the neutral outcome are denoted as positive numbers and losses as negative ones. The outcomes x_i of uncertain prospect f are arranged in increasing order, $x_{-m}, ..., x_0, ..., x_n$, with $-m$ to -1 indexing losses, 0 the neutral outcome and 1 to n indexing gains. All positive outcomes, encapsulated by f^+, are multiplied by decision weights $\pi^+(f^+) = (\pi_0^+, ..., \pi_n^+)$; all negative outcomes in f^- by decision weights $\pi^-(f^-) = (\pi_{-m}^-, ..., \pi_0^-)$. π_0^+ and π_0^- are in effect redundant since $v(x_0) = v(0) = 0$.

The value function is additive in gains and losses, so that

$$V(f) = V(f^+) + V(f^-) = \sum_{i=0}^{n} \pi_i^+ v(x_i) + \sum_{i=-m}^{0} \pi_i^- v(x_i). \tag{1}$$

For risky prospects given by probability distribution p_i, decision weights are defined by:

$$\pi_n^+ \equiv w^+(p_n), \tag{2}$$

$$\pi_{-m}^- \equiv w^-(p_{-m}), \tag{3}$$

$$\pi_i^+ \equiv w^+(p_i + ... + p_n) - w^+(p_{i+1} + ... + p_n), 0 \leq i \leq n-1, \tag{4}$$

$$\pi_i^- \equiv w^-(p_{-m} + ... + p_i) - w^-(p_{-m} + ... + p_{i-1}), 1-m \leq i \leq 0. \tag{5}$$

Our interest is in the PWFs w^+ and w^-, defined respectively for gains and losses.[8] They convert probabilities $0 \leq p_i \leq 1$ into weighted probabilities $w^+(p_i)$ and $w^-(p_i)$ through strictly increasing functions that satisfy $w^+(0) = w^-(0) = 0$ and $w^+(1) = w^-(1) = 1$.

Expressions 2 to 5 describe the transformation of weighted probabilities into decision weights. The decision weights on the best gain (expression 2) and worst loss (expression 3) are equal to the weighted probabilities associated with these outcomes. The decision weight on other positive outcomes (expression 4) is equal to the weighted probability that an outcome is at least as high as x_i, $w^+(p_i + ... + p_n)$, minus the weighted probability that the outcome is strictly better, $w^+(p_{i+1} + ... + p_n)$. The decision weight on negative outcomes other than the worst outcome (expression 5) is defined analogously as the difference between the weighted probability that an outcome is at least as bad as x_i, $w^-(p_{-m} + ... + p_i)$ and the weighted probability that it is strictly worse, $w^-(p_{-m} + ... + p_{i-1})$.

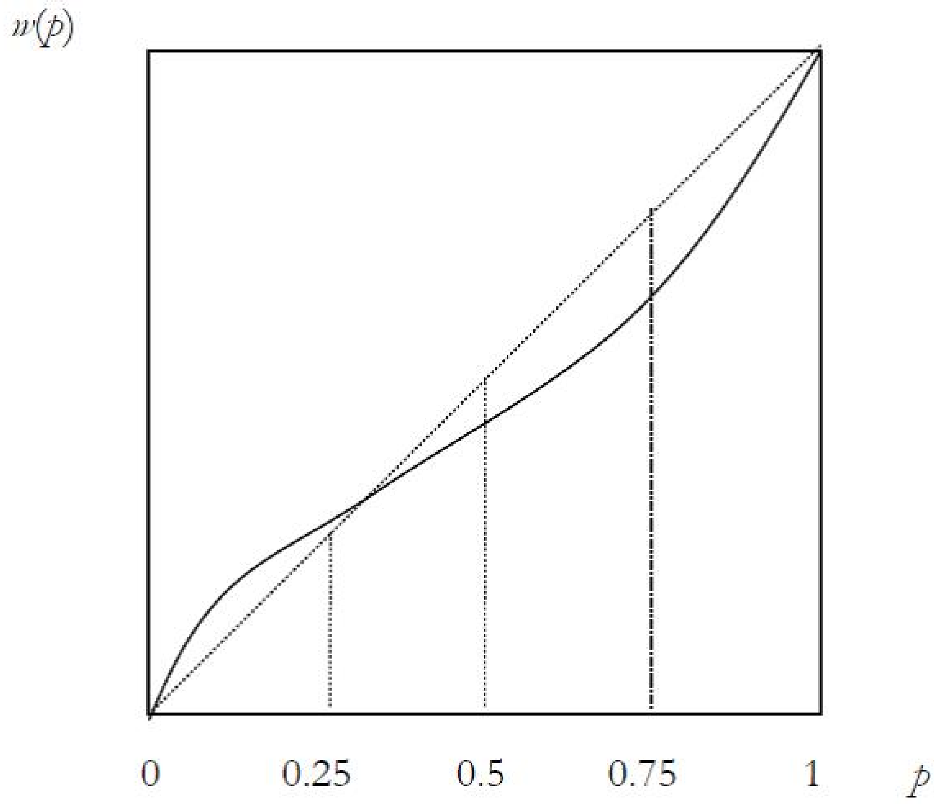
In subsections 2.3 and 2.4, we specify decision weights π_n^+, π_i^+, π_{-m}^- and π_i^- for three-outcome lotteries, and show how tests for nonlinear probability weighting may be derived from them. But first we wish to devote some space to S-shaped and inverse S-shaped PWFs, and the psychological intuitions underpinning these PWFs, since these provide the hypotheses for our experimental tests.

[8] As will become clear later, tests for probability weighting using common consequence effects control for features of the value function, which therefore do not concern us here.

2.2 S-shaped and Inverse S-shaped Probability Weighting Functions

The probability weighting postulated in cumulative prospect theory (Tversky and Kahneman, 1992), as it was in original prospect theory (Kahneman and Tversky, 1979), is that according to an inverse S-shaped PWF (Fig. 1). The psychological intuition invoked by Kahneman and Tversky is that of "diminishing sensitivity" relative to the reference points of $p^* = 0$ and $p^* = 1$, where the superscript * is used to indicate a reference probability. The idea is that changes near these reference probabilities are felt more acutely than changes further away from them: sensitivity to such changes diminishes as they take place further away from these reference points. So, for example, a farmer considering the prospect of an investment in fertiliser would mind more (the value of the prospect would be more affected) if the probability of a loss changes from 0 to 5 percent than if it changed from 25 to 30 percent. Likewise, that farmer would mind more if the probability of a gain resulting from the investment dropped from 100 to 95 percent than if it dropped from 65 to 60 percent, if she weighed probabilities according to an inverse S-shaped PWF.

Figure 1: An inverse S-shaped PWF



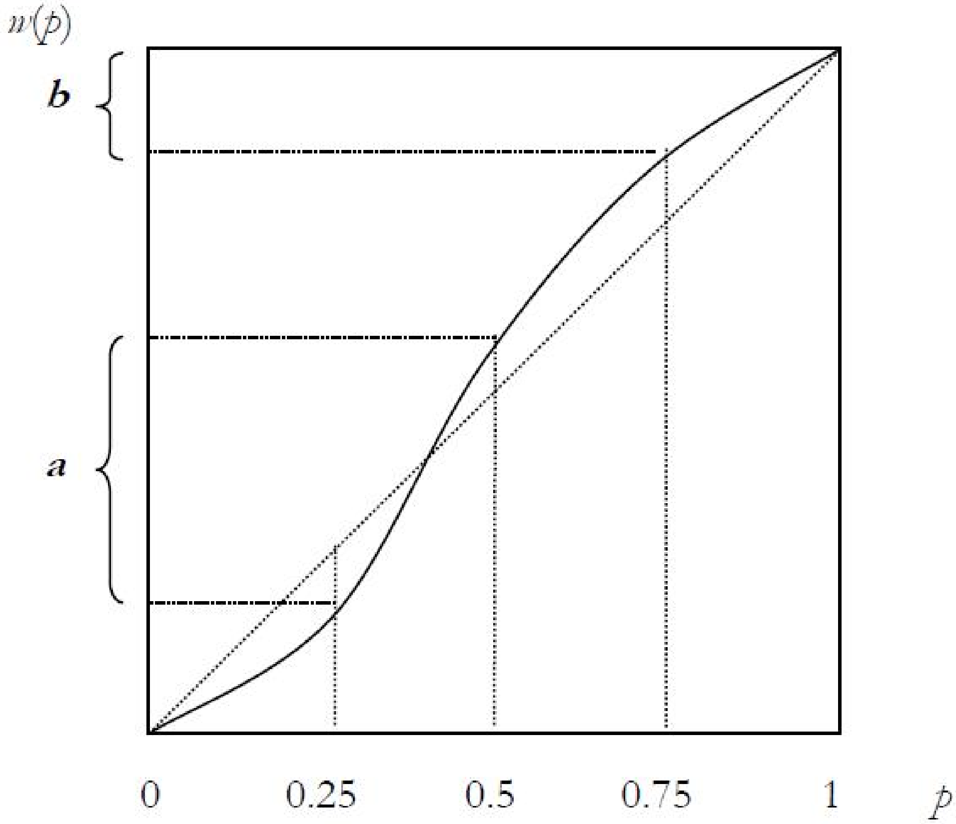
The bulk of the empirical evidence obtained in Western labs is consistent with an inverse S-shaped PWF, but there are exceptions.[9] By contrast, the limited evidence available for developing countries is sometimes consistent with an inverse S-shaped PWF (Tanaka et al., 2010; Liu, 2013), and sometimes consistent with an S-shaped PWF (Humphrey and Verschoor, 2004a,b).[10] In S-shaped PWFs (Fig. 2), changes in a middle interval of probabilities are felt more acutely than changes near the end points. Compare for example in Fig. 2 the increase in $w(p)$ of size a when p increases from 0.25 to 0.5 to the

[9] See footnote 2.

[10] As mentioned in the introduction, Tanaka et al. (2010) and Liu (2013) use a one-parameter functional form for the PWF, whereas the probabilities in Humphrey and Verschoor (2004a,b) are fairly crude (0.25, 0.5 and 0.75). Moreover, probability weighting in the losses domain is not considered in any of these studies. Here we advance the literature through more refined tracking of the PWF both in the gains and in the losses domain.

increase in $w(p)$ of size b when p increases from 0.75 to 1.0. So, a farmer considering an investment in fertiliser would weight the probability increase of a gain from 50 to 60 percent more than the increase from 90 to 100 percent. Similarly, the probability of a loss decreasing from 50 to 40 percent would matter more than a decrease from 10 to 0 percent, if probabilities are weighted according to an S-shaped PWF.

Figure 2: An S-shaped PWF



An S-shaped PWF is consistent with a reference probability somewhere in between the extremes of its domain. The pyschological intuition underpinning that of a reference probability somewhere in the middle of its domain could be an awareness of the pervasive nature of risk. For instance, if the reference probability is informed by the historical relative frequency of outcomes, then in particularly hazardous environments, in which outcomes seldom occur with probabilities near 0 or 100 percent, a reference probability (or several reference probabilities) in between these two extremes is plausible.

Rural areas of developing countries are such environments (Fafchamps, 2003). As detailed in subsection 4.1, sharp negative income shocks due to harvest failure, droughts and floods are very common in the study area. For instance, 77 percent of farmers in our sample experienced at least one sharp negative income shock in the five years before we asked them about it due to a harvest failure. We do not claim to know how reference probabilities are formed in hazardous environments, but simply assert that when certainty ($p = 0, p = 1$) is at best an abstract concept, then it is plausible that the reference probability p^* lies somewhere between the two probabilities representing certainty.

Diminishing sensitivity relative to reference probability $p^*, 0 < p^* < 1$, would give rise to an S-shaped PWF: convex below p^* and concave above p^*, giving rise to a relatively steep curve in the vicinity of p^* and relative flatness near the end points of $p = 0$ and $p = 1$. The discussion so far thus suggests that an S-shaped probability weighting function is psychologically plausible in rural areas of developing countries. As mentioned, some of the empirical evidence to date is consistent with that observation (Humphrey and Verschoor, 2004a,b), even though it is in need of more refined tests and extension to the domain of losses.

