GRIPS Discussion Paper 14-01

Risky rotten kids: an experiment on risk attitudes amongst adolescents in rural Uganda

Alistair Munro
Yuki Tanaka

April 2014

National Graduate Institute for Policy Studies
7-22-1 Roppongi, Minato-ku,
Tokyo, Japan 106-8677

Risky rotten kids: an experiment on risk attitudes amongst adolescents in rural Uganda☆

Alistair Munro[1], Yuki Tanaka

National Graduate Institute for Policy Studies (GRIPS), Roppongi 7-22-1, Minato-ku, Tokyo, Japan, 106-8677.

Abstract

According to some simple models of the household, parental transfers should equalize measured risk attitudes amongst family members. We explore the theory behind this notion and then use a Holt-Laury mechanism to compare attitudes to risk amongst 412 teenage children and their parents in 38 rural villages in central and eastern Uganda. Although within household risk preferences appear to be weakly correlated, we find large and systematic differences between parental and child attitudes that are not eliminated by controlling for loss-aversion and background variables such as age and education. Children are substantially more risk loving than their parents and conversely, slightly more loss averse than their parents. When we control for individual, household, village and regional factors the results are largely unchanged and in particular age is not an explanation of the differences in attitudes. We find that some aspects of risk and time preferences are linked to poor performance at school, including repeating a year and dropping out. Overall our results are compatible with a world in which parents protect children from risk. Moreover, because measured risk (and discounting attitudes

☆The main experiment for this research was conducted in 2011 by the National Graduate Institute for Policy Studies (GRIPS) and Makerere University with funding from the GRIPS Global COE programme "The Transferability of East Asian Development Strategies and State Building". We wish to thank participants at the Economic Science Association Asia-Pacific Meeting, Tokyo, 2013 for their comments as well Marcelo Echague Pastore for his research assistance and the team from Makerere University: George Sentumbwe, Angela Nagutta, Marion Iceduna, Florence Nakkazi, Paul Maloba and William Nsereko Kinaalwa, led by Dr. Serunkuuma that conducted the fieldwork.

Email address: `alistair-munro "at" grips.ac.jp` (Alistair Munro)

[1]Corresponding Author

differ between parents and their children, they suggest the value of measuring the attitudes of both generations when considering the relationship between preferences and schooling decisions.

Keywords: household, experiment, family, couples, children, risk attitudes, Holt-Laury, prospect theory

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1. Introduction.

According to some basic models of the household, parental transfers should equalize measured risk attitudes amongst family members. In this paper we report on the use of a Holt-Laury mechanism to compare attitudes to risk and time discounting amongst 412 teenage children and their parents in 38 rural villages in central and eastern Uganda. A main motivation is the state of the literature on the intergenerational transmission of risk and time preference attitudes. Much of the discussion in this literature focuses on 'nature versus nurture' (e.g. Paola (2012)) but we argue that according to many economic models, intra-household risk sharing may also produce positive correlation in risk-taking even when underlying risk attitudes are not correlated.[2] As such, we start from a simple household model in which parental transfers bring children's risk taking into line with parental attitudes. This baseline model, labelled the 'risky rotten kids' model, in reference to Becker (1974)'s original theory of the unitary household, provides a benchmark with which to compare risk taking by parents and their offspring.

Another motivation is provided by the state of the school system in Uganda. Despite the introduction of universal primary and secondary education in Uganda the rate of continuation to the 5th year remains low at 56%. One factor among many affecting the low performance may be the preference of the parents and the adolescents themselves towards education, since education entails long-term investment with uncertain outcomes. Such investment does not only include opportunity cost of schooling for adolescents but also direct cost of education such as uniforms, meals and scholastic materials. Past studies have acknowledged the role of risk attitude and discount rate in household decision on schooling, but have typically focused on the preferences of one actor such as the parent (e.g Wölfel and Heineck (2012)) or the

[2]Similar arguments can be made for discount rates.

elicited risk attitude of the individual as an adult (e.g. Belzil and Leonardi (2007)). However it may be that for adolescents of secondary school age, not only the parents' preferences but their own preferences affect the schooling decision. . In this context we conduct an experiment targeting adolescents aged 12 to 18 to investigate the impact of adolescents' preferences on their own schooling decision. [3]

Recently there have been a significant number of experiments conducted on intra-household decision-making. For instance, Bateman and Munro (2005) test EUT for individuals and couples. Using student couples, He et al. (2012) do something similar, while Iversen et al. (2011) conduct an experiment on household efficiency amongst couples in a region that overlaps with the area of this study. However, most of the family experiments involve spouses as participants rather than children and indeed the set of economics experiments which mix children and their parents is rather limited. In the original economics experiment, Peters et al. (2004), mixes families in the public goods games and find children tend to free ride whereas parents 'teach the kids a lesson' by behaving cooperatively. In Brazil, Reynolds (2008)conducts a trust experiment played between 153 teenage mothers and their mothers in Salvador, North-Eastern Brazil and finds in favour of a cooperative (joint payoff maximizing) model. Also in Brazil, Bursztyn and Coffman (2012)consider the effect of cash payments on school decisions while Cipriani et al. (2013) examine contributions for parents and children for public good games and cannot reject a null of no correlation within families.

There is also a substantial literature on risk attitudes amongst adults and children that is relevant, but as with intra-household experiments, studies that bring together results from adults and children from the same household are limited. Levin and Hart (2003) measure the risk aversion of young children, Levin et al. (2007) shows that choices are reasonably stable across time. Harbaugh et al. (2002) compare risk attitudes of children and adults in the USA, Sutter et al. (2010) measure attitudes to risk and time preferences amongst teenagers in Italy while Eckel et al. (2012) considers peer effects in the risk attitudes of school children. Weller et al. (2010) compares risk attitudes from age 5 to 85 in a cross-section of US subjects. That paper, in common with others, finds that generally risk aversion increases with age.

[3] In sub-Saharan Africa, Weir (2011) for Ethiopia and Appleton (2001), for Uganda provide evidence on the factors that constrain participation in education.

Within the group of papers that studies risk aversion in children, Levin and Hart (2003) is notable because in one experiment they examine the correlation between the choices made by children (6-8 year olds) and their carers (typically a parent) and find positive correlation. Meanwhile, in a large-scale study Dohmen et al. (2012) and Paola (2012) compare intergenerational risk attitudes in Germany and in both studies detect positive correlation between the generations. Using a simply lottery choice, Zhong et al. (2009) find high levels of correlation of risk attitudes amongst a group of Chinese twins, and attribute a large part (57%) of it to heredity rather than a shared environment. Cesarini et al. (2009) study, over 900 twins in Sweden were faced individually with a sequence of six choices involving a 50:50 lottery and fixed sum of money. The authors find high levels of correlation in behaviour - the Spearman correlation is 0.222 for mono-zygotic ("identical") twins and 0.025 for DZ ("fraternal") twins, and estimate that approximately 20% of variation in the attitude to risk revealed in the study is heritable.

To preview our results, we find that although within household risk preferences appear to be weakly correlated, there are large and systematic differences between parental and child attitudes that are not eliminated by controlling for loss-aversion and probability weighting. Children are substantially more risk loving than their parents and conversely, more loss averse than their parents. When we control for individual, household, village and regional factors the results are largely unchanged and in particular age is not an explanation of the differences in attitudes. Overall our results are compatible with a world in which parents protect children from risk. When we turn to the relationship between risk and time preferences and schooling we find that the preferences of both adolescents and their parents can help explain the variation in years of repetition and dropping out. Moreove these factors are as strong as some other, more traditional explanatory variables such as the education level and wealth of the parents.

2. Theory.

The standard 'rotten kid' theorem model of intra-household allocation is due to Becker (1974). In this $n+1$ agent model there is a parent, n children (we set $n = 1$ in the exposition that follows) and one private good that is available in continuous quantities. The child maximizes a utility function, v while the parent maximizes $u + \lambda v$, with $\lambda > 0$. Importantly, the parent has the last word on transfers within the family. In this setting, the child will choose the same action as would be chosen by the parent maximizing $u + \lambda v$. It is very well-known that this theorem is not general (see also Bergstrom (1989) or Dijkstra (2007)). It does not generalize easily to situations of multiple goods, asymmetric information, boundary cases, changes in the sequencing of actions and so on. Still, it provides a benchmark model for understanding intra-household incentives and allocation that enabled subsequent researchers to interpret empirical patterns of intra-household behaviour and to suggest other more appropriate theories.

In the same spirit we develop a simple model of intra-household decision-making in the presence of risk (for models which consider some similar issues in the context of labour supply decisions, see Chami (1998) or Laferrère and Wolff (2006))[4]. The main point of our theory is to show that in households where there are strategic interpersonal transfers, then there are some reasons for expecting risk attitudes to be linked. As with the original model, we do not suggest that is correct model of the household or even the best in many situations. Rather it is useful order to generate a null hypothesis for the experimental setting.

Consider a two person household where initial wealth for the parent and child is M_1 and M_2 respectively. The parent makes a transfer, z, to the child so that the parent has final consumption $M_1 - z$, while the child has final consumption, $M_2 + z$. For simplicity, we take it that M_1 is always sufficiently large relative to M_2 that in all circumstances the parent would wish to make a positive transfer. The von Neumann-Morgenstern utility functions, u and v are three times differentiable and increasing in their arguments.