We summarise these considerations by spelling out the following four hypotheses, which we test in the paper. An inverse S-shaped PWF gives rise to the first two hypotheses.

Hypothesis 1 *The PWF is concave for probabilities* $[0, p^y)$.

Hypothesis 2 *The PWF is convex for probabilities* $(p^y, 1]$.

Note that theory provides no guidance as to the magnitude of inflection point p^y; the bulk of the empirical evidence suggests that $p^y \approx 1/3$.[11]

By contrast, an S-shaped PWF implies the next two hypotheses.

Hypothesis 3 *The PWF is concave for probabilities* $(p^y, 1]$.

Hypothesis 4 *The PWF is convex for probabilities* $[0, p^y)$.

In these two hypotheses, inflection point p^y is also reference probability p^*, with $0 < p^* < 1$. Again theory provides no guidance as to its magnitude, so empirical tests should allow for it to lie anywhere in a considerable interval if they are to detect it.

All four hypotheses are evaluated relative to the null hypothesis of no probability weighting, which implies that the PWF is a straigt line connecting $(p, w(p)) = (0, 0)$ and $(p, w(p)) = (1, 1)$ The null hypothesis follows from the independence axiom of expected utility theory. We next show how common consequence effects are useful for testing these hypotheses, first for gains and then for losses.

2.3 Common Consequence Effects in the Gains Domain

For deriving conditions for the curvature of the PWF (convex or concave), we make use of common consequence effects. We limit the discussion to three-outcome lotteries, since these feature in our experimental design. The lotteries we consider are of the form $(p_0, x_0; p_1, x_1; p_2, x_2)$, where x_0 denotes the neutral outcome and $x_2 > x_1 > x_0$. For convenience, we rewrite $x_2 \equiv x, x_1 \equiv y, x_0 \equiv z; p_2 \equiv p, p_1 \equiv q$, and $p_0 \equiv r$. The three-outcome lotteries we consider may thus be denoted $(p, x; q, y)$ in which the best outcome x occurs with probability p, the intermediate outcome y with probability q, and the worst (and neutral) outcome z with probability $r = 1 - p - q$.

In the gains domain, the value function of CPT for the three-outcome prospects we consider may be written as

$$v(f^+) = \pi_x^+ v(x) + \pi_y^+ v(y) + \pi_z^+ v(z). \tag{6}$$

From expressions 2 and 4 it follows that $\pi_x^+ = w^+(p)$ and $\pi_y^+ = w^+(p+q) - w^+(p)$. Since $v(z) = 0$, the value function may therefore be rewritten as

$$v = w^+(p)v(x) + (w^+(p+q) - w^+(p))v(y). \tag{7}$$

This value function is identical to the one obtained in Wu and Gonzalez (1998), who derive their common consequence conditions in the context of rank-dependent expected utility (RDEU) (Quiggin,

[11] Among the reviews of studies of probability weighting, both Prelec (1998) and Starmer (2000) point this out.

1982; Yaari, 1987; Segal, 1989). In the gains domain, RDEU is indistinguishable from CPT. However, in the losses domain, RDEU does not provide separate predictions: it simply ranks outcomes from worst to best and does not consider them relative to a neutral outcome. Following a slightly different approach, we therefore obtain in this subsection identical common consequence conditions for gains to those obtained by Wu and Gonzalez (1998), and derive novel common consequence conditions in the next subsection, for losses.

Consider a choice between safe lottery S (S for safe), characterised by $(p^{'}, q^{'})$ and risky lottery R (R for risky), characterised by (p, q). Compared to S, R has a higher probability of the best outcome $(p > p^{'})$ and a higher probability of the worst outcome $(1 - p - q > 1 - p^{'} - q^{'})$. Now consider a choice between a second pair of lotteries S_ϵ and R_ϵ, which are derived from S and R, respectively, by shifting probability mass ϵ from the worst to the intermediate outcome.[12] S_ϵ is thus characterised by $(p^{'}, q^{'} + \epsilon)$ and R_ϵ by $(p, q + \epsilon)$. A series of binary lottery choices constructed along these lines is known as a common consequence ladder: each lottery choice in the ladder is connected to every other one through a shift of probability mass ϵ between the same two outcomes, both in the safe and in the risky lottery. Importantly, outcomes x, y and z are held constant, so that features of the value function are controlled for in common consequence conditions for the curvature of the PWF.

Nonlinear probability weighting may be inferred from preference reversals upon a common consequence shift. Consider the preference reversal $R \prec S$ while $R_\epsilon \succ S_\epsilon$, so the safe lottery is preferred before and the risky lottery after common consequence shift ϵ, $\epsilon > 0$. Such a preference reversal is an example of a common consequence effect. The common consequence effect considered here implies that the value of the risky prospect has risen more than the value of the safe prospect as a result of the common consequence shift, or $\triangle v = v_\epsilon - v > \triangle v^{'} = v_\epsilon^{'} - v^{'}$. For spelling out implications for the curvature of the PWF, we obtain expressions for $\triangle v$ and $\triangle v^{'}$, using equation 7. The value of the risky lottery R, so before the common consequence shift, may be rewritten as follows, since $v = w^{+}(p)[v(x) - v(y)] + w^{+}(p + q)v(y)$:

$$v = w^{+}(p)[v(x) - v(y)] + w^{+}(p + q)v(y). \tag{8}$$

Likewise, the value of the risky lottery R_ϵ, so after the common consequence shift, is equal to $v_\epsilon = w(p)v(x) + (w(p + q + \epsilon) - w(p))v(y)$, which may be rewritten as

$$v_\epsilon = w^{+}(p)[v(x) - v(y)] + w^{+}(p + q + \epsilon)v(y). \tag{9}$$

The increase in the value of the risky lottery as a result of the common consequence shift may thus be expressed as

$$\triangle v = v_\epsilon - v = (w^{+}(p + q + \epsilon) - w^{+}(p + q))v(y). \tag{10}$$

Taking similar steps, the increase in the value of the safe lottery brought about by the common consequence shift is equal to

$$\triangle v^{'} = v_\epsilon^{'} - v^{'} = (w^{+}(p^{'} + q^{'} + \epsilon) - w^{+}(p^{'} + q^{'}))v(y). \tag{11}$$

The preference reversal $R \prec S$ while $R_\epsilon \succ S_\epsilon$ implies that $\triangle v > \triangle v^{'}$, which by equations 10

[12] In Machina's unit probability triangle, this amounts to an identical horizontal translation of S and R; see Wu and Gonzalez (1998, p. 123). The common consequence effects we consider in this subsection are therefore known as horizontal common consequence effects.

and 11 is equivalent to

$$w^{+}(p+q+\epsilon) - w^{+}(p+q) > w^{+}(p^{'}+q^{'}+\epsilon) - w^{+}(p^{'}+q^{'}). \quad (12)$$

This inequality may be used to pronounce on the curvature of the PWF for specific intervals of its domain. Consider the interval $[p+q, p^{'}+q^{'}+\epsilon]$, in which $p+q < p^{'}+q^{'}$ (which we ensure in the experimental design). Strict concavity of $w^{+}(.)$ in interval $[p+q, p^{'}+q^{'}+\epsilon]$ ensures that inequality 12 holds since, by the definition of concavity, the PWF is steeper for the interval of probabilities $[p+q, p+q+\epsilon]$ than for the interval $[p^{'}+q^{'}, p^{'}+q^{'}+\epsilon]$, which lies to the right of the first-mentioned interval. Strict concavity of $w^{+}(.)$ in the interval $[p+q, p^{'}+q^{'}+\epsilon]$ is thus a sufficient condition for inequality 12 to hold. For it to be a necessary condition, more structure needs to be imposed.[13] Prudently, one should therefore limit pronouncements on the curvature of the PWF in the light of preference reversals $R \prec S$ while $R_{\epsilon} \succ S_{\epsilon}$ to stating that evidence has been obtained that the PWF is steeper in the interval $[p+q, p+q+\epsilon]$ than in the interval $[p^{'}+q^{'}, p^{'}+q^{'}+\epsilon]$, while remaining agnostic about concavity in the entire interval of its domain $[p+q, p^{'}+q^{'}+\epsilon]$.

Mirroring the steps taken to obtain inequality 12 by reversing the inequality signs in these steps, we may state that the preference reversal $R \succ S$ while $R_{\epsilon} \prec S_{\epsilon}$ implies the following inequality:

$$w^{+}(p+q+\epsilon) - w^{+}(p+q) < w^{+}(p^{'}+q^{'}+\epsilon) - w^{+}(p^{'}+q^{'}) \quad (13)$$

or that the PWF is steeper in the interval $[p^{'}+q^{'}, p^{'}+q^{'}+\epsilon]$ than in the interval $[p+q, p+q+\epsilon]$.

2.4 Common Consequence Effects in the Losses Domain

We next derive common consequence conditions for the curvature of the PWF in the domain of losses, in the context of CPT. We consider three-outcome lotteries of the form $(p, x; q, y; r, z)$ in which the worst outcome x occurs with probability p, the intermediate outcome y with probability q, and the neutral outcome z with probability $r = 1-p-q$. So now $x < y < z$ and $v(z) = 0$.

In the losses domain, the value function of such three-outcome lotteries may be written as

$$V(f^{-}) = \pi_{x}^{-}v(x) + \pi_{y}^{-}v(y) + \pi_{z}^{-}v(z). \quad (14)$$

From expressions 3 and 5 it follows that $\pi_{x}^{-} = w^{-}(p)$ and $\pi_{y}^{-} = w^{-}(p+q) - w^{-}(p)$. Since $v(z) = 0$,

$$v = w^{-}(p)v(x) + (w^{-}(p+q) - w^{-}(p))v(y). \quad (15)$$

The problem of obtaining common consequence conditions is thus symmetrical in its starting point to that for gains. However, since $v(x) < 0$ and $v(y) < 0$, some of the key inequalities reverse. Moreover, the common consequence shifts we consider, from the worst to the intermediate outcome, give rise to changes in the value of prospects that are not symmetrical to such changes in the domain of gains, as will be seen below.

Consider a choice between safe lottery S, $(p^{'}, x; q^{'}, y)$ and risky lottery R, $(p, x; q, y)$, in which $p^{'} < p$ and $1-p^{'}-q^{'} < 1-p-q$, i.e. the probability of the worst outcome occurring and that of the best (neutral) outcome occurring are both lower in S than in R. By construction, $q^{'} < q$.

[13] Wu and Gonzalez (1998, pp. 125ff.) show that for small ϵ, continuous and twice differentiable $w(.)$, a local condition $w''(p+q) < 0$ is approached as $p^{'}+q^{'} \rightarrow p+q$.

Our interest is in the curvature of w^-, which we infer from the absence or presence of preference reversals between various pairs of lotteries that relate to each other through common consequence shifts in the form of a shift of probability mass from the worst to the intermediate outcome. S_ϵ is thus characterised by $(p^{'} - \epsilon, q^{'} + \epsilon)$ and R_ϵ by $(p - \epsilon, q + \epsilon)$.

Consider the preference reversal $R \prec S$ while $R_\epsilon \succ S_\epsilon$ after the common consequence shift ϵ, $\epsilon > 0$.[14] As before, this implies that $\triangle v = v_\epsilon - v > \triangle v^{'} = v^{'}_\epsilon - v^{'}$. For the risky lottery, the common consequence shift implies that

$$v = w^-(p)v(x) + (w^-(p+q) - w^-(p))v(y) = w^-(p)[v(x) - v(y)] + w^-(p+q)v(y) \tag{16}$$

after the common consequence shift becomes

$$v_\epsilon = w^-(p-\epsilon)v(x) + (w^-(p+q) - w^-(p-\epsilon))v(y) = w^-(p-\epsilon)[v(x) - v(y)] + w^-(p+q)v(y) \tag{17}$$

(since $p - \epsilon + q + \epsilon = p + q$). The increase in value of the risky lottery as a result of the common consequence shift may thus be written as

$$\triangle v = v_\epsilon - v = [w^-(p-\epsilon) - w^-(p)][v(x) - v(y)] > 0, \tag{18}$$

which is strictly positive since $w^-(p - \epsilon) < w^-(p)$ and $v(x) < v(y)$.

Analogously, for safe lotteries S and S_ϵ

$$\triangle v^{'} = v^{'}_\epsilon - v^{'} = [w^-(p^{'}-\epsilon) - w^-(p^{'})][v(x) - v(y)] > 0. \tag{19}$$

Preference reversal $R \prec S$ while $R_\epsilon \succ S_\epsilon$ implies

$$\triangle v > \triangle v^{'} \Leftrightarrow [w^-(p-\epsilon) - w^-(p)][v(x) - v(y)] > [w^-(p^{'}-\epsilon) - w^-(p^{'})][v(x) - v(y)]. \tag{20}$$

Dividing both sides by $[v(x) - v(y)] < 0$ reverses the inequality and gives the following common consequence condition:

$$R \prec S, R_\epsilon \succ S_\epsilon \Rightarrow \triangle v > \triangle v^{'} \Leftrightarrow w^-(p-\epsilon) - w^-(p) < w^-(p^{'}-\epsilon) - w^-(p^{'}). \tag{21}$$

In words, the preference reversal implies that the PWF for losses is steeper in the interval of its domain $[p^{'} - \epsilon, p^{'}]$ than in $[p - \epsilon, p]$. Since $p^{'} < p$, strict concavity in the interval of its domain $[p^{'} - \epsilon, p]$ is a sufficient condition for $w^-(p - \epsilon) - w^-(p) < w^-(p^{'} - \epsilon) - w^-(p^{'})$ but not a necessary condition (cf. the discussion on the corresponding concavity condition in Section 2.3), so we limit our empirical conclusions to the relative steepness of the PWF for interval $[p^{'} - \epsilon, p^{'}]$ compared to that of $[p - \epsilon, p]$.

Working through the same logic for the opposite preference reversal yields the mirroring common consequence condition

$$R \succ S, R_\epsilon \prec S_\epsilon \Rightarrow \triangle v < \triangle v^{'} \Leftrightarrow w^-(p-\epsilon) - w^-(p) > w^-(p^{'}-\epsilon) - w^-(p^{'}) \tag{22}$$

so that the PWF for losses is steeper in the interval $[p - \epsilon, p]$ than in the interval $[p^{'} - \epsilon, p^{'}]$.

[14] Such a common consequence effect occurs in response to a vertical translation of lotteries R and S in Machina's unit probability triangle, and is therefore known as a vertical common consequence effect. See Wu and Gonzalez (1998, p.123) for an example in the gains domain.

We will next show how our experimental design makes use of the common consequence conditions obtained in subsections 2.3 and 2.4 to test the hypotheses presented in subsection 2.2.

3 Experimental Design, Survey and Fieldwork Implementation

In this section, we describe our data collection instruments. We first show how we implemented common consequence ladders in a sample with low levels of literacy, present the lottery choices we designed and provide a rationale for the intervals of probabilities and magnitudes of the common consequence shifts we focused on. Next we describe the steps we took to establish a neutral outcome in subjects' minds in the weeks leading up to the experiment, so that gains and losses were meaningful concepts to them when they chose between lotteries. We then present the other key elements of our experimental design: random assignment to either the gains or losses version of the common consequence ladders, and design choices as to the order of the experimental tasks, a simple control for risk aversion, and the random selection of one task for payment. The experiment was complemented with a survey, which we outline in the last subsection, along with details of sample selection and fieldwork implementation.

3.1 Implementing Common Consequence Ladders

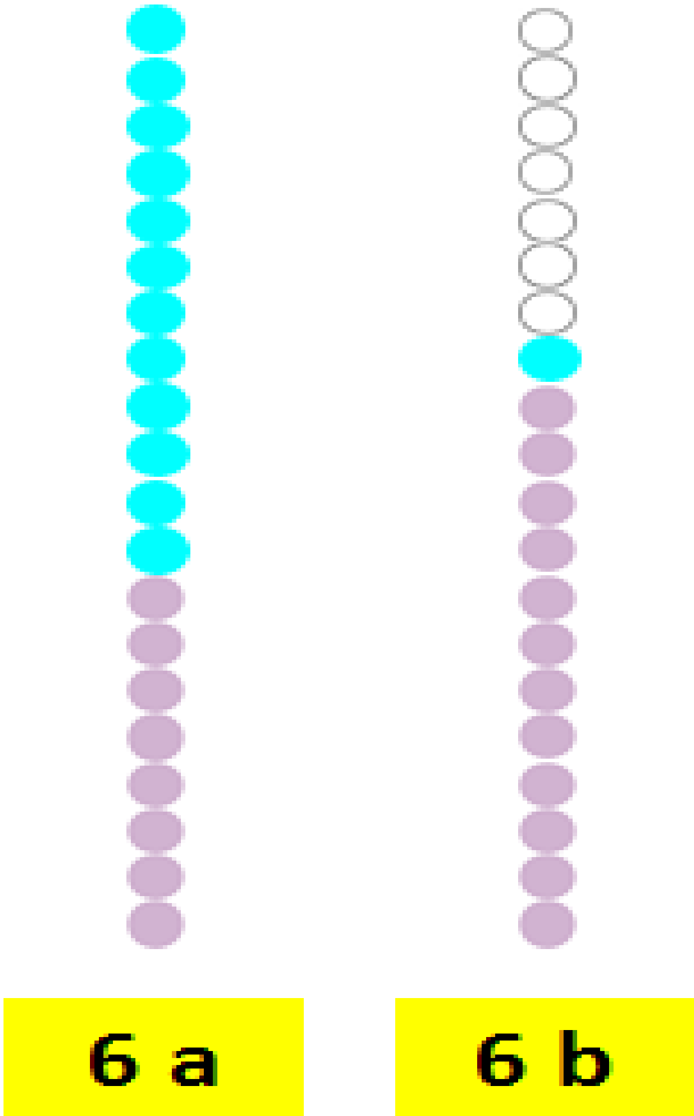
Literacy and the ability to translate visual displays on a computer screen into concrete realisations cannot be guaranteed in the study area, so we needed a device for implementing pairwise lottery choices that does not rely on written instructions, and is concrete and simple. Based on extensive piloting, we settled on the following device. Each lottery was represented by twenty coloured counters. So, for example, lottery 6a in the gains domain (see Table 1) has a .4 chance of the neutral outcome, a .6 chance of the intermediate outcome and a 0 chance of the best outcome. This lottery was represented by 8 lilac counters ($8/20 = .4$) and 12 light blue counters. These were vertically set out on a table in single file so that the 8 lilac counters were neatly arranged at the bottom and the 12 light blue counters on top of those. Underneath that column of counters 6a was clearly written on a large post-it note stuck to the table. About 40 cm next to the column of counters representing lottery 6a, was lottery 6b set out in similar fashion (12 lilac, 1 light blue and 7 white counters). Figure 3 illustrates these two lotteries.

Before they took their decisions, a demonstration was given to subjects of what would happen once they chose one of the two lotteries. All counters representing that lottery would be put in a bag, shuffled thoroughly and one would be picked out by a volunteer looking the other way. The value of the colour of the counter would be paid out to subjects who had chosen that lottery. We demonstrated this both for the relatively safe (6a) and for the relatively risky lottery (6b). A control question designed to capture understanding of the essence of the device revealed that subject comprehension was very good: 96 percent answered it correctly.[15]

We ensured that all paired lotteries were spatially sufficiently apart so that each lottery choice problem would be considered in isolation. For this purpose we used five large tables arranged in the middle of the experiment room. On one side were set out lottery pairs 1 to 5, on the other 6 to 10, with plenty of space left in the middle between the lottery pairs on each side of the table. This arrangement

[15] The control question asked for the gains version of the experiment was: "We just want to check your understanding of the task. Can you please tell me, of the two lotteries here in front of you, which one offers the higher chance of leaving with exactly 10,000 shillings?" For the losses version of the experiment, a very similar control question was asked. See the experimental instructions in the online appendix.

Figure 3: An example of a lottery choice problem



Notes. This represents choice problem 6 in the gains condition of the experiment. Subjects were shown that the counters of the lottery they preferred would be put in a bag, from which one counter would be randomly selected. The value of the outcome that counter represents would be their payment. In the gains condition, lilac counters represented 8,000 Ugandan shillings, light blue counters 10,000 shillings and white counters 13,000 shillings.

not only encouraged considering each choice in isolation, but also greatly facilitated reversing the order in which lottery choices were presented (see subsection 3.4).

3.2 Common Consequence Ladders Implemented

Table 1 presents the common consequence ladder implemented in the gains domain. The first pair of lotteries (on rung I) constitutes the least attractive choice, the next pair (rung II) the least attractive choice but one, and so forth, until the most attractive choice in terms of expected value of the lotteries (rung X). Each pair consists of a relatively safe and a relatively risky lottery, which subjects face in the form of the number of counters of up to three colours presented in the last three columns. The probability of each outcome is indicated in parentheses.

These ten lottery choice problems were determined as follows. The comparison of choices between

Table 1: Common consequence ladder (gains)

Rung	Order	Risky or Safe	Lilac @ 8,000 (z)	Light blue @ 10,000 (y)	White @ 13,000 (x)
I	7a	S	9 ($r^{'}$ =0.45)	11 ($q^{'}$ =0.55)	0 ($p^{'}$ =0)
	7b	R	13 (r =0.65)	0 (q =0)	7 (p =0.35)
II	6a	S	8 (0.4)	12 (0.6)	0 (0)
	6b	R	12 (0.6)	1 (0.05)	7 (0.35)
III	10a	S	7 (0.35)	13 (0.65)	0 (0)
	10b	R	11 (0.55)	2 (0.1)	7 (0.35)
IV	5a	S	6 (0.3)	14 (0.7)	0 (0)
	5b	R	10 (0.5)	3 (0.15)	7 (0.35)
V	2a	S	5 (0.25)	15 (0.75)	0 (0)
	2b	R	9 (0.45)	4 (0.2)	7 (0.35)
VI	3a	S	4 (0.2)	16 (0.8)	0 (0)
	3b	R	8 (0.4)	5 (0.25)	7 (0.35)
VII	4a	S	3 (0.15)	17 (0.85)	0 (0)
	4b	R	7 (0.35)	6 (0.3)	7 (0.35)
VIII	9a	S	2 (0.1)	18 (0.9)	0 (0)
	9b	R	6 (0.3)	7 (0.35)	7 (0.35)
IX	8a	S	1 (0.05)	19 (0.95)	0 (0)
	8b	R	5 (0.25)	8 (0.4)	7 (0.35)
X	1a	S	0 (0)	20 (1)	0 (0)
	1b	R	4 (0.2)	9 (0.45)	7 (0.35)

Notes. The table presents the 10 pairwise lottery choices in the gains condition of the experiment. The number of counters of each colour determines the probability of x (white), y (light blue) and z (lilac); probabilities of outcomes are in parentheses. The first column indicates the rung on the common consequence ladder each pair of lotteries represents; the second column the order in which they were presented (the reverse order for a randomly selected half of subjects).

rungs allows pronouncing on the relative steepness of the PWF for specific intervals of probabilities. For the horizontal common consequence effects we consider, comparisons are between intervals $[p+q, p+q+\epsilon]$ and $[p^{'}+q^{'}, p^{'}+q^{'}+\epsilon]$ with $p^{'}+q^{'} > p+q$ needing to be ensured in the design (see subsection 2.3).