In this context, consider an intervention that consists of a lottery that pays Δ_1 with probability p and Δ_2 with probability $(1-p)$. We shall suppose that $\Delta_1 > 0$ and $\Delta_2 < 0$. We wish to know whether and when the child and parent will accept the lottery, rather than the status quo and we say that revealed preferences are aligned if for all lotteries, both parent and child would make the same choice.

We consider two possible time lines for the decision. In the *precommitment* version, the parent first announces a transfer function $z(\Delta)$ then the agent (the child or the parent) chooses whether to accept the lottery. Note that $z(0)$ is the transfer in the situation where there is no lottery. The state

[4] General models of efficient risk sharing within groups can be found in Wilson (1968) or Townsend (1994)

of the world $i = 1, 2$ is then revealed and the lottery paid out along with the appropriate transfer. In the *no-commitment* version, the allocation of z is decided optimally by the parent after the state of the world is revealed. Consider first the precommitment case.

Proposition 1. *Under precommitment the parent accepts the lottery if and only it is accepted by the child.*

Proof. With precommitment the parent can choose any incentive scheme she or he wishes, to make the child conform. For example if the parent prefers not to accept the lottery, set $z(0) = argmax\{u(M_1 - z) + \lambda v(M_2 + z)\}$ and $z(\Delta_1) = z(\Delta_2) = z(0) - A$, for some $A > 0$. Conversely, if the parent prefers to accept the lottery, set $z(\Delta_1) = argmax\{u(M_1 + \Delta_1 - z) + \lambda v(M_2 + z)\}$, $z(\Delta_2) = argmax\{u(M_1 + \Delta_2 - z) + \lambda v(M_2 + z)\}$ and $z(0) = min\{z(\Delta_1), z(\Delta_2)\}$ $\square$

In this situation of precommitment the rotten kid theorem prevails. The child chooses the action that would be taken by the parent. In addition, provided $u + \lambda v$ is concave in z, the parent will choose $z(\Delta)$ such that,

$$u'(M_1 + \Delta - z) = \lambda v'(M_2 + z) \tag{1}$$

Write $z_\Delta = \frac{dz}{d\Delta}$ and $z_{\Delta\Delta} = \frac{d^2 z}{d\Delta^2}$. At an interior optimum for z, equation 1 applies and therefore,

$$z_\Delta = \frac{u''}{u'' + \lambda v''} \tag{2}$$

Although the precommitment result is general, in the no-commitment case, parent and child preferences are necessarily aligned only under specific circumstances.

Proposition 2. *Under no-commitment, if both agents are risk averse and u and v are either a) quadratic in their arguments or b) show constant absolute risk aversion (CARA), then the parent accepts a lottery if and only it is accepted by the child.*

Proof. The parent accepts if,

$$\begin{aligned} pu\left(M_1 + \triangle_1 - z(\Delta_1)\right) + \lambda v\left(M_2 + z(\Delta_1)\right) \\ + (1-p)u\left(M_1 + \triangle_2 - z(\Delta_2)\right) + \lambda v\left(M_2 + z(\Delta_2)\right) \\ \geq u\left(M_1 - z\left(0\right)\right) + \lambda v\left(M_2 + z(0)\right) \end{aligned}$$

Because of the differentiability of both u and v, we have,

$$u(\Delta) + \lambda v(\Delta)$$
$$= u(0) + \int_0^\Delta u'(s)(1 - z_\Delta)\, ds + \lambda v(0) + \int_0^\Delta \lambda v'(s) z_\Delta ds$$
$$= u(0) + \lambda v(0) + \lambda \int_0^\Delta v'(s)\, ds \quad (3)$$

where the last part follows from 1. So, using equation (3) the parent accepts a lottery when,

$$p \int_0^{\Delta_1} v'(s)ds - (1-p) \int_{\Delta_2}^0 v'(s)ds \geq 0 \quad (4)$$

Meanwhile the child accepts the lottery, provided

$$p \int_0^{\Delta_1} v'(s) z_\Delta ds - (1-p) \int_{\Delta_2}^0 v'(s) z_\Delta ds \geq 0 \quad (5)$$

Comparing (4) and (5) we see that parent and child acceptance conditions are equivalent if z_Δ is constant. Obviously this is true if utility for both agents is quadratic (so that u'' and v'' are constant). Meanwhile, using (1) again,

$$z_\Delta = \frac{u''/u'}{u''/u' + \lambda v''/u'} = \frac{u''/u'}{u''/u' + v''/v'} \quad (6)$$

If utility is CARA then u''/u' and v''/v' are constant and the result follows. □

This is a risky choice version of the rotten kid theorem and provides a benchmark result. It means that, for example, parent and child can make the same choice in a Holt-Laury exercise, even if the two individuals have, when separate, quite different attitudes to risk. As we noted in the introduction the correlation in risk attitudes between generations has not received much attention. Most of the discussion about correlation has been in terms of inheritance and environmental influences, (Dohmen et al. (2012)) but the model outline here suggests that, at least for families that share a household, intra-household transfers may create common risk attitudes even when risk preferences per se are not inherited.

A question is what happens when individual preferences are neither quadratic nor CARA.

Proposition 3. *Suppose there is no commitment, and both agents are strictly risk averse. The parent accepts when the child accepts provided* $z_{\Delta\Delta} \leq 0$*; the child accepts when the parent accepts provided* $z_{\Delta\Delta} \geq 0$.

Proof. Consider,

$$p \int_0^{\Delta_1} v'(s) \left(z_\Delta(s) - z_\Delta(0)\right) ds - (1-p) \int_{\Delta_2}^{0} v'(s) \left(z_\Delta(s) - z_\Delta(0)\right) ds \quad (7)$$

This expression takes the sign of $z_{\Delta\Delta}$. Thus if the child accepts the lottery (i.e. (5) holds) and $z_{\Delta\Delta} \leq 0$ then the parent also accepts. Meanwhile if the parent accepts the lottery ((4) holds) and $z_{\Delta\Delta} \geq 0$ then the child also accepts. □

The sign of $z_{\Delta\Delta}$ depends on the preferences of the parent and the child. Formally,

$$z_{\Delta\Delta} = \frac{\left(\lambda v''\right)^2 u''' - \left(u''\right)^2 \lambda v'''}{\left(u'' + \lambda v''\right)^3} \quad (8)$$

A person is said to be prudent when the third derivative of the von Neumann-Morgenstern utility function is positive. In such a case for example, an increase in risk leads to a rise in saving (Kimball (1990)). Here, the sign of $z_{\Delta\Delta}$ depends on the relative prudence of parent and child. When the parent is prudent and the child is not, then z is concave in Δ. In such circumstances the parent accepts the lottery when the child accepts, but not necessarily vice versa. In other words, the parent reveals greater risk aversion in choices compared to the child. Conversely, if the parent is not prudent but the child is, then it is the child who reveals greater risk aversion.

2.1. Changing the Model.

It is clearly useful to understand how the result is sensitive to the assumptions of the model. There are numerous ways in which the relationship between parent and child could be different from that supposed in the previous section, but we consider three kinds of adjustment: making an exit constraint binding for the parent, relaxing the assumption that the parent respects the child's risk tolerance and adding in loss aversion. These changes are meant to be illustrative rather than exhaustive.

First, suppose the child can exit the household and the fall-back utility (i.e. the utility at which exit is optimal) is $\underline{v}$. When this is binding in all relevant states of the world, then the child is actually indifferent between accepting and not accepting the lottery. On the other hand, the parent bears all the risk and so the parent's preferences will differ from the child. More specifically, if the parent accepts the lottery then so does the child, but the converse need not be true. In this sense the parent reveals more risk aversion than the child. Suppose now that the constraint is binding for Δ less than Δ^* , where $\Delta^* \geq \Delta_2$. In this situation, the parent accepts the lottery when,

$$p \int_0^{\Delta_1} u'(s)ds - (1-p) \int_{\Delta_2}^0 u'(s)ds \geq 0 \tag{9}$$

Meanwhile, the lottery is acceptable to the child when,

$$p \int_0^{\Delta_1} v'(s)z_\Delta ds - (1-p) \int_{\Delta^*}^0 v'(s)z_\Delta ds \geq 0 \tag{10}$$

(In this equation, it is supposed for simplicity that $\Delta^* < 0$ but the arguments which follow do not hinge on this feature.) We have the following proposition:

Proposition 4. *Suppose there is no commitment, the utility functions u and v are both CARA and $\Delta^* \geq \Delta_2$. If the lottery is acceptable to the parent, then the lottery is acceptable to the child. Conversely, if the lottery is not acceptable to the child it is not acceptable to the parent.*

Proof. Since utility functions show CARA and $u' = \lambda v'$ for $\Delta \geq \Delta^*$ then equation ((10)) can be rewritten as,

$$p \int_0^{\Delta_1} u'(s)z_\Delta ds - (1-p) \int_{\Delta^*}^0 u'(s)ds \geq 0 \tag{11}$$

The difference between ((9)) with ((11)) is in the lower limit on the second integral. It follows that when the left hand side of ((9)) is positive, then so is the left hand side of ((11)). □

So in general if the child's constraint is binding for some values of Δ then the parent bears all the incremental risk from lower values of Δ. As a result, the child is better insured against risk and therefore more willing to take on risky bets. As a result the revealed risk preferences of the child and parent diverge even when preferences show CARA, with the parent displaying higher risk aversion.