Consider for example a preference reversal between rung I and rung II. $p+q = .35$ refers to the probability of either the white or light blue counter being selected in I.R, $p^{'}+q^{'} = .55$ to the probability of that outcome in I.S, and common consequence shift ϵ is added to the analogous probabilities in II.S and II.R. A preference reversal therefore indicates the relative steepness of the PWF in probability intervals $[.35, .4]$ compared to $[.55, .6]$. Following the same logic, comparing rungs V and VI pronounces on the relative steepness of the PWF in intervals $[.55, .6]$ and $[.75, .8]$, rungs IX and X intervals $[.75, .8]$ and $[.95, 1.0]$, and so forth, for a total number of possible comparisons of $10 * 9/2 = 45$ across each combination of rungs.

Such tracking of the PWF for gains is thus limited to part of its domain $[.35, 1.0]$, which we decided for the sake of realism, avoiding cognitive overload and prioritising more refined measurement to measurement over the entire domain [0, 1.0]. As to realism, farmers' investments in fertiliser, improved seeds and other pertinent agricultural investment goods in Uganda are successful with a probability considerably higher than 0.35 (Verschoor et al., 2016, Table A1, p.147). Avoiding cognitive overload made us decide after piloting that no more than 10 rungs should be implemented and that each lottery should have no more than 20 counters. As to refined measurement, limiting tracking of the PWF to part of its domain $[.35, 1.0]$ meant that we could set $\epsilon = .05$ between each two adjacent rungs in the common consequence ladder for gains.

Table 2: Common consequence ladder (losses)

Rung	Order	Risky or Safe	Lilac @ 3,000 (x)	Light blue @ 5,000 (y)	White @ 8,000 (z)
I	3a	S	14 ($p^{'}$ =0.7)	6 ($q^{'}$ =0.3)	0 ($r^{'}$ =0)
	3b	R	16 (p =0.8)	0 (q =0)	4 (r =0.2)
II	1a	S	13 (0.65)	7 (0.35)	0 (0)
	1b	R	15 (0.75)	1 (0.05)	4 (0.2)
III	6a	S	12 (0.6)	8 (0.4)	0 (0)
	6b	R	14 (0.7)	2 (0.1)	4 (0.2)
IV	9a	S	10 (0.5)	10 (0.5)	0 (0)
	9b	R	12 (0.6)	4 (0.2)	4 (0.2)
V	4a	S	8 (0.4)	12 (0.6)	0 (0)
	4b	R	10 (0.5)	6 (0.3)	4 (0.2)
VI	10a	S	6 (0.3)	14 (0.7)	0 (0)
	10b	R	8 (0.4)	8 (0.4)	4 (0.2)
VII	5a	S	4 (0.2)	16 (0.8)	0 (0)
	5b	R	6 (0.3)	10 (0.5)	4 (0.2)
VIII	2a	S	2 (0.1)	18 (0.9)	0 (0)
	2b	R	4 (0.2)	12 (0.6)	4 (0.2)
IX	7a	S	1 (0.05)	19 (0.95)	0 (0)
	7b	R	3 (0.15)	13 (0.65)	4 (0.2)
X	8a	S	0 (0)	20 (1)	0 (0)
	8b	R	2 (0.1)	14 (0.7)	4 (0.2)

Notes. The table presents the 10 pairwise lottery choices in the losses condition of the experiment. The number of counters of each colour determines the probability of x (lilac), y (light blue) and z (white); probabilities of outcomes are in parentheses. The first column indicates the rung on the common consequence ladder each pair of lotteries represents; the second column the order in which they were presented (the reverse order for a randomly selected half of subjects).

Table 2 presents the common consequence ladder implemented in the losses domain. Pairs of lotteries are again presented in order from the one with the lowest expected values of S and R on rung I to the one with the highest expected value on rung X. For losses, comparisons across paired lotteries are relevant for the relative steepness of the PWF between probability intervals $[p^{'} - \epsilon, p^{'}]$ and $[p - \epsilon, p]$ (see subsection 2.4).

For example, in lottery I.R, $p = .8$ and in lottery I.S, $p^{'} = .7$. When the common consequence shift of size $\epsilon = .05$ is considered between paired lotteries I and paired lotteries II, then $p^{'} - \epsilon = .65$ and $p - \epsilon = .75$. A preference reversal from R to S or S to R between lotteries I and lotteries II thus indicates that the PWF is steeper in one of the two probability intervals $[.65, .7]$ and $[.75, .8]$ than it is in the other.

Following similar logic, comparing choices in V and VI pronounces on the relative steepness of the PWF in intervals $[.3, .4]$ and $[.4, .5]$, comparing choices in IX and X on $[0, .05]$ and $[.1, .15]$, and so forth, again for a total possible number of comparisons of $10 * 9/2 = 45$.

The tracking of the PWF for losses is thus restricted to part of its domain $[0, .8]$. Considerations of realism, refinement where it matters most and avoiding cognitive overload have again inspired this design choice. The last two mentioned are similar to those considerations for gains. As to realism, sharp negative income shocks are common in the study area (see subsection 4.1), which suggests sizeable reference probabilities somewhere in the middle of the PWF's domain (cf. subsection 2.2). In order to reduce the risk of failing to detect reference probabilities, we therefore cast our net somewhat wider than in the gains domain. Moreover, whereas for gains it seemed important to close in on certainty at one end of the PWF's domain (a 100 percent certain gain), for losses it seemed important to close in on certainty at the other end (a zero percent chance of a loss).

The two common consequence ladders presented here are valid to the extent that we have successfully established in subjects' minds that $z = 8,000$ Ugandan shillings is thought of as the neutral outcome. We next show how we attempted this.

3.3 Establishing the Neutral Outcome

Three weeks before a subject was scheduled to participate (see table 3), we gave them a voucher. The voucher contained their name, address and photo, as well as the figure of 8,000 shillings prominently displayed. The following scripted message was read out to participants individually when the voucher was handed over:

> On the day of the research workshop you'll be asked to take some decisions about this money. Depending on the decisions you will be asked to take, you could end up with more than 8,000 or with less than 8,000 shillings.

During the delivery of the experimental instructions three weeks later, the voucher was referred to when the outcome of 8,000 shillings was introduced (see online appendix A, p.8):

> Remember, you have already been given a voucher worth 8,000 shillings. Therefore, if a white counter is eventually drawn, then you do not earn any extra money, but keep your 8,000 shillings.

The vouchers were thus intended to instil a sense of entitlement. Deception was avoided through emphasising that the money could be lost, depending on the decisions subjects were asked to take. In order to avoid disappointment, an unannounced show-up fee of 5,000 shillings was paid after the resolution of the game. The amount of 5,000 shillings was the maximum amount that could be lost in the losses condition. Minimum earnings were therefore 8,000 shillings, or about twice the median daily wage in the study area. Crucially though, the 8,000 shillings mentioned on the voucher could truthfully be lost, exactly as per the experimental instructions that subjects responded to.[16]

3.4 Other Elements of the Experimental Design

Other elements of the design were as follows. We implemented a simple investment game so as to be able to control for risk aversion, based on the Gneezy and Potters (1997) design. Subjects were endowed with 20 counters, each representing 400 shillings, so 8,000 shillings in total. They chose to invest k counters, where $k \in \{0, 1, ..., 20\}$ for facing the lottery $(0.5, 8000 - 400k; 0.5, 8000 + 800k)$. In other words, their investment was tripled if successful and lost in its entirety if it failed.[17] The fate of their investment is determined by tossing a coin. We assume a power Constant Relative Risk Aversion (CRRA) utility function over experimental earnings x, which is defined as $U(x) = x^{1-r}/(1-r)$, where r is the coefficient of CRRA. As is conventional, we compute the CRRA coefficient for indifference

[16] When losses are implemented in experiments, it is customary to either work with hypothetical payoffs (e.g. Etchart-Vincent, 2004; Abdellaoui et al., 2005) or to practise mild forms of deception when implementing real incentives (e.g. Yesuf and Bluffstone, 2009). Both are done for ethical reasons, so as to ensure that subjects have no legitimate grounds for feeling deprived as a result of their participation in the experiment. The implementation of hypothetical losses has been compared in one study with that of real incentives, and little difference was found (Etchart-Vincent and l'Haridon, 2011). Even so, we could not be certain that this would hold in our sample, so we implemented real losses from an initial endowment, while avoiding deception and the house-money effect (Thaler and Johnson, 1990).

[17] The rate of return on investment was calibrated during the pilot for inducing variation in behaviour.

between investing k and $k-1$, on the one hand, and k and $k+1$ on the other, to find the CRRA coefficient range that corresponds with the observed behaviour of investing k. The investment decision was always task 11, so after the 10 lottery choices of the main experiment had taken place.

The random-lottery incentive system was used, so that only one decision was implemented and each of the 11 lottery choices (the decision in the investment game is in effect also a lottery choice) had an equal chance of being played out for real. Subjects were told this before they took their decisions.

The order of the ten paired lottery choices was randomised, both in the gains condition and in the losses condition (see tables 1 and 2). Moreover, whether a subject faced the sequence of lottery choices $1, 2, ..., 10$ or that of $10, 9, ..., 1$ was randomly determined.

Two experimental teams were used for delivering the instructions, who were purposively rotated across sessions and game conditions (see table 3), so that we can control for experimenter effects. The experimental teams are experienced and were intensively trained for two weeks, in addition to their involvement in extensive piloting.

Subjects were randomly assigned to either the gains condition or the losses condition of the experiment in a between-subject design.

Experimental instructions were delivered in person because literacy cannot be guaranteed in the study area. Decision-making was partially private: other subjects were not present but an enumerator recorded choices.

The experimental script was translated into Lugisu, the local language of the study area, and back-translated into English in order to check for inadvertent changes in meanings.

A number of instructions and reassurances were given at the outset to promote orderly, leisurely and autonomous decision-making; see the experimental script in online appendix A.

3.5 Study Area, Sample Selection, Survey and Fieldwork Implementation

We selected five sub-counties from a rural area in eastern Uganda: Sironko District and Lower Bulambuli District, which together comprise the former Sironko District. These sub-counties are sufficiently far apart to avoid cross-contamination between experimental days. This area has a current estimated population size of about 300,000, most of whom are from the Bagisu ethnic group (and if not, have adopted their customs), and a total land area of 1,270 square kilometres.[18] About 95 percent of people are primarily engaged in own-account crop farming, with the remainder typically growing crops as a secondary activity in addition to salaried employment. Average land holdings are about 1.5 acres, there are very few big farmers in the region, and irrigation use is low.

Sample selection took place during June-August and data collection during September-December 2012. We randomly selected within each sub-county 10 villages. In each village, we organised the compilation of a list of all adult (18+) members by household and randomly selected up to 20 adults (some villages had fewer than 20 eligible adults) subject to the constraint of no more than one participant per household. We ensured that both devising the sampling frame and the random selection process were witnessed by a broad representation of village members, to encourage trust in the fairness of the selection process. We assessed availability of the randomly selected individuals and randomly replaced them if necessary (in 5.9 percent of cases). Of the individuals selected for participation, 370 were randomly assigned to the common consequence experiments, 184 of them to the gains condition,

[18] The information presented in this paragraph is taken from the District Local Government Five Year District Development Plans (2010/11 - 2014/15) for Sironko and Bulambuli.

186 to the losses condition.[19]

Data collection followed the same basic pattern in each sub-county. Three weeks before their relevant experimental session, individuals were visited, reminded about their participation and given the voucher described in subsection 3.3. In the week before 'game day' we visited all selected participants again to administer a household survey questionnaire, in order to collect data on basic socio-economic variables, agricultural practices, and the experience of income shocks. The experiment then took place at the end of the week in a central location (usually in a school on a non-school day); for participants from remote villages, we organised transport.

Table 3: Experimental sessions

Date	Time	Sub-county	Condition	Team	Observations (reverse order)
Oct. 1, 2012	a.m.	Bwikhonge	Gains	1	20 (10)
Oct. 1, 2012	a.m.	Bwikhonge	Losses	2	20 (8)
Oct. 1, 2012	p.m.	Bwikhonge	Gains	2	20 (7)
Oct. 1, 2012	p.m.	Bwikhonge	Losses	1	18 (10)
Oct. 8, 2012	a.m.	Bulegeni T.C.	Gains	1	18 (10)
Oct. 8, 2012	a.m.	Bulegeni T.C.	Losses	2	20 (12)
Oct. 8, 2012	p.m.	Bulegeni T.C.	Gains	2	21 (13)
Oct. 8, 2012	p.m.	Bulegeni T.C.	Losses	1	20 (13)
Oct. 15, 2012	a.m.	Simu	Gains	1	13 (7)
Oct. 15, 2012	a.m.	Simu	Losses	2	14 (7)
Oct. 15, 2012	p.m.	Simu	Gains	2	16 (8)
Oct. 15, 2012	p.m.	Simu	Losses	1	16 (8)
Oct. 22, 2012	a.m.	Bukiise	Gains	1	22 (7)
Oct. 22, 2012	a.m.	Bukiise	Losses	2	21 (10)
Oct. 22, 2012	p.m.	Bukiise	Gains	2	20 (6)
Oct. 22, 2012	p.m.	Bukiise	Losses	1	20 (14)
Oct. 29, 2012	a.m.	Buhugu	Gains	1	19 (9)
Oct. 29, 2012	a.m.	Buhugu	Losses	2	18 (10)
Oct. 29, 2012	p.m.	Buhugu	Gains	2	15 (8)
Oct. 29, 2012	p.m.	Buhugu	Losses	1	19 (9)
		Total	Gains		184 (85)
		Total	Losses		186 (95)
		Total			370 (180)

Notes. Experiments were administered on five Saturdays in October 2012. Sub-counties are sufficiently far apart to avoid cross-contamination between experimental days. In order to avoid cross-contamination between sessions on the same experimental day, subjects in the morning sessions were kept waiting in a separate area until the afternoon sessions subjects had entered the experimental venue. Subjects were randomly assigned to the gains or losses condition, and to the 1-10 order or the 10-1 order of the experimental tasks. To control for experimenter effects, two experimental teams were purposively rotated.

4 Results

In this section, we present our main results. We first show summary statistics and ascertain whether condition assignment has given rise to inadvertent selection issues. Next, we analyse common consequence effects in the gains and losses domain, respectively, and derive the shape of the PWFs (one

[19] Other selected individuals participated in experiments not reported on in this paper.

for losses, one for gains) that organise the data. Finally, we present the results of multivariate analysis that searches for correlates of the particularly pronounced nonlinear probability weighting that the univariate analysis has pointed to.

4.1 Sample Characteristics

We begin by describing our sample and assess differences on observables between game conditions. Table 4 presents summary statistics and a corresponding balancing test. About 30 percent of subjects are traditional farmers. We consulted agricultural experts in the study area in order to define traditional farmers.[20] Traditional farmers grow maize intercropped with beans, with a minimal reliance on bought inputs such as improved seeds, pesticides and inorganic fertiliser; if they do buy inputs, then this would be limited to purchasing unimproved seeds on local markets. We therefore classified all subjects as traditional farmers who grow only maize and beans and do so without buying improved seeds, pesticides or fertiliser. All other subjects either buy such inputs or grow cash crops that are more lucrative than maize and beans but require higher cash outlays (e.g. tomatoes, cabbages and onions) or both. According to the local experts, traditional farmers avoid initial cash outlays so as not to jeopardise their food security in periods of drought or excessive flooding. This is a recognised motive in development economics (Fafchamps, 2003, pp.18ff.).

The wealth index presented in the table is the first component of a principal component analysis based on a list of about 30 types of assets that our survey collected information on (this method of constructing a wealth index is due to Filmer and Pritchett (2001)). Risk aversion is measured using the constant relative risk aversion (CRRA) coefficient based on behaviour in the investment game presented in subsection 3.4.

We asked several questions about income shocks. The way we asked these questions was by inquiring whether respondents had experienced a sharp drop in income in the past five years as a result of specified events. 77 percent had experienced a sharp drop in income resulting from harvest failure, 59 percent from severe flooding and 84 percent from a severe drought. Farmers in the sample are clearly used to frequent sharp income shocks.

Most variables in table 4 are nog significantly different between game conditions, but two variables are. One is the wealth index. We think this should be due to chance, as the random assignment to game condition was rigorously carried out. Game comprehension is the other variable that is significantly different between game conditions: 99 percent answered the control question correctly in the gains condition and 93 percent in the losses condition, which is significantly different at the 10 percent level. This could well be due to the differences between the game versions, with the losses instructions possibly slightly harder to understand. Reassuringly, the omnibus χ^2-statistic of a test of all ten slopes being equal to zero in a logistic regression of condition assignment on the variables presented in the table is insignificant ($\chi^2 = 10.8$, $p = .46$), suggesting that inadvertent selection is not a major concern.

4.2 Tracking the PWF

We next present the choice patterns that the common consequence shifts have given rise to, and show the shapes of the PWFs, one in the gains and one in the losses domain, that organise the data. In table 5, we show the choice patterns in the gains domain. We limit the analysis to choice patterns

[20] These agricultural experts were interviewed individually and included the District Agricultural Officer, several agricultural extension workers, and several leaders of farmers' groups.

Table 4: Summary statistics and balancing test

Variable	Mean (Standard deviation) Total (*N=370*)	Gains condition (*N=184*)	Losses condition (*N=186*)	*t*-statistic	*p*-value
Traditional farmer (=1)	.30	.30	.31	-.12	.90
	(.46)	(.46)	(.46)		
Wealth index	.06	-.20	.31	-2.06	.04
	(2.38)	(1.88)	(2.77)		
Risk aversion (CRRA)	1.29	1.40	1.17	1.10	.27
	(2.01)	(2.26)	(1.74)		
Female (=1)	.52	.55	.48	1.31	.20
	(.50)	(.50)	(.50)		
Years of schooling	5.46	5.37	5.55	.49	.62
	(3.59)	(3.51)	(3.68)		
Age	40.85	40.50	41.20	.48	.63
	(14.03)	(14.45)	(13.63)		
Harvest failed	.77	.78	.75	.65	.52
in past 5 years (=1)	(.42)	(.41)	(.43)		
Experienced severe flooding	.59	.60	.58	.40	.69
in past 5 years (=1)	(.49)	(.49)	(.50)		
Experienced severe drought	.84	.85	.83	.49	.62
in past 5 years (=1)	(.37)	(.36)	(.38)		
Control question correct (=1)	.96	.99	.93	1.87	.06
	(.31)	(.35)	(.26)		

Notes. The table presents summary statistics and a test of the null hypothesis that mean values are equal by game condition. In a logistic regression of condition assignment on all variables presented in the table, the null hypothesis of all coefficients being jointly equal to zero cannot be rejected ($\chi^2 = 10.8; p = .46$).

between adjacent rungs on the common consequence ladder. There are four possible combinations when two rungs are considered: twice safe (SS), twice risky (RR), first safe then risky (SR), and first risky then safe (RS). SS and RR are consistent with expected utility theory, while SR and RS are not and point to nonlinear probability weighting. So for example, when choosing between the paired lotteries first on rung I and then on rung II, 31.7 percent of subjects chose the safe lottery in each choice problem, 39.9 percent the risky lottery both times, 12.0 percent chose the safe lottery on rung I and the risky lottery on rung II, and 16.4 percent chose the risky lottery on rung I and the safe lottery on rung II.

Using a test based on the binomial distribution, we test whether SR is significantly different from RS for each of the nine steps between adjacent rungs. In the example of the step from rung I to rung II, RS is significantly higher than SR ($p = .05$). As demonstrated in subsection 2.3, this points to nonlinear probability weighting. The probabilities for which this may be inferred are spelt out in the final column of table 5. In total there are four significant common consequence effects at the 10 percent level: the PWF is less steep for probabilities $[.35, .4]$ than for $[.55, .6]$, less steep for $[.55, .6]$ than for $[.75, .8]$, steeper for $[.6, .65]$ than for $[.8, .85]$, and less steep for $[.65, .7]$ than for $[.85, .9]$.

A PWF that is consistent with these common consequence effects would be convex from .35 to .65, concave from .65 to .85, and convex from .85 to 1. It would thus be particularly steep around inflection point .65 and when approaching 1.0, which suggests two reference probabilities.

In the losses domain, there are also four significant common consequence effects (table 6). These demonstrate that the PWF is steeper for probabilities $[0, .05]$ than for $[.1, .15]$, less steep for $[.05, .1]$ than for $[.15, .2]$, steeper for $[.3, .4]$ than for $[.4, .5]$, and less steep for $[.6, .65]$ than for $[.7, .75]$. The PWF in the losses domain that organises the data is concave from 0 to .15, convex from .15 to .3, concave from .3 to .6 and convex from .6 to .8. It is thus particularly steep immediately when the probability of losses becomes strictly positive and around .3. This suggests the reference probabilities of 0 and .3.

Table 5: Common consequence effects between adjacent rungs (gains)

	Responses (Percentage)					
Rungs	SS	RR	SR	RS	p-value	Inference
I-II	31.7	39.9	12.0	16.4	.05*	$w(.4) - w(.35) < w(.6) - w(.55)$
II-III	35.0	41.5	13.1	10.4	.14	$w(.45) - (w.4) \approx w(.65) - w(.6)$
III-IV	30.1	36.1	15.3	18.6	.12	$w(.5) - w(.45) \approx w(.7) - w(.65)$
IV-V	31.7	35.0	16.9	16.4	.51	$w(.55) - w(.5) \approx w(.75) - w(.7)$
V-VI	37.1	36.1	10.9	15.9	.03**	$w(.6) - w(.55) < w(.8) - w(.75)$
VI-VII	34.4	33.3	18.6	13.7	.04**	$w(.65) - w(.6) > w(.85) - w(.8)$
VII-VIII	36.6	36.6	11.5	15.3	.07*	$w(.7) - w(.65) < w(.9) - w(.85)$
VIII-IX	36.1	35.0	15.9	13.1	.15	$w(.75) - w(.7) \approx w(.95) - w(.9)$
IX-X	32.8	34.4	16.4	16.4	.59	$w(.8) - w(.75) \approx w(1.0) - w(.95)$

Notes. $N = 184$. Responses columns show the proportion of each of the four possible choice patterns between paired lotteries on adjacent rungs of the common consequence ladder in the gains domain. p-values are reported for a test based on the binomial distribution that $SR = RS$. * denotes rejection of the null at the 10 percent level, and ** at the 5 percent level.