In the second twist on the basic model, we suppose that the parent maximizes the function, $u + \lambda g(v)$ where g is a strictly increasing function of v (and three times differentiable). If g is strictly concave we say that the parent is *overprotective* and if g is strictly convex, we say the parent is *under-protective*. The idea is that a parent may not respect the risk attitudes expressed by the child. In this situation the first order condition for the optimal transfer by the parent is,

$$u' = \lambda g' v' \tag{12}$$

and therefore,

$$z_\Delta = \frac{u''}{u'' + \lambda \left(g' v'' + g'' \left(v' \right)^2 \right)} \tag{13}$$

The parent's maximand can be written as,,

$$\begin{aligned} u(\Delta) &+ \lambda v(\Delta) \\ &= u(0) + \int_0^\Delta u'(s) \left(1 - z_\Delta\right) ds + \lambda v(0) + \int_0^\Delta \lambda g' v'(s) z_\Delta ds \\ &= u(0) + \lambda v(0) + \lambda \int_0^\Delta g' v'(s) \, ds \end{aligned} \tag{14}$$

So, using equation ((12)) the parent accepts a lottery when,

$$p \int_0^{\Delta_1} g' v'(s) ds - (1-p) \int_{\Delta_2}^0 g' v'(s) ds \geq 0 \tag{15}$$

Meanwhile as before the child accepts the lottery, provided

$$p \int_0^{\Delta_1} v'(s) z_\Delta ds - (1-p) \int_{\Delta_2}^0 v'(s) z_\Delta ds \geq 0 \tag{16}$$

Proposition 5. *Suppose there is no commitment, both agents are strictly risk averse and both u and g(v) represent CARA utility functions. If g is concave, then if the lottery is acceptable to the parent, then the lottery is acceptable to the child. Conversely, if g is convex, if the lottery is acceptable to the child it is acceptable to the parent.*

Proof. If u and g(v) show CARA then $z_{\Delta}$is constant, using the same argument applied in equation (6). In this case, the child accepts the lottery provided,

$$p\int_{0}^{\Delta_1} v'(s)ds-(1-p)\int_{\Delta_2}^{0} v'(s)ds\geq 0 \tag{17}$$

Let $g'(\Delta)$ be the derivative of g with respect to v evaluated at Δ, and consider,

$$p\int_{0}^{\Delta_1}\left(g'(\Delta)-g'(0)\right)v'(s)ds-(1-p)\int_{\Delta_2}^{0}\left(g'(\Delta)-g'(0)\right)v'(s)ds \tag{18}$$

Equation (18) takes the sign of g''. Hence, if g is concave (18) is negative and therefore if (15) is positive then so is (16). Conversely if g is convex and (16) is positive then so is (15). □

The examples used above all take expected utility as a shared assumption. In contrast, in models of reference dependent preferences, such as cumulative prospect theory, it is often argued that losses are weighted more heavily than gains. For some of the widely used versions of such models a weight $\eta>1$ is attached to the utility from losses (e.g. Tanaka et al. (2010)). If the no lottery income is taken as the reference point, so that the functions u and v are used for gains (e.g. Δ_1) while $-\eta u$ and $-\eta v$ are used for losses then the valuation functions for the parent becomes.

$$\begin{cases} u(\Delta-z(\Delta))+\lambda v(z(\Delta)) & \Delta\geq 0\\ -\eta u(-\Delta+z(\Delta))-\eta\lambda v(-z(\Delta)) & \Delta<0\end{cases} \tag{19}$$

The value function for the child is defined in an analogous manner. Note that the sharing rule implies that changes in parental and child consumption are positively correlated, so that a loss for the child is a loss for the parent and so on. With this formulation, the propositions are unchanged, but with more complex versions of reference dependent preferences the propositions must be modified. For instance, in the original model of Kahneman and Tversky (1979), individuals are risk loving on the loss domain which would imply one person would bear all the downside risk of the lottery in the optimal allocation.[5] For such a case the relative attractiveness of a lottery for the parent and child would depend on who suffers the downside loss.[6]

Proposition 6. *Suppose that v and u (a) are concave in the positive domain and convex in the negative domain (b) are twice differentiable except possibly at 0, where the negative derivative is no smaller than the positive derivative. Then (i) the child accepts the lottery if the downside loss is taken by the parent; (ii) if the agent who suffers the downside loss accepts the lottery then so does the other agent.*

Proof. Consider the case where the parent takes the downside loss. The parent accepts the lottery provided,

$$p\int_0^{\Delta_1} \lambda v'(s)ds - (1-p)\int_{\Delta_2}^0 u'(s)ds \geq 0 \tag{20}$$

while the child accepts when,

$$p\int_0^{\Delta_1} v'(s)z_\Delta ds \geq 0 \tag{21}$$

The left hand side of equation (21) is non-negative so the child always accepts the lottery.

In the case where the child takes the downside loss, the parent accepts the lottery provided,

$$p\int_0^{\Delta_1} \lambda v'(s)ds - (1-p)\int_{\Delta_2}^0 \lambda v'(s)ds \geq 0 \tag{22}$$

Meanwhile the child accepts when,

$$p\int_0^{\Delta_1} v'(s)z_\Delta ds - (1-p)\int_{\Delta_2}^0 v'(s)ds \geq 0 \tag{23}$$

Since $0 \leq z_\Delta \leq 1$, then when the child accepts so does the parent. □

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[5] The weighted sum, $u + \lambda v$, is convex and therefore the first order conditions represent a minimum. For large losses, it may be optimal to overload the loss - i.e. create a gain for one person and a larger loss for the other person.

[6] Some of the tasks used in our experiments involve choices between sure gains and lotteries involving only positive sums in which case this final argument would not apply, provided the participants treat no gain as the reference point.

The simple theory outlined above suggests that the revealed risk attitudes of parents and their live-at-home children should be linked and in some particular circumstances they should be coincident. Of course there are other reasons for a link, notably shared genes and a shared environment in which parents can be expected to pass on some of their preferences and attitudes to their offspring. In the experimental evidence which follows we explore the extent of this correlation.

3. Method.

The data for the study is drawn from an ongoing panel, the Research on Poverty, Environment and Agricultural Technology (REPEAT) project in Uganda, Yamano et al. (2004), Tanaka and Munro (2013). In wave 3, conducted in 2009, a selection of adult participants took part in individual experiments to measure risk attitudes and time preferences. The villages (or Local Council 1, the lowest administrative unit in Uganda) were selected from a stratified random sample across six agro-climatic zones: the high potential bi-modal rainfall zone, the medium potential bi-modal rainfall zone, the low potential bi-modal rainfall zone, the uni-modal rainfall zone, the south-western highlands and the eastern highlands (Yamano et al. (2004)). Because of the security concerns, the northern and north-eastern parts of the country were excluded from the sampling. 1 shows the selected villages where the 2009 experiment with 1289 participants took place.

In the adults sample, the average household size is 7.7 members. The mean dependency ratio, the ratio of the number of adults to that of children, is 1.2. Per capita income and the asset value of the respondents' household are on average 152.7 US dollars (USD) and 207.2 USD respectively. Around 68 per cent of all the respondents were male with an average age of 45 years. While 66 per cent of them are literate, the average years of schooling is 5.7. The average farm size was largest in the bi-modal rainfall zones than in other zones, but this fact does not necessarily translate to the differences in average per capita expenditure. The uni-modal zone has lower agricultural potential with shortest growing period, but the average wealth is similar to that in the high potential bi-modal rainfall zone with the same average land size. In terms of crop production, while staple food crops such as maize and matooke are grown by the majority of households in all the agro-climatic zones, other crops such as coffee, sweet potato and rice have more regional variation. The average distance to district town and the road condition for

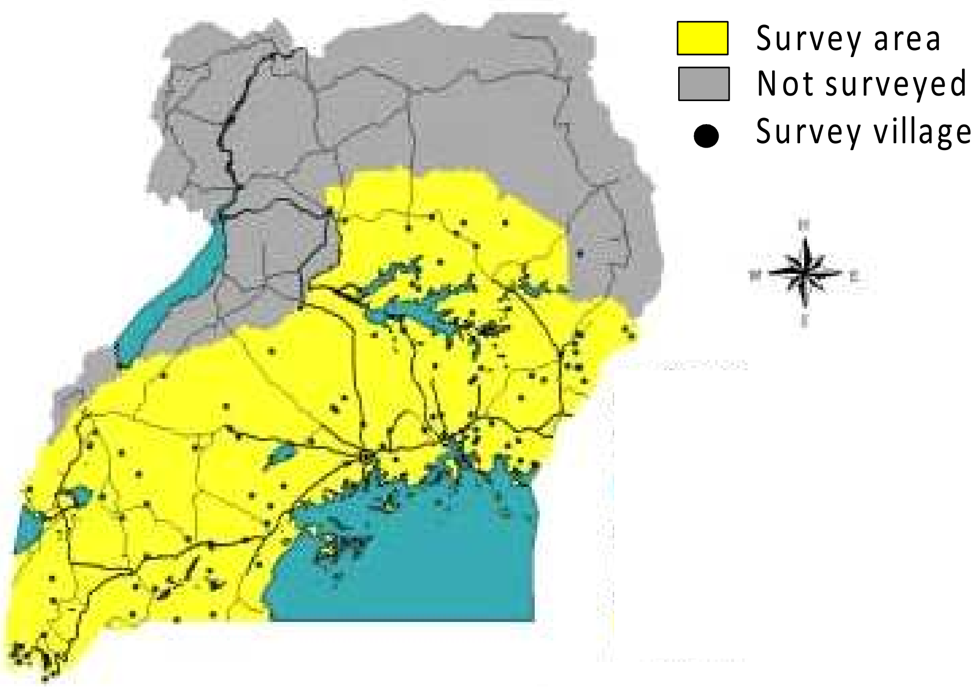

Figure 1: Study Area.

the road to district town also vary by region. In the low potential bi-modal rainfall zone, the distance to town is furthest, but the proportion of villages with all season tarmac road for the road to district town is the highest; in contrast, in the uni-modal rainfall zone, the average distance is shortest but in 75 per cent of the villages, the road condition is all season dirt. In terms of the population density, the high potential bi-modal rainfall zone is most populous, followed by the uni-modal rainfall zone. The number of primary and secondary schools seems to correlate with population density: the more the people, the more schools there are.