Table 6: Common consequence effects between adjacent rungs (losses)

	Responses (Percentage)					
Rungs	SS	RR	SR	RS	p-value	Inference
I-II	24.0	48.6	12.6	14.8	.22	$w(.7) - w(.65) \approx w(.8) - w(.75)$
II-III	25.1	43.7	13.6	17.5	.09*	$w(.65) - w(.6) < w(.75) - w(.7)$
III-IV	28.8	44.6	13.6	13.0	.47	$w(.6) - w(.5) \approx w(.7) - w(.6)$
IV-V	25.0	38.0	16.9	20.1	.16	$w(.5) - w(.4) \approx w(.6) - w(.5)$
V-VI	25.5	41.9	20.0	13.0	.01***	$w(.4) - w(.3) > w(.5) - w(.4)$
VI-VII	21.7	41.9	16.9	19.6	.20	$w(.3) - w(.2) \approx w(.4) - w(.3)$
VII-VIII	26.1	40.2	15.2	18.5	.15	$w(.2) - w(.1) \approx w(.3) - w(.2)$
VIII-IX	33.2	37.0	11.4	18.5	.01***	$w(.1) - w(.05) < w(.2) - w(.15)$
IX-X	31.0	32.1	20.7	16.3	.08*	$w(.05) - w(0) > w(.15) - w(.1)$

Notes. $N = 186$. Responses columns show the proportion of each of the four possible choice patterns between paired lotteries on adjacent rungs of the common consequence ladder in the losses domain. p-values are reported for a test based on the binomial distribution that $SR = RS$. * denotes rejection of the null at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

4.3 Multivariate analysis of nonlinear probability weighting

The probability weighting near the end points of $p = 0$ (losses) and $p = 1$ (gains) is particularly pronounced and interesting. In context, they are plausible. When the probability of a loss rises from zero to non-zero, or when the probability of a gain falls from unity to less than unity, subsistence farmers would mind this particularly for real-life decisions since their livelihoods are at stake. We next investigate whether traditional farmers exhibit such probability weighting more than others. If a traditional farmer is affected more than others by the probability of a loss rising from zero to something slightly larger than zero, then this would help explain why such a farmer is not as entrepreneurial as the non-traditional farmers. Likewise, if a traditional farmer is affected more than others by the probability of a gain falling from unity to something slightly lower than unity, then this would equally help explain the avoiding of risky investment prospects. In other words, if convexity of the PWF near $p = 1$ in the gains domain and concavity near $p = 0$ in the losses domain are found especially among traditional farmers, then this hints at the external validity of our experimental game.

For this analysis, we use choice patterns on the final rungs, with SR pointing to convexity near $p = 1$ in the gains domain and to concavity near $p = 0$ in the losses domain (see tables 5 and 6). In a probit regression of a dummy that takes the value 1 for SR on the final rungs, the traditional farmer dummy is significant at the 5 percent level, both in the gains domain and in the losses domain (table 7). This suggests that traditional farmers exhibit the sort of probability weighting that would help explain lower investment than their peers.

5 Discussion

In this section, we begin by presenting our results in terms of our hypotheses and the related literature on probability weighting. We then reflect on the implications of the probability-weighting habits we have uncovered. In particular, we discuss their relevance for an old idea in development economics: that subsistence farmers pursue a safety-first algorithm in their livelihoods decisions.

5.1 Nonlinear Probability Weighting

To recapitulate the discussion in subsection 2.2, the dominant probability weighting found in Western labs is that according to an inverse S; see the reviews of the many studies of probability weighting in Wu and Gonzalez (1996, 1998); Prelec (1998); Gonzalez and Wu (1999); Starmer (2000); Sugden (2004); Stott (2006); Fehr-Duda and Epper (2012), whereas studies that report exceptions to the common finding of an inverse S-shaped PWF are listed in Blavatsky (2006). This is consistent with Kahneman and Tversky (1979)'s and Tversky and Kahneman (1992)'s principle of diminishing sensitivity relative to reference probabilities $p^* = 0$ and $p^* = 1$. The evidence on probability weighting in developing countries is scarce. Imposing Prelec (1998)'s functional form, Tanaka et al. (2010) find evidence for an inverse S-shaped PWF in a rural sample from Vietnam. Adopting the methodology developed by Tanaka et al. (2010), Liu (2013) also finds evidence for an inverse S-shaped PWF, in a sample of Chinese cotton farmers. By contrast, Humphrey and Verschoor (2004a,b), in five rural samples from Ethiopia, Uganda and India find evidence for an S-shaped PWF. As in our study, they use common consequence shifts to investigate nonlinear probability weighting. Unlike in our study, the probabilities they consider are limited to 0, .25, .5, .75 and 1. Moreover, they do not study losses.

The findings of the present study add new knowledge about the probability weighting habits

Table 7: Probability weighting near $p = 0$ and $p = 1$: Regression analysis

	Dependent variables	
Variable	Convex near $p = 1$ (gains)	Concave near $p = 0$ (losses)
Traditional farmer (=1)	.13**	.18**
	(.07)	(.09)
Wealth index	.02*	.00
	(.01)	(.02)
Risk aversion (CRRA)	.01	-.03
	(.01)	(.03)
Female (=1)	-.00	-.06
	(.05)	(.08)
Years of schooling	.00	-.02
	(.00)	(.01)
Age	.00	-.01*
	(.00)	(.00)
Harvest failed in past 5 years (=1)	.02	.17*
	(.06)	(.09)
Experienced severe flooding in past 5 years (=1)	-.04	-.12
	(.07)	(.10)
Experienced severe drought in past 5 years (=1)	-.08	.15
	(.11)	(.13)
Order 1-10 (=1)	-.10*	-.07
	(.05)	(.08)
Experimenter team (=1 for team 1, 0 for team 2)	-.06	.25
	(.12)	(.19)
Control question correct (=1)	.04	-.08
	(.05)	(.15)
N	176	184
Pseudo R^2	0.16	0.10

Notes. Probit regression, reporting marginal effects, for the 360 subjects for whom complete survey data is available (176 subjects in the gains condition, 184 in the losses condition); robust standard errors are in parentheses; session fixed effects were used (not reported in the table). ***, **, * indicate two-sided significance levels at 1 percent, 5 percent and 10 percent respectively.

of people in developing countries. They are usefully summarised in terms of our hypotheses (see subsection 2.2). The first two hypotheses assume diminishing sensitivity relative to $p^* = 0$ and $p^* = 1$, giving rise to an inverse S-shaped PWF. Hypothesis 1 states that the PWF is concave for probabilities $[0, p^y)$. For gains we have not investigated this (see subsection 3.2 for the reasons). For losses, we found that the PWF is concave for probabilities $[0, .15]$, confirming hypothesis 1. Moreover, we found that this concavity is more pronounced for traditional farmers, who avoid lucrative but risky investment opportunities in real life.

Hypothesis 2 states that the PWF is convex for probabilities $(p^y, 1]$. For losses, we have not investigated this (see again subsection 3.2 for the reasons). For gains, we find convexity for probabilities $[.85, 1]$, confirming hypothesis 2. However, we find concavity for $[.65, .85]$, rejecting the assumption underpinning hypotheses 1 and 2 of a unique inflection point.

Hypotheses 3 and 4 assume diminishing sensitivity relative to reference probability $p^*, 0 < p^* < 1$, giving rise to an S-shaped PWF. Hypothesis 3 states that the PWF is concave for probabilities

$(p^y, 1]$. For gains, this is rejected, as we find convexity for $[.85, 1]$. Moreover, convexity of the PWF approaching $p = 1$ is found to be particularly pronounced for traditional farmers. For losses, we have not investigated this, as mentioned above. Finally, hypothesis 4 states that the PWF is convex for probabilities $[0, p^y)$. For gains this has not been investigated, and for losses we reject hypothesis 4, as the PWF is found to be concave for $[0, .15]$.

Overall, we find support for probability weighting that is consistent with multiple reference probabilities. For gains, these are $p^* = .65$ and $p^* = 1$. $p^* = .65$ on its own would give rise to an S-shaped PWF, while $p^* = 1$ is consistent with an inverse S-shape. For losses, these are $p^* = 0$ and $p^* = .3$. $p^* = 0$ is consistent with an inverse S-shape, while $p^* = .3$ on its own would generate an S. Because of multiple reference probabilities, we find neither an S-shaped PWF nor an inverse S-shaped PWF, but a shape with two steep stretches: approaching 1.0 and around .65 for gains, departing from 0 and around .3 for losses. It is important to note that proposed parametric forms for the PWF in the literature do not accommodate these shapes (see the overview in Fehr-Duda and Epper (2012, subsection 3.6)).

5.2 Consistency with a Survival Algorithm

We next discuss the implications of the probability weighting habits we uncovered for an idea that was floated in development economics in the late 1960s and widely circulated in the 1970s: that poor farmers in developing countries pursue a survival or safety-first algorithm, also known as a subsistence ethic (Lipton, 1968; Roumasset, 1976; Scott, 1976). The idea can be articulated in many ways; one would be to say that farmers maximise expected profits subject to a probability constraint on disastrous outcomes. Disastrous outcomes are those that cause consumption to fall below a subsistence (or survival) threshold.

In its extreme form, the algorithm prescribes the absolute avoidance of dangerous outcomes. Even highly lucrative opportunities may then be shunned if they entail a nonzero probability of a disastrous outcome. For farmers whose normal consumption is on or very near the subsistence threshold, this would mean avoiding all investment prospects that are more profitable but which also have a higher variance of income than traditional agriculture. In our study area, the main investments that are available to farmers (fertiliser, pesticides, improved seeds, growing cash crops) are all characterised by a higher expected value and higher variance of profits than the traditionally practised semi-subsistence agriculture (Verschoor et al., 2016). A safety-first algorithm would prescribe to traditional farmers whose consumption is close to the subsistence threshold that these investments are not undertaken.

The concavity of the PWF near $p = 0$ in the losses domain is consistent with this prescription: reducing the probability of a loss to zero is particularly meaningful since a practitioner of a safety-first algorithm can now accept the prospect. For the same reason, the convexity of the PWF near $p = 1$ in the gains domain is consistent with a safety-first algorithm: an investment prospect whose success is not guaranteed must be shunned by a practitioner of the algorithm, but may be embraced when success becomes certain.

The interpretation of the probability weighting habits near $p = 0$ (losses) and near $p = 1$ (gains) as pointing to a safety-first algorithm is made more plausible by our finding that the PWF of traditional farmers exhibits more curvature near these end points than that of others. The closing in on certainty is particularly attractive for them, which would make sense if a safety-first algorithm is responsible for their abstaining from investment in their livelihoods decisions. The influence of a safety-first algorithm thus helps explain the reference probabilities of zero and one.

By contrast, the reference probabilities of .3 (losses) and .65 (gains) that our findings point to would be consistent with the behaviour of farmers who are in the habit of investing. A picture of no investment is far from accurate in eastern Uganda: 65 percent of farmers buy fertiliser for the growing of their crops, 31 percent grow cash crops, despite great income volatility and sizeable probabilities of investment losses (Verschoor et al., 2016, p.140). The reference probabilities we find suggest that a farmer would particularly register the probability of a loss, or the probability of *not* realising a gain, deviating from about a third (.3 for losses; $1 - .65 = .35$ for gains). Diminishing sensitivity relative to these reference probabilities would help explain the investment habits of those who harden themselves against the frequent losses and unrealised gains that are to be expected in the hazardous environment of a rural area of a sub-Saharan African country.

6 Conclusion

In this study we investigated the probability weighting habits of farmers from eastern Uganda. Almost all of these farmers operate on a very small scale. About a third of these farmers are traditional in the sense that we have defined it: they avoid the inputs and crops that require more investment than the food crops grown in the traditional way. The non-traditional livelihoods strategies they avoid are more lucrative but jeopardise food security in periods of drought or excessive rainfall.

We find evidence of multiple reference probabilities. The reference probabilities of 0 and 1 are consistent with an inverse S-shaped probability weighting function (PWF). In that respect, our findings are similar to the bulk of the evidence from Western labs. However, we also find evidence of medium-sized reference probabilities. These, were it not for the simultaneous influence of the reference probabilities of 0 and 1, would produce an S-shaped PWF. In that respect, our findings are similar to earlier studies of probability weighting in developing countries.

We investigated probability weighting separately in the gains domain and in the losses domain. Both the concavity of the PWF we find near 0 in the losses domain and the convexity of the PWF we find near 1 in the gains domain are consistent with a safety-first or survival algorithm. This interpretation is reinforced by our finding that traditional farmers exhibit the probability weighting habits just mentioned more than others in the sample.

We find evidence for a reference probability of .3 in the losses domain and of .65 in the gains domain. This suggests two things. First, the shape of the PWF is different for losses than it is for gains, which underscores the importance of investigating probability weighting in these two domains separately. Second, they are both about a third away from the relevant probability representing certainty: certainly no losses (0 percent), certainly gains (100 percent). “Safety first” is therefore not the whole story. Plausibly, the all-pervasive nature of risk causes probabilities of gains and losses to be evaluated relative to “normal” levels of danger. Investing in agriculture means habitually taking risk, the more so in Africa, which appears to translate into medium-sized reference probabilities. This could help explain why our findings are different to those typically obtained in Western labs.

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ONLINE APPENDIX A (NOT FOR PUBLICATION): EXPERIMENTAL SCRIPT

Gains version

Setting up

[Experimenters to set up the room as follows, before any subjects arrive. Place five tables around the room, evenly spaced. On each, place two pairs of lotteries, where each lottery consists of 20 coloured counters. Group the counters together by colour so that the subject can easily see how many of each colour of counter is in each lottery.

The lotteries and tables should be placed in such a way that a subject by first walking along the tables on one side, and then back along the tables on the other side, encounters the pairs of lotteries in the order given below.

The chart below shows how many of which colours of counters to include in each lottery. Lotteries 1a and 1b will be placed on the first table and so on. Place labels with the lottery numbers written on them next to each lottery.

Table number	Lottery number	Number of lilac counters	Number of light blue counters	Number of white counters
1	1a	-	20	-
	1b	4	9	7
2	2a	5	15	-
	2b	9	4	7
3	3a	4	16	-
	3b	8	5	7
4	4a	3	17	-
	4b	7	6	7
5	5a	6	14	-
	5b	10	3	7
5	6a	8	12	-
	6b	12	1	7
4	7a	9	11	-
	7b	13	0	7
3	8a	1	19	-
	8b	5	8	7
2	9a	2	18	-
	9b	6	7	7
1	10a	7	13	-
	10b	11	2	7

For example, the third table will on one side have two lotteries on it, one consisting of a group of 4 lilac counters and 16 light blue counters, with the lottery number 3a next to it; the other consisting of 6 lilac counters, 7 light blue counters and 7 white counters, with the lottery number 3b next to it.

On the other side, the third table will again have two lotteries on it, one consisting of a group of 1 lilac counter and 19 light blue counters, with the lottery number 8a next to it; the other consisting of 3 lilac counters, 10 light blue counters and 7 white counters, with the lottery number 8b next to it.]

Common consequence ladders: gains version

Welcome and general introduction

Welcome. Thank you for taking the time to come today. [Introduce Experimenters and Assistants] You can ask any of us questions during today's programme.

We have invited you here, today, because we want to learn about how people in this area take decisions. You are going to be asked to take decisions about money. The money that results from your decisions will be yours to keep.

What you need to do will be explained fully in a few minutes. But first we want to make a couple of things clear.

First of all, this is not our money. We belong to a university, and this money has been given to us for research.

Participation is voluntary. You may still choose not to participate in the exercise.

We also have to make clear that this is research about your decisions. Therefore you cannot talk with others. This is very important. I'm afraid that if we find you talking with others, we will have to send you home, and you will not be able to earn any money here today. Of course, if you have questions, you can ask one of us. We also ask you to switch off your mobile phones.

Make sure that you listen carefully to us. You will be able to make a good amount of money here today, and it is important that you follow our instructions.

During today's programme, you will be asked to make one or more choices, which will be explained to you very clearly. Only one of your choices will be selected to determine the money you will be paid. At the end of the exercise, we will randomly select one of your decisions to be paid out. Any money you earn will be paid out to you privately and confidentially after all parts of the exercise are complete.

Now, before we explain what you need to do, it is really important to bear one more thing in mind. You will be asked to take decisions that are not a matter of getting it right or wrong; they are about what you prefer. However, it is important to think seriously about your choices because they will affect how much money you can take home.

There are two parts to today's programme. In both parts you will be asked to take decisions. Only one of the decisions will be selected. You will be told which decision that is at <u>the</u> end, and that decision determines how much money you take home. However, you will only find out which decision is selected at the end, so with every decision you take, remember: for all you know**, this could be the one that determines how much money you take home**.

We will now start with explaining part 1. When you've finished taking all decisions related to part 1, we will start explaining part 2. You will make 10 decisions in Part 1 and 1 decision in Part 2 so 11 decisions in total. After you have made all decisions, one decision will be selected by drawing one counter from a bag with 11 numbered counters so that each decision is exactly as likely to be selected as any other. Therefore, each decision could be the one that determines how much money you take home.

Common consequence ladders: gains version

Part 1

[For a randomly selected half of the subjects, choice problems 1-10 are played in the order presented above; in the other half, they are played in the reverse order. This will be indicated on each subject's data entry sheet.

These instructions should be delivered to all subjects together.]

"As you can see, there are five tables. On each side of a table you will be asked to make a choice between two lotteries, meaning that you will make ten choices in total."

"Each lottery consists of 20 counters of different colours. Each counter is worth a different amount of money. Lilac counters are worth 8000 Shillings, light blue counters are worth 10,000 Shillings, and white counters are worth 13,000 Shillings. Remember, you have already been given a voucher worth 8000 Shillings. Therefore, if a lilac counter is eventually drawn, then you do not earn any extra money, but keep your 8000 Shillings. If a light blue counter is drawn, then you keep your 8000 Shillings, and receive an additional 2000 Shillings. Finally, if you draw a white counter, then you keep your 8000 Shillings, and receive an additional 5000 Shillings, meaning you would leave with 13,000 Shillings in total. If you want to check the values of the counters at any time, please refer to the poster on the wall, here **[indicate poster]**."

"On each table, one lottery will have more lilac counters than the other, but it will also have more white counters than the other. This means that if you select that lottery instead of the other one, you have a higher chance of only leaving with 8000 Shillings in total, but you also have a higher chance of leaving with 13,000 Shillings."

"If one of your decisions from Part 1 is selected at the end of the programme, all of the counters from the lottery you choose will be placed into a bag, and one will be drawn at random. If it is lilac, you earn 8000 Shillings, if it is light blue you earn 10,000 Shillings, and if it is white you earn 13,000 Shillings. Let me demonstrate how this is done."

[Lead the subjects to the fifth table on the side where lotteries 6a and 6b are displayed]

"For example, on this table, one lottery consists of 8 lilac counters and 12 light blue counters. The other consists of 12 lilac counters, 1 light blue counter, and 7 white counters. If you select the first lottery, lottery 6a, you have a chance of leaving with either 8000 or 10,000 Shillings. If you select the second lottery, lottery 6b, you are more likely to leave with 8000 Shillings because it contains 12 lilac counters rather than 8. However, you are also more likely to leave with 13,000 Shillings, because there are 7 white counters in lottery a, and none in lottery b. Therefore, you must choose which lottery is preferable to you, a or b; there are no right or wrong choices."

[Now demonstrate how we will draw a counter at the end if choice problem 6 were selected:

- **First put 8 lilac counters and 12 light blue counters in a bag and explain that this would happen for everybody who had chosen lottery 6a.**
- **Then shake the bag and ask a volunteer to draw a counter. If it is lilac, explain that this would mean the subject goes home with 8000 shillings. If it is light blue, 10,000 shillings.**
- **Next put 12 lilac counters, 1 light blue counter and 7 white counters in a bag and explain that this would happen for everybody who had chosen lottery 6b.**
- **Then shake the bag and ask a volunteer to draw a counter. If it is lilac, explain that this would mean the subject goes home with 8000 shillings. If it is light blue, 10,000 shillings. If it is white, 13,000 shillings.]**

"Do you have any questions about how the tasks will work?"

Common consequence ladders: gains version

[Answer any questions as clearly and accurately as possible; then ask all subjects to wait outside of the experiment room. An experimenter or assistant should bring the first subject into the experiment room, and then lead subject to their appropriate first choice problem]

“We just want to check your understanding of the task. Can you please tell me, of the two lotteries here in front of you, which one offers the higher chance of leaving with exactly 10,000/=? **[Record whether subject’s answer was correct or not, offer explanation if their first answer was incorrect.]**

If you have no further questions, we will now begin. Please choose which of the two lotteries on this table you would prefer. When you have made your decision, point to the one you have chosen, and I will record your choice”

[Wait for subject to make their choice, and record it; then do the same for all other choice problems in the order relevant for this session]

Part 2

[A table is set up as follows. On its top are a beaker that can be closed with a lid, a coin with paper tightly wrapped around and affixed to it with the letter A clearly written on one side, B on the other, and 20 individual counters spread out]

[Invite all subjects into the room to explain the following instructions to them as a group.]

We now begin part 2 of today’s programme. There are 20 counters spread out on this table. Each counter is worth 400 Shillings so 20 times 400 equals 8,000 shillings. These 20 counters represent the 8,000 shillings on the voucher which you have been given a few weeks ago. That money is yours and you can do with it exactly what you like.

For example, you could decide to do nothing with it. That means we give you 8,000 actual shillings and you can take those 8,000 shillings home.

But we’re also giving you the opportunity to invest some or all of that money. Let me show you what happens if you decide to invest.

For example, let’s say you decided to invest 4,000 shillings. You would then take 10 counters (remember, each counter represents 400 shillings) and you would place them here, right next to the beaker.

Now, we would then toss this coin that has A written on one side and B on the other. We put it in the beaker, put the lid on top, shake it and then we put the beaker upside down, like this; we remove the beaker: and which side of the coin shows?

It’s [A/B]. That means the investment [is successful/failed]. So there are 2 possibilities: the investment can succeed or fail. It succeeds when A comes up; it fails when B comes up. Now let me explain what success and failure mean.

If the investment succeeds, we triple what you have invested. So since you had invested 4,000, we give you back three times 4,000 equals 12,000 **[count out cash next to invested counters]**. We add that to the money you had not invested (4,000) **[count out cash next to uninvested counters]**, so you go home with 4,000 + 12,000 = 16,000 **[count out total cash].**

Now, what happens if the investment fails? Your investment failing means you lose all of it. In this case you go home with the money that you didn't invest. So you will take home 4,000 **[count out cash next to uninvested counters]**

So remember, if your investment succeeds (that is when A comes up) you receive three times the amount you invested PLUS the money you did not invest. And if your investment fails (that is when B comes up), you keep the money you did not invest, but nothing else. I´ll give you a few more examples of how that would work out.

- If you decide to invest 3 counters, and your investment fails, you take home 6,800; and if it were to succeed 10,400.
- If you invest 7 counters, and your investment fails, you take home 5,200; and if it were to succeed 13,600.
- If you invest 17 counters, and your investment fails, you take home 1,200; and if it were to succeed 21,600.
- If you invest 20 counters, and your investment fails, you take home nothing; and if it were to succeed 24,000.

So, you should feel free to invest any number of counters you choose: you can invest zero counters; you can invest 20 counters, or any number of counters between zero and 20.

"Do you have any questions about how the tasks will work?"

[Answer any questions as clearly and accurately as possible; then ask all subjects to wait outside of the experiment room. An experimenter or assistant should bring the first subject into the experiment room, and then ask the subject the following control question and record the answer]

We just want to check your understanding of the task. If A comes up, what happens to your investment? **[pause for answer, correct if necessary]** and if B comes up what happens to your investment? **[pause for answer, correct if necessary. Record whether or not subject answers correctly: 1=both parts correct, 0=one or more parts incorrect.]**

Thank you; please now move the number of counters you would like to invest next to the beaker. Remember each counter is worth 400 shillings.

[Wait for subject to make their choice, and record it; then do the same for all other choice problems in the order relevant for this session]

<u>Resolution</u>

[Invite all subjects into the room.] "Thank you. Now you have made all of your decisions, we will find out how much money you will each leave with today. Remember that we said at the beginning that only one decision will determine how much money you will take home. So we must now select that decision. The decision selected will be the same for each of you.