In 2011, two regions (Eastern and Central) were selected for a follow up experiment with adolescent children (defined here as 12-18 years old) from the panel households. Within the region, a 50% sample of 36 villages was randomly picked, stratified according to mean income in 2005 (high/low), primary school staff student ratio (high low), distance to secondary school (high low) and distance to town (near and far). Within each target village all panel households with children in this age range were identified and invited to take part.

3.1. Experimental Design

The experimental design follows the familiar format of the pair-wise choice framework (Holt and Laury (2002)) simplified and converted into local currency. We played eight games in total using exactly the same parameters and payoffs for parents and children. The options within the four risk games games are presented in the Appendix. Incentives were given for the risk games in order to elicit the subjects' preferences using the random lottery method. Thus, participants were informed prior to making choices that one of the risk games would be played for real and they would be paid cash according to their answers in the game. In the risk games 1, 2 and 3, involving gains (positive amounts), we asked the subjects to choose between column A, which offered a sure income of 4000 Ugandan Shillings (USh)[7] and column B, which offered two different amounts with probabilities ranging from 0.25 to 0.75. Considering the level of education and illiteracy of some of our subjects, we simplified the notion of probabilities using four balls compared to some of the versions of the Holt Laury framework that are used in laboratories. In all tasks Column B is progressively preferable as one goes down the

[7]Between one and two days' wages for a typical adult subject in our study. For teenagers, 85% of whom were in school, the salience of the prizes was probably much larger.

list. The fourth risk game, which involved gains and losses and was used to measure the loss aversion, and the four time preference games were played similarly, though the time preference games were played hypothetically due to logistical constraints.

After all subjects had completed all eight answer sheets, a community leader drew a ball from a bingo cage containing 32 balls (eight balls for each of the rows in the four risk games). This ball determined the row number of the risk game to be played. Participants who had chosen an option with some risk then individually chose a ball from the four balls, 1, 2, 3 or 4, which identified the prize amount and then finally the payment was made. In terms of protocols there was very little difference between the experiments with adults and with their children. The children were invited through the adults, but the parents were not present during the playing of the games to give advice and so on. The training methods used for the assistants and the examples and script were the same in both cases. The adolescents did face a survey questionnaire specific to their own educational experience, but this was employed after the experiment was completed.

4. Results.

We begin with some background information on the sample of children and adults who took part in the experiment, including those adults who are not linked to adolescent participants. We provide some information about the family characteristics, but more details on the parental sample and the REPEAT panel can be found in Tanaka and Munro (2013). Except where stated the demographic and background variables are from the 2009 wave. The exceptions are the number of schools in the community, which was last asked in the 2005 wave and the education level and age of child respondents which was asked in 2011. Logged variables (Ln(x)) are actually ln(x+1)). Community level variables for assets and land size are means for the whole REPEAT sample in that community. The difference between the community assets variables and means of household variables therefore represents some selection bias in participation in the 2009 experiment.

The first five variables in the table represent the agroclimatic regions. The omitted category is Eastern Highlands. The maximum number of observations in the two sub-samples is given at the base at the table.

Our second background figure shows the age composition of the experiment with children. The subjects were in the age range 12-17 with peaks in

Table 1: Background Information on the Sample.

	Adults		Children	
Variable	Mean	SD	Mean	SD
Bimodal Low Rainfall	0.127	0.333	0.185	0.389
Bimodal Medium Rainfall	0.204	0.403	0.288	0.453
Bimodal High Rainfall	0.312	0.463	0.366	0.482
Uni-modal Medium Rainfall	0.101	0.301	0.093	0.29
South West Highlands	0.174	0.379	0	0
Distance to Town (miles)	13.947	10.991	15.82	11.03
All Tarmac Road	0.236	0.425	0.215	0.411
Distance x All Tarmac	3.622	7.888	4.815	10.71
Population Density	711.4	834.79	519.521	569.43
Number of Schools, 2005	1.035	1.529	.893	0.592
Ln (Community Assets, US$)	13.06	1.273	12.994	0.457
Ln (Community Land, acres)	1.675	0.563	1.847	0.454
Household Size	7.576	3.688	9.532	4.084
Dependency Ratio	1.461	1.088	1.788	1.21
Ln (Land in acres)	1.594	0.743	1.918	0.766
Land owner	0.774	0.419	0.639	0.481
Ln (Value of assets, US$)	12.54	1.228	12.76	0.96
Age	44.98	14.74	14.88	2.013
Gender (female =1)	0.319	0.466	0.434	0.496
Years of education	5.722	3.656	6.102	2.172
Head of the household	0.753	0.432	0	0
Children in the household	4.123	2.511	5.58	2.63
SD = standard deviation	N=1289		N=412	

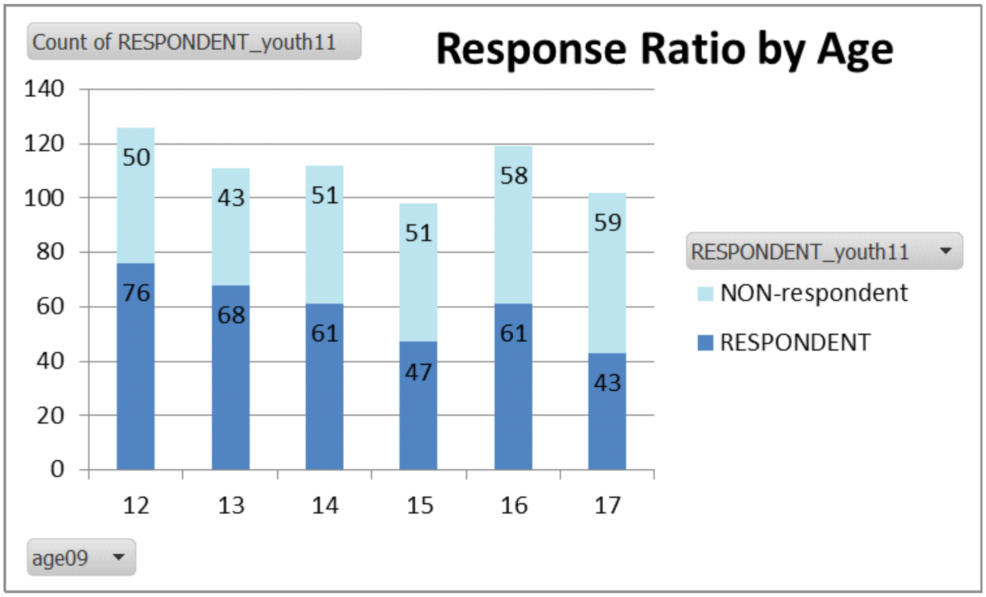

Figure 2: Response Rates.

the distribution at 12 and 16. Non-response rates did not have a clear relationship with age, although there is some evidence in favour of the hypothesis that response rates were lower with the older age groups. As a result the mean age for respondents was 14.2 as opposed to 14.6 for non-respondents. For the children, there were also some small but significant gender and schooling differences between the sample and the targeted group: 52% of the non-respondent group were female compared to 44% in the respondents, whereas mean schooling was 0.5 years greater amongst non-respondents compared to respondents. Children who took part in the experiment were also more likely to come from families with smaller land size, lower assets and be headed by a female, although these differences were not significant at the 5% level.

Moving on from the descriptive data we now provide summary evidence on the results of the game. Figure 3 shows the average switching point for the children (red) and adults (blue) in the four tasks. In all tasks the children have the higher switching point, meaning that on average children are more likely to prefer the riskier choices.