I have here counters with the numbers 1 to 11 written on it. The numbers 1 to 10 stand for the 10 decisions you took during part 1 of today's programme; number 11 for the decision you took in part 2. **[Put counters in a bag; draw one; and resolve the game. If the number is 1-10, draw a single counter from each of the two lotteries. If 11 is drawn, toss the coin and inform subjects of the result of their investment. One enumerator sits outside the room, subjects exit one-by-one and are paid by that enumerator.]**

Losses version

Setting up

[Experimenters to set up the room as follows, before any subjects arrive. Place five tables around the room, evenly spaced. On each, place two pairs of lotteries, where each lottery consists of 20 coloured counters. Group the counters together by colour so that the subject can easily see how many of each colour of counter is in each lottery.

The lotteries and tables should be placed in such a way that a subject by first walking along the tables on one side, and then back along the tables on the other side, encounters the pairs of lotteries in the order given below.

The chart below shows how many of which colours of counters to include in each lottery. Lotteries 1a and 1b will be placed on the first table and so on. Place labels with the lottery numbers written on them next to each lottery.

Table number	Lottery number	Number of lilac counters	Number of light blue counters	Number of white counters
1	1a	13	7	-
	1b	15	1	4
2	2a	2	18	-
	2b	4	12	4
3	3a	14	6	-
	3b	16	-	4
4	4a	8	12	-
	4b	10	6	4
5	5a	4	16	-
	5b	6	10	4
5	6a	12	8	-
	6b	14	2	4
4	7a	1	19	-
	7b	3	13	4
3	8a	-	20	-
	8b	2	14	4
2	9a	10	10	-
	9b	12	4	4
1	10a	6	14	-
	10b	8	8	4

For example, the third table will on one side have two lotteries on it, one consisting of a group of 14 lilac counters and 6 light blue counters, with the lottery number 3a next to it; the other consisting of 16 lilac counters, and 4 white counters, with the lottery number 3b next to it.

On the other side, the third table will again have two lotteries on it, one consisting of a group of 20 light blue counters, with the lottery number 8a next to it; the other consisting of 2 lilac counters, 14 light blue counters and 4 white counters, with the lottery number 8b next to it.]

Common consequence ladders: losses version

<u>Welcome and general introduction</u>

Welcome. Thank you for taking the time to come today. [Introduce Experimenters and Assistants] You can ask any of us questions during today's programme.

We have invited you here, today, because we want to learn about how people in this area take decisions. You are going to be asked to take decisions about money. The money that results from your decisions will be yours to keep.

What you need to do will be explained fully in a few minutes. But first we want to make a couple of things clear.

First of all, this is not our money. We belong to a university, and this money has been given to us for research.

Participation is voluntary. You may still choose not to participate in the exercise.

We also have to make clear that this is research about your decisions. Therefore you cannot talk with others. This is very important. I'm afraid that if we find you talking with others, we will have to send you home, and you will not be able to earn any money here today. Of course, if you have questions, you can ask one of us. We also ask you to switch off your mobile phones.

Make sure that you listen carefully to us. You will be able to make a good amount of money here today, and it is important that you follow our instructions.

During today's programme, you will be asked to make one or more choices, which will be explained to you very clearly. Only one of your choices will be selected to determine the money you will be paid. At the end of the exercise, we will randomly select one of your decisions to be paid out. Any money you earn will be paid out to you privately and confidentially after all parts of the exercise are complete.

Now, before we explain what you need to do, it is really important to bear one more thing in mind. You will be asked to take decisions that are not a matter of getting it right or wrong; they are about what you prefer. However, it is important to think seriously about your choices because they will affect how much money you can take home.

There are two parts to today's programme. In both parts you will be asked to take decisions. Only one of the decisions will be selected. You will be told which decision that is at the end, and that decision determines how much money you take home. However, you will only find out which decision is selected at the end, so with every decision you take, remember: for all you know**, this could be the one that determines how much money you take home**.

We will now start with explaining part 1. When you've finished taking all decisions related to part 1, we will start explaining part 2. You will make 10 decisions in Part 1 and 1 decision in Part 2 so 11 decisions in total. After you have made all decisions, one decision will be selected by drawing one counter from a bag with 11 numbered counters so that each decision is exactly as likely to be selected as any other. Therefore, each decision could be the one that determines how much money you take home.

Part 1

[For a randomly selected half of the subjects, choice problems 1-10 are played in the order presented above; in the other half, they are played in the reverse order. This will be indicated on each subject's data entry sheet.

These instructions should be delivered to all subjects together.]

"As you can see, there are five tables. On each side of a table you will be asked to make a choice between two lotteries, meaning that you will make ten choices in total."

"Each lottery consists of 20 counters of different colours. Each counter is worth a different amount of money. Lilac counters are worth 3000 Shillings, light blue counters are worth 5000 Shillings, and white counters are worth 8000 Shillings. Remember, you have already been given a voucher worth 8000 Shillings. Therefore, if a white counter is eventually drawn, then you do not earn any extra money, but keep your 8000 Shillings. If a light blue counter is drawn, then you lose 3000 shillings and keep 5000 Shillings. Finally, if you draw a lilac counter, then you lose 5000 shillings and keep 3000 Shillings. If you want to check the values of the counters at any time, please refer to the poster on the wall, here **[indicate poster]**."

"On each table, one lottery will have more lilac counters than the other, but it will also have more white counters than the other. This means that if you select that lottery instead of the other one, you have a higher chance of leaving with 8000 Shillings, but you also have a higher chance of leaving with 3000 Shillings."

"If one of your decisions from Part 1 is selected at the end of the programme, all of the counters from the lottery you choose will be placed into a bag, and one will be drawn at random. If it is lilac, you earn 3000 Shillings, if it is light blue you earn 5000 Shillings, and if it is white you earn 8000 Shillings. Let me demonstrate how this is done."

[Lead the subjects to the fifth table on the side where lotteries 6a and 6b are displayed]

"For example, on this table, one lottery consists of 12 lilac counters and 8 light blue counters. The other consists of 14 lilac counters, 2 light blue counters, and 4 white counters. If you select the first lottery, lottery 6a, you have a chance of leaving with either 3000 or 5000 Shillings. If you select the second lottery, lottery 6b, you are more likely to leave with 3000 Shillings because it contains 14 lilac counters rather than 12. However, you are also more likely to leave with 8000 Shillings, because there are 4 white counters in lottery a, and none in lottery b. Therefore, you must choose which lottery is preferable to you, a or b; there are no right or wrong choices."

[Now demonstrate how we will draw a counter at the end if choice problem 6 were selected:

- **First put 12 lilac counters and 8 light blue counters in a bag and explain that this would happen for everybody who had chosen lottery 6a.**
- **Then shake the bag and ask a volunteer to draw a counter. If it is lilac, explain that this would mean the subject goes home with 3000 shillings. If it is light blue, 5000 shillings.**
- **Next put 14 lilac counters, 2 light blue counter and 4 white counters in a bag and explain that this would happen for everybody who had chosen lottery 6b.**
- **Then shake the bag and ask a volunteer to draw a counter. If it is lilac, explain that this would mean the subject goes home with 3000 shillings. If it is light blue, 5000 shillings. If it is white, 8000 shillings.]**

"Do you have any questions about how the tasks will work?"

[Answer any questions as clearly and accurately as possible; then ask all subjects to wait outside of the experiment room. An experimenter or assistant should bring the first subject into the experiment room, and then lead subject to their appropriate first choice problem]

"We just want to check your understanding of the task. Can you please tell me, of the two lotteries here in front of you, which one offers the higher chance of leaving with exactly 5000/=? **[Record whether subject's answer was correct or not, offer explanation if their first answer was incorrect.]**

"If you have no further questions, we will now begin. Please choose which of the two lotteries on this table you would prefer. When you have made your decision, point to the one you have chosen, and I will record your choice"

[Wait for subject to make their choice, and record it; then do the same for all other choice problems in the order relevant for this session]

<u>Part 2</u>

[A table is set up as follows. On its top are a beaker that can be closed with a lid, a coin with paper tightly wrapped around and affixed to it with the letter A clearly written on one side, B on the other, and 20 individual counters spread out]

[Invite all subjects into the room to explain the following instructions to them as a group.]

We now begin part 2 of today's programme. There are 20 counters spread out on this table. Each counter is worth 400 Shillings so 20 times 400 equals 8000 shillings. These 20 counters represent the 8,000 shillings on the voucher which you have been given a few weeks ago. That money is yours and you can do with it exactly what you like.

For example, you could decide to do nothing with it. That means we give you 8,000 actual shillings and you can take those 8,000 shillings home.

But we're also giving you the opportunity to invest some or all of that money. Let me show you what happens if you decide to invest.

For example, let's say you decided to invest 4,000 shillings. You would then take 10 counters (remember, each counter represents 400 shillings) and you would place them here, right next to the beaker.

Now, we would then toss this coin that has A written on one side and B on the other. We put it in the beaker, put the lid on top, shake it and then we put the beaker upside down, like this; we remove the beaker: and which side of the coin shows?

It's [A/B]. That means the investment [is successful/failed]. So there are 2 possibilities: the investment can succeed or fail. It succeeds when A comes up; it fails when B comes up. Now let me explain what success and failure mean.

If the investment succeeds, we triple what you have invested. So since you had invested 4,000, we give you back three times 4,000 equals 12,000 **[count out cash next to invested counters]**. We add that to the money you had not invested (4,000) **[count out cash next to uninvested counters]**, so you go home with 4,000 + 12,000 = 16,000 **[count out total cash].**

Common consequence ladders: losses version

Now, what happens if the investment fails? Your investment failing means you lose all of it. In this case you go home with the money that you didn't invest. So you will take home 4,000 **[count out cash next to uninvested counters]**

So remember, if your investment succeeds (that is when A comes up) you receive three times the amount you invested PLUS the money you did not invest. And if your investment fails (that is when B comes up), you keep the money you did not invest, but nothing else. I´ll give you a few more examples of how that would work out.

- If you decide to invest 3 counters, and your investment fails, you take home 6,800; and if it were to succeed 10,400.
- If you invest 7 counters, and your investment fails, you take home 5,200; and if it were to succeed 13,600.
- If you invest 17 counters, and your investment fails, you take home 1,200; and if it were to succeed 21,600.
- If you invest 20 counters, and your investment fails, you take home nothing; and if it were to succeed 24,000.

So, you should feel free to invest any number of counters you choose: you can invest zero counters; you can invest 20 counters, or any number of counters between zero and 20.

"Do you have any questions about how the tasks will work?"

[Answer any questions as clearly and accurately as possible; then ask all subjects to wait outside of the experiment room. An experimenter or assistant should bring the first subject into the experiment room, and then ask the subject the following control question and record the answer]

We just want to check your understanding of the task. If A comes up, what happens to your investment? **[pause for answer, correct if necessary]** and if B comes up what happens to your investment? **[pause for answer, correct if necessary. Record whether or not subject answers correctly: 1=both parts correct, 0=one or more parts incorrect.]**

Thank you; please now move the number of counters you would like to invest next to the beaker. Remember each counter is worth 400 shillings.

[Wait for subject to make their choice, and record it; then do the same for all other choice problems in the order relevant for this session]

<u>Resolution</u>

[Invite all subjects into the room.] "Thank you. Now you have made all of your decisions, we will find out how much money you will each leave with today. Remember that we said at the beginning that only one decision will determine how much money you will take home. So we must now select that decision. The decision selected will be the same for each of you.

I have here pieces of paper with the numbers 1 to 11 written on it. The numbers 1 to 10 stand for the 10 decisions you took during part 1 of today's programme; number 11 for the decision you took in part 2. **[Put pieces of paper in a bag; draw one; and resolve the game. If the number is 1-10, draw a single counter from each of the two lotteries. If 11 is drawn, toss the coin and inform subjects of the result of their investment.]** You have now found out how much you have earned from the game. There is also a show-up fee of 5000/= which will be given to you for participating. This will be added to your payment. **[One enumerator sits outside the room, subjects exit one-by-one and are paid by that enumerator.]**