Next for particular games we show the distributions of switching points. Recall that lower switching points indicate greater risk tolerance. Figure 4

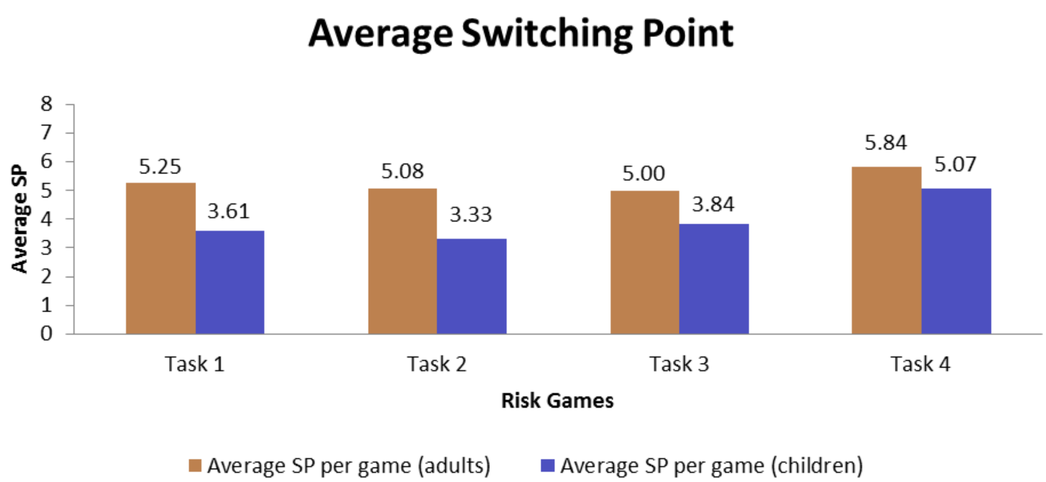

Figure 3: Switching Points.

shows the frequency of switching points for task 3. The pattern was similar for tasks 2 and 1. Here we see that the adolescents were more likely to choose the risky option even when the expected gain from this was negative. In other words many of the subjects were risk loving. Parents were generally more cautious and were more likely to switch to the risky option when the difference in expected value was large.

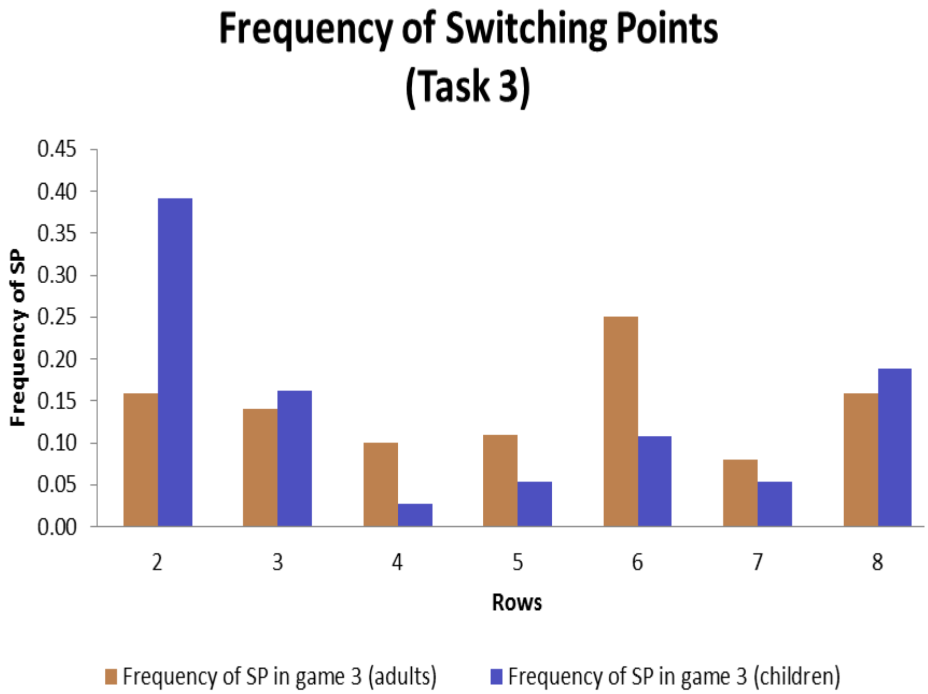

Figure 4: Distribution of Switching Points.

The distribution of responses to task three can be usefully compared to those for four which has possible losses for the participants (see Figure 5). In this case, both adults and children were much more likely to choose the safer and loss-minimizing option in each row.

A number of studies, including Weller et al. (2010) have found that risk aversion increases with age when lotteries involve only gains. The evidence on other kinds of risky tasks is more limited, but Levin et al. (2007) for instance in a study of younger children and their carers find higher risk aversion amongst adults for gains-only tasks but no difference in attitudes when tasks involved some chance of losses. Our experiment involves older children and their parents, but is consistent with this picture except that the difference in behaviour by children and adults is not smoothly associated

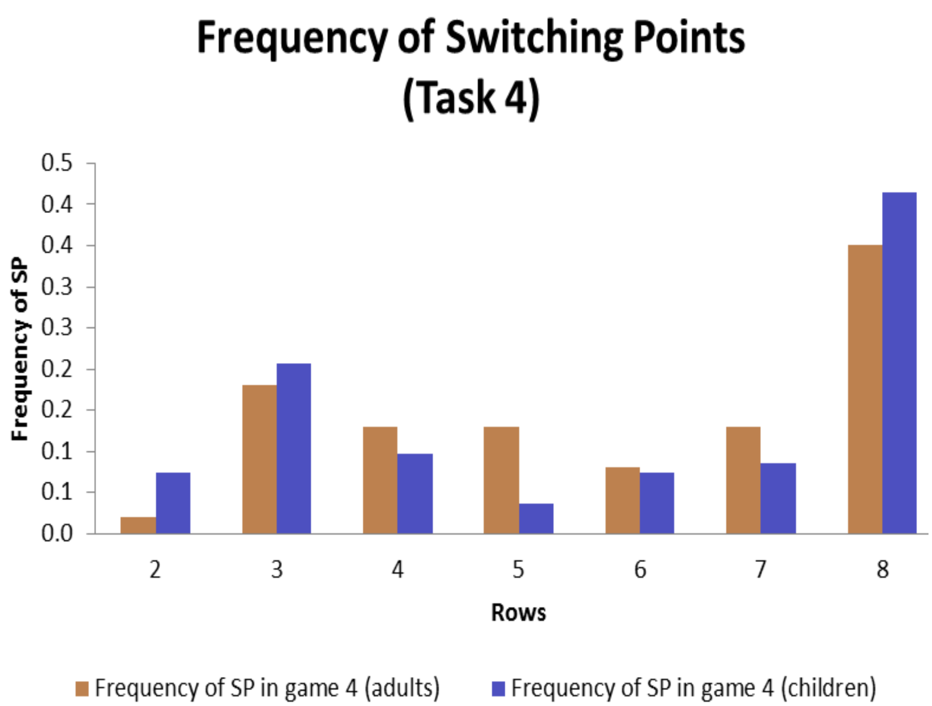

Figure 5: Switching point for a task with losses.

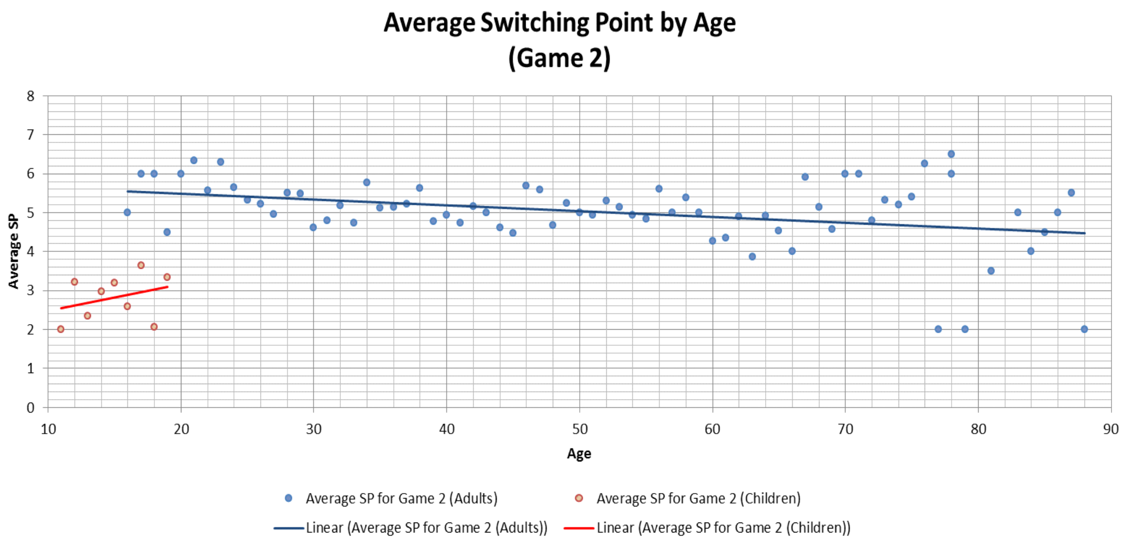

Figure 6: Age and switching.

with age. Figure 6 and Figure 7 illustrate this point, showing (particular in the first case) that the data is more consistent with a discontinuity: adults are more risk averse. And indeed, amongst adults, it actually appears that there is weak evidence of declining risk aversion with age.

For task 4, the results are not so clear cut and at least to the naked eye, it is possible that switching point is not linked to age. To investigate the issue further and to examine the correlates of risk aversion in the experiment we construct a parametric model of choice, based on a stripped down version of cumulative prospect theory model.[8]

[8]Adding a probability weighting coefficient to the model makes little difference to the results and does not change the basic message that risk aversion is higher for the adults.

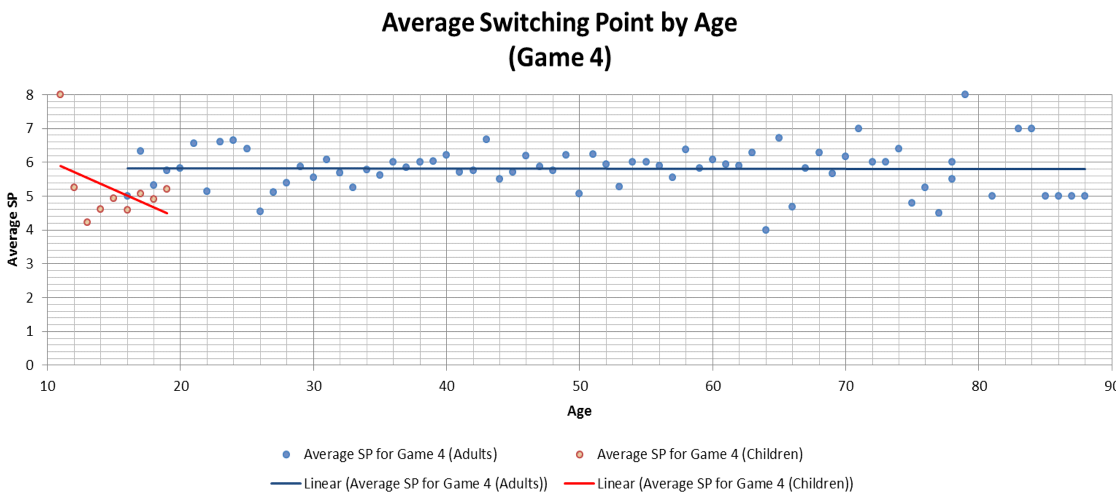

Figure 7: Age and Switching: Task 4.

We suppose that preferences can be summarized by:

$$u = \frac{M^{1-\sigma}}{1-\sigma} \; 0 \leq M \tag{24}$$

$$u = \frac{\eta(-M)^{1-\sigma}}{1-\sigma} \; M < 0$$

In this equation, $\eta > 0$ is a measure of loss aversion while σ is the coefficient of risk aversion. With the data in the experiment being in interval form we need to process it to produce point estimates of risk and loss aversion. We use the first three tasks for each player to calculate an estimate for σ and then task four to estimate η. We do this in two alternative ways. In the *calculation* method, for each of tasks 1-3 we take the mid point of the first interval in which subjects switch from the safer choice to the riskier choice. For example if the player picks A in task 2, row 3 and B in task 2 row 4, then her or his choices imply $\frac{4000^{1-\sigma}}{1-\sigma} \geq 0.75\frac{5000^{1-\sigma}}{1-\sigma}+0.25\frac{2000^{1-\sigma}}{1-\sigma}$ and $\frac{4000^{1-\sigma}}{1-\sigma} \leq 0.75\frac{5500^{1-\sigma}}{1-\sigma}+0.25\frac{2000^{1-\sigma}}{1-\sigma}$. Solving the two equations simultaneously, the implied interval for the risk aversion parameter is $0.92 < \sigma \leq 1.62$. In the case of subjects who switch from A to B at one of the extremes one side of the interval for σ is open-ended. For instance a subject who chooses A in task 1, row 1 and B in the second row of the same task, has an implied value of σ that is less than -0.62. In this situation we use the boundary of the interval as the estimate (e.g. -0.62). To get the overall estimate of risk aversion we average the figure from the first three tasks.[9] For task 4, we use the estimated figure for σ to estimate an interval for the loss aversion parameter (see Tanaka et al. (2010) for a similar approach). We then take the mean of this interval. As with the risk aversion parameter we use the known boundary for the open intervals in the case of individuals who switch choices in the extreme rows.

As an alternative we also use interval regression to produce estimates of σ and η, regressing the interval on a variety of conditioning variables for the agroclimatic region, household and individual. We label this the *estimation* method. Again we do the procedure sequentially, using the data from tasks 1-3 to estimate the risk aversion equation which is then used to generate intervals for the loss aversion equation. The estimated equations are used to predict individual values of σ and η for each individual. This alternative method has the advantage that it does not impose values for individuals who switch at the extremes. [10]

The results for the estimated equations are show in Table 2 where standard errors are clustered at the household level and are shown in parentheses. The bottom line of the table reports chi-squared statistics for two likelihood ratio tests of the null hypothesis of no significant difference between the coefficients of the adult and child games. These null hypotheses are rejected at standard significance levels (p =0.000). In fact with some obvious exceptions such as distance to town, the relationship between control variables and risk or loss aversion seems quite different for children and their parents. One clear feature of the data though is the absence of significantly positive age

[9]In our experiment we did not force subjects to obey first order stochastic dominance. As a result, we have some subjects who switch back between A and B within a task. For these subjects we use the first switching interval. Dropping them or using an average switching point as a basis for an estimate or risk aversion does not change the conclusions of the study.

[10]The disadvantage is that it is not appropriate when we want to link estimates of risk aversion to environmental and household variables. Moreover, because most of the control variables are constant within a household it tends to produce spurious within household correlation of risk attitudes and loss aversion. A third alternative would be use interval regression to estimate $\sigma$and η separately for each individual without using the controls, but the problem we face here is the limited data provided by four tasks.

effects.[11] Actually, the coefficient on age for adults is negative and significant at the 10% level, although the size of the effect is quite small. Another feature of the data is the absence of significant differences between male and female respondents, whether adult or children.

Figure 8 shows separate plots for child and parent risk attitude based on the calculated data. Given the discrete nature of the data and the limited number of questions asked of the subjects we have some jumps at the ends of the cumulative distribution, but what is clear is that there are higher fraction of children with lower risk aversion coefficients. In contrast, at high levels of risk aversion, the cumulative frequencies are approximately the same. Using a Kolmogorov-Smirnov test, the two distributions are significantly different (p=0.000).

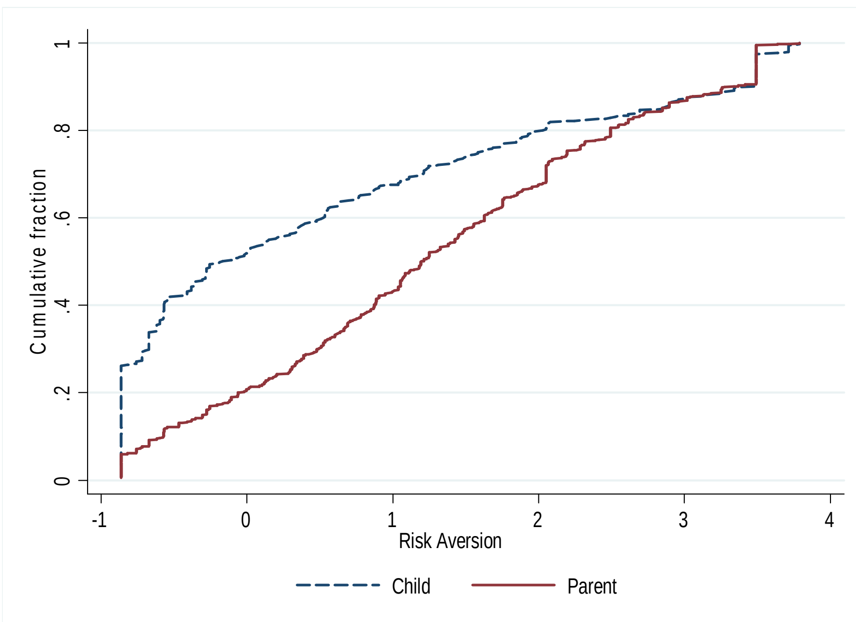

Figure 8: Distribution of calculated risk aversion.

[11]We experiment with age squared and cubed to see if there are non-linear effects of age, but these additional variables are not significant.

Table 2: Adults and Child: Aversion to Risk and Loss Estimates

Variables	Risk Adults	Children	Loss Aversion Adults	Child
Bimodal, Low Rainfall	-0.603**	-1.712	-0.076	-3.595
	(0.280)	(1.173)	(0.281)	(3.225)
Bimodal, Medium Rainfall	-0.915***	-1.722*	0.563**	0.062
	(0.266)	(0.992)	(0.271)	(3.280)
Bimodal, High Rainfall	-0.298	0.257	-0.014	-6.359*
	(0.228)	(1.039)	(0.243)	(3.388)
Uni-modal, Medium Rainfall	0.199	1.284	1.278***	-4.033
	(0.297)	(0.909)	(0.328)	(3.490)
South West Highlands	-1.007***		-0.414*	
	(0.238)		(0.240)	
Distance to Town	-0.010	-0.105***	0.015**	0.192**
	(0.007)	(0.027)	(0.007)	(0.083)
All Tarmac Road	0.384	-3.825***	-0.290	5.126
	(0.284)	(1.373)	(0.254)	(4.370)
Distance x All Tarmac Road	-0.030**	0.218***	-0.014	-0.347**
	(0.013)	(0.053)	(0.012)	(0.147)
Population Density	0.000	-0.000	0.000***	0.005**
	(0.000)	(0.000)	(0.000)	(0.002)
# Schools in 2005	0.024	0.310	0.146***	0.929
	(0.036)	(0.363)	(0.044)	(1.210)
Ln (community assets)	-0.046	0.219	0.011	0.613
	(0.100)	(0.605)	(0.099)	(2.245)
Ln (community land)	0.517***	0.641	-0.160	-5.861***
	(0.130)	(0.533)	(0.139)	(1.897)
Household size	0.001	0.097	0.010	0.213
	(0.053)	(0.110)	(0.037)	(0.451)
Household Dependency Ratio	0.027	0.118	-0.111	1.298
	(0.108)	(0.254)	(0.098)	(1.056)
Ln (land in 2009, hectares)	0.091	-0.131	-0.074	2.705**
	(0.095)	(0.303)	(0.092)	(1.117)
Household owns land	-0.118	0.573	1.092***	1.115
	(0.138)	(0.546)	(0.130)	(1.601)
Ln (value of assets in 2009)	-0.055	0.098	-0.048	-1.735**
	(0.058)	(0.263)	(0.055)	(0.849)
Age	-0.009*	0.123	-0.004	-0.332
	(0.005)	(0.086)	(0.005)	(0.350)
Gender (1=female)	0.203	-0.075	-0.173	-0.269
	(0.162)	(0.372)	(0.156)	(1.337)
Education (years)	0.010	0.021	-0.021	0.483
	(0.017)	(0.113)	(0.018)	(0.342)
Head of household	0.019		-0.028	
	(0.183)		(0.181)	
Children in 2009	-0.013	-0.107	0.066	-0.551
	(0.089)	(0.199)	(0.068)	(0.784)
Constant	2.557**	-6.643	2.162*	27.275
	(1.275)	(7.711)	(1.247)	(23.424)
Ln(sigma)	0.823***	1.343***	0.560***	2.452***
	(0.024)	(0.062)	(0.025)	(0.214)
Observations	3,299	1,106	1,087	387
log likelihood	-6554	-1693	-2242	-1151
likelihood ratio test	423.9***		1406.94***	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Figure 9 shows the cumulative distribution of coefficients of loss aversion. Here the difference between the distributions is not so obvious, but parents are typically less loss averse than children. A Kolmogorov-Smirmov test with a null of no difference in distributions yields a p-value of 0.020.

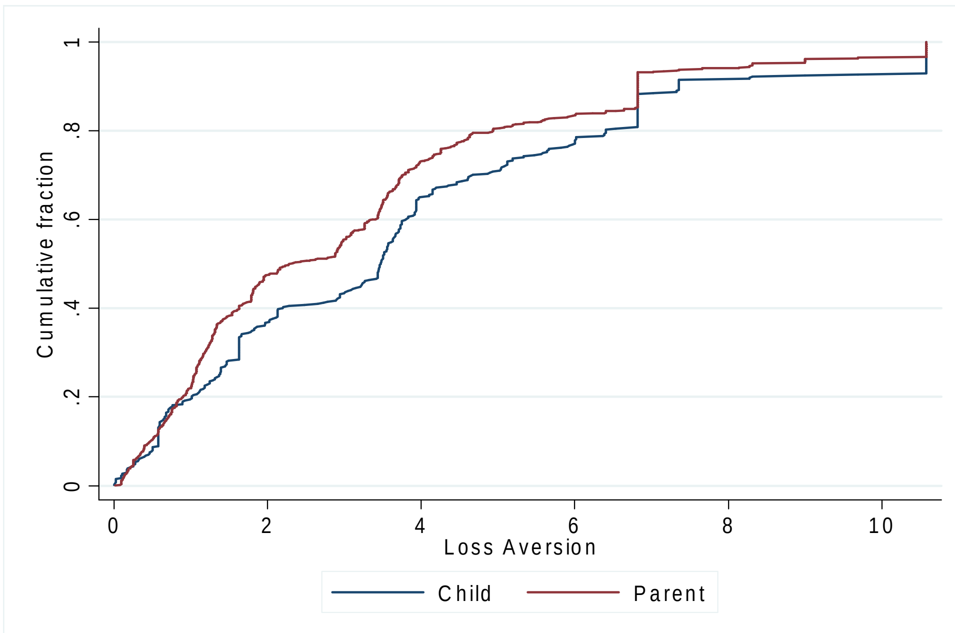

Figure 9: Distributions of calculated loss aversion parameters.

The fact that the children are risk loving whereas the parents are risk averse provides a contradiction of the risky rotten kid theorem at the aggregate level, but we also need to see the household level data. To produce the plots shown in Figure 10 we pair each child with his or her parent and calculate $\sigma_c - \sigma_p$ where σ_c is the child's risk aversion parameter and $\sigma_p$is the parent's parameter. Two plots are shown: one using the regression-based estimates of risk aversion and one using the calculation method. In both cases, the children are generally less risk averse than the parent. For instance, for the calculated data, 71% of children have lower risk aversion.

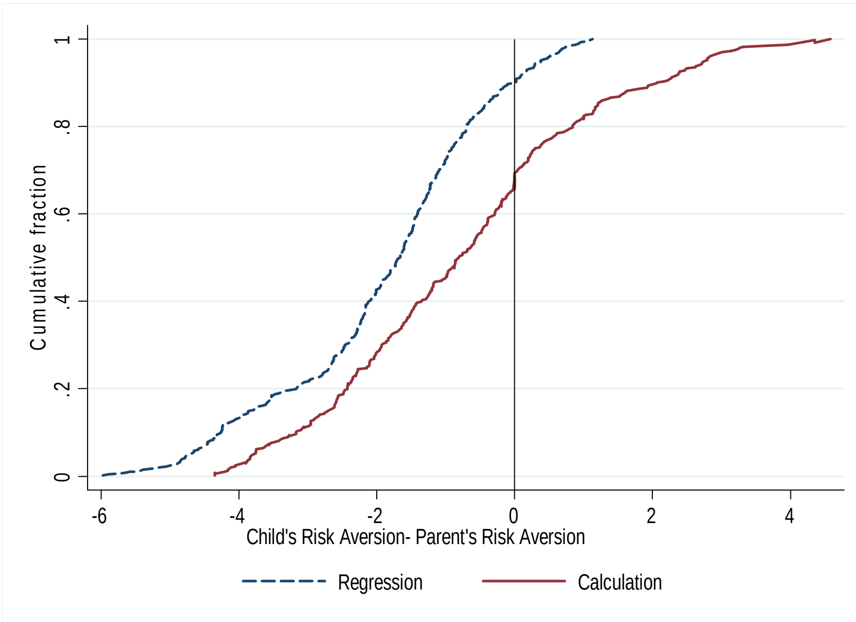

Figure 10: Difference between parents and children, risk aversion.

For loss aversion generally children have higher loss aversion coefficients than their parents as is shown in Figure 11. For the calculated data, approximately 60% of children have higher loss aversion coefficients.

Although we reject equality of the parental and child attitude to risk, we have not so far examined their correlation. For calculated risk aversion, the correlation coefficient between parent and child values is 0.0941 ($p = 0.049$ for a test of the null that this is zero). So, in line with Cipriani et al. (2013)'s results from the investigation of public good contributions, we come close to accepting the null of no parental-child correlation in risk attitudes.If we correct for the fact that in many cases more than one child from the same family take part in the experiment, by clustering the data at the household level, the p-value is 0.11. For loss aversion the correlation coefficient is 0.2034 ($p = 0.001$) meaning that we clearly reject a hypothesis of no correlation in loss aversion, in favour of positive correlation. Though the sample is relatively small, we can also test for correlations between siblings, using the

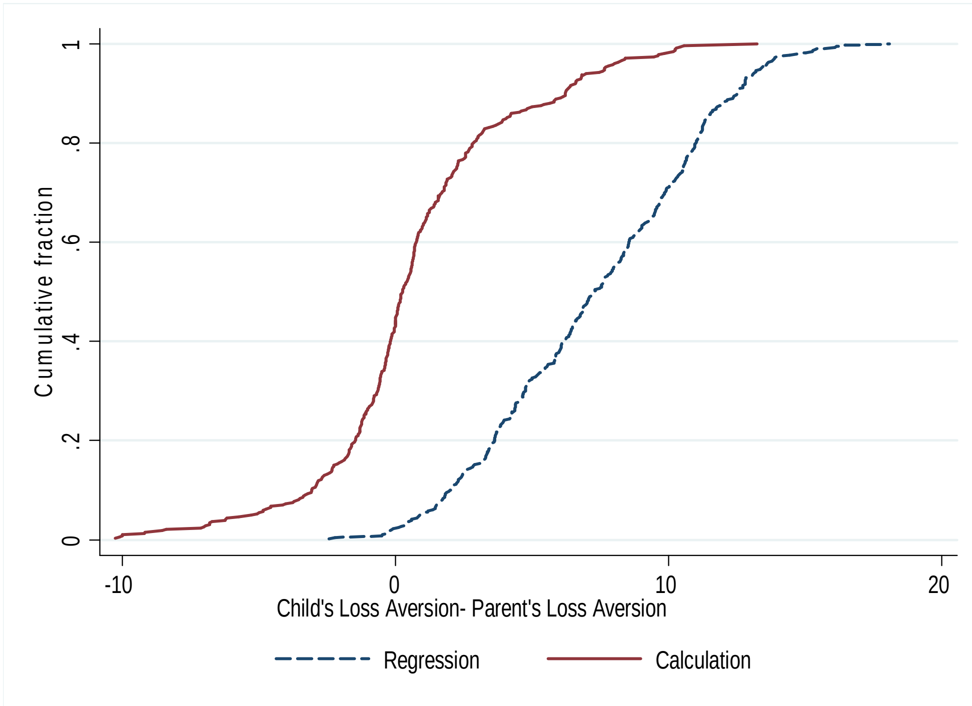

Figure 11: Difference between parents and children, loss aversion.

123 households where more than one child took part. In this case the within-sibling correlation of calculated risk parameter is 0.356 ($p = 0.029$) while the within-sibling correlation of loss aversion is 0.126 ($= 0.174$). So there is some evidence of weak within-household correlation and the evidence is always in favour of positive correlation between the relatives.

5. Schooling.

From a wider perspective we wish to know whether these features of preferences are reflected in school behaviours.[12] Out of the sample of participants, approximately 13% had formally left school. Many of the children

[12]One thing we cannot do in this section is to establish causation, because as well as reflecting preferences educational experience also changes attitudes. The variables that might serve as instruments for our preference measures are either too weak or might have a direct effect on outcomes.

though had extended periods of absence in the previous school year or repeated one or more years of schooling. The modal number of repeated years was 1 (43% of students), with only 19.4% that had not repeated a year. Approximately 80% of children had one or more days of absence in their previous term of schooling, but the majority (68.3%) reported that in total they were absent for one week or less. Out of those who had been absent and were still attending school, 57% declared that the primary reason was their own sickness. However, 11.6% were caring for others and 10.9% where absent for unspecified family activities. Only 6.7% reported that an inability to pay school fees was the main reason for absence. For repetition, overwhelmingly the most common reason given was poor grades.

Though our data from adults and children on time preference is not the product of incentivized questions because attitude to time may reasonably play a role in schooling decisions we include it in the following models. In order to this, for both adult and child we calculate estimates of the discount rate and present bias. The assumption is that preferences over a stream of consumption $\{m_T, m_{T+1}, ...\}$ beginning at time T can be summarized by the equation,

$$u_T = m_T + b \sum_{t=1}^{t=\infty} \rho^t m_{t+T} \tag{25}$$

In this equation b is a measure of present bias and ρ is the discount factor. A higher value for the factor means the individual is more patient. When $b = 1$, the individual has no present bias and choices are time consistent. When $b < 1$ the individual shows a bias towards present consumption. In the experiment, we present subjects with four hypothetical tasks, two of which have an option for immediate reward and two of which only involve delayed rewards. An example of the task used is presented in the Appendix. According to equation (25) present bias plays no role in choices where all options involve delay. Thus we use these two questions to produce a calculated value for the discount rate ($= -1 + 1/\rho$) and then use this estimate and the two tasks that have immediate reward options to calculate a measure of present bias. [13]

[13]Some of the results for the adult sample can be found in Tanaka and Munro (2013). In general we find that present bias is clustered around 1 for both children and parents, but children have lower discount rates. In fact the mean discount rate for adults is around

Because many of the factors that might influence school behaviour might also affect the decision to take-up the invitation to participate in the experiment, we use a Heckman selection model. We use local rainfall on the day of the experiment and temperature on the same day as the variables that are unique to the selection equation; the identifying assumption is that transient changes in rainfall and temperature might affect the decision to attend the experiment but they have no long-term impact on absence, repetition and drop-out. Note that region dummies are included in the model and this captures major differences in annual weather patterns[14]. In Table 3 we report regression results for equations that link parental and child attributes to repetition, school absence and remaining in school. In the table the first reported equation is for the number of years repeated. [15] The second is the associated selection equation. The dependent variables in the final two equations are days of absence in the preceding term and a dummy for whether the child is still in school (0) or has dropped out (1).

If we consider the selection equation first, we see that age and being female are negative factors. Students in more heavily populated areas are less likely to respond to the invitation to attend as are the children of landowners. In the model, we have dummy variables for the relationship between the child and the head of the household. The omitted category here is child plus a handful of children in other categories, such as non-relative or son/daughter in law. Relative to the omitted category, being another relative or niece or nephew lowers the probability of attendance. We also include 'invited' which is the number of children from the household invited to take part in the experiment. Generally, the more children invited the less likely it was that any individual child turned up though the effect is not significant. In terms of effect size, a one year increase in age reduces the probability of attendance by 5.3%, whereas an increase in rainfall from 0 to 1 cm, lowers

50%, compared to 6% for children. These results are in line with the hypothesis that the parents are protecting children from the financial pressures faced by the household.

[14]The Eastern region overlap with the unimodal and East Highlands agroclimatic zones while the bimodal low rainfall areas are solely in the Central area. Bi-modal high and medium rainfall areas fall into both our sample regions

[15]The first model is estimated in a two step procedure because of difficulties in convergence for the maximum likelihood method. The final two models are estimated using maximum likelihood with errors clustered on households. For the final two models the selection equation is omitted from the table, but it is very similar in both cases to the equation for the Years repeated model.

attendance probability by approximately 14%.[16] While the selection equation is interesting in itself, but it is worth noting that a Wald test of the null hypothesis of zero correlation between the error terms in the selection and main equations yields p-values of 0.96 and 0.30 for the school drop-out and days absent models respectively. For the Years repeated equation, a test of the hypothesis that the inverse Mills ratio is zero yields a p-value of 0.071, so for this equation the null of no selection bias is rejected at the 10% level of significance.

In the equation for years of schooling repeated, children where the adult female had more education were less likely to repeat.[17] Where there were more male adults in the household, number of years of repetition is lower. Children in the Eastern region and in more densely populated areas were also less likely to repeat, which may reflect school quality. Perhaps surprisingly, travel time to school was negatively associated with repetition. This was true even if we only looked at children who were still in school. Travel time is not a factor in absence either, so it may be that conditional on getting to school, children's performance is not damaged by commuting. There are only weak links from the risk and discounting variables to school year repetition. Children who are more risk averse and have lower discount rates are likely to have more years of repetition whereas the head's risk aversion is negatively linked to repetition, at the 10% level of significance. [18]

For the days of absence equation, very few conclusions can be drawn with any certainty. Age is positively linked to days of absence as living in the Eastern region. Days of absence tends to be larger if the person who took part in the adult experiment was female. The causal link is not obvious here - it is probably due to the fact that in many cases female participants in the adult experiment were household heads as well and in many cases, de facto single parents. In support of this interpretation we note that having more male adults in the household is associated with lower absenteeism.

The final equation concerns school attendance. Not surprisingly age of the child is positively associated with leaving school. Meanwhile a higher

[16]Rainfall was not common during the experiment: approximately 20% of subjects were in an area where rain was recorded on the relevant day; in the case of 17 out of 412 subjects the rainfall exceeded 1cm.

[17]Our variable for adult female education is either the years of education for the spouse of the head where the head is male or the years of education when the head is female.

[18]The results of a poisson model are very similar and are therefore not reported here.

Table 3: Preferences and Schooling.

Variables	Years repeated	Selection equation	Days absent	School Dropout (probit)
Age of child in 2009	-0.075	-0.166***	0.641**	0.406***
	(0.095)	(0.029)	(0.322)	(0.104)
Gender (Female =1)	-0.067	-0.226**	-0.627	-0.247
	(0.200)	(0.103)	(0.795)	(0.244)
Region dummy (Eastern = 1)	-0.488*	-0.120	2.195**	-0.094
	(0.258)	(0.150)	(0.937)	(0.312)
Distance to Town	-0.004	-0.008	0.120	0.021*
	(0.010)	(0.006)	(0.088)	(0.012)
All Tarmac Road	-0.203	0.223	-0.887	0.221
	(0.262)	(0.165)	(1.607)	(0.319)
Population density	-0.000*	-0.000***	-0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.000)
Travel Time to School	-0.007**	-0.001	0.003	-0.010***
	(0.003)	(0.002)	(0.010)	(0.003)
Household Size	0.072***	0.016	0.229*	-0.045
	(0.027)	(0.019)	(0.125)	(0.037)
Number of Adult Men in Household	-0.192**	0.041	-0.837**	-0.070
	(0.087)	(0.055)	(0.356)	(0.102)
Loss Aversion	-0.015		0.034	-0.026
	(0.022)		(0.121)	(0.040)
Risk Aversion	0.083*		0.135	-0.156**
	(0.049)		(0.292)	(0.077)
Present Bias	-0.114		2.826*	-0.646
	(0.328)		(1.628)	(0.467)
Discount rate	-0.012**		-0.022	0.020**
	(0.005)		(0.028)	(0.009)
Head's Loss Aversion	-0.054		0.200	0.042
	(0.033)		(0.167)	(0.048)
Head's Risk Aversion	-0.095*		-0.047	-0.110
	(0.054)		(0.277)	(0.077)
Head's Present Bias	-0.381		-1.542	-1.139**
	(0.370)		(1.844)	(0.444)
Head's Discount Rate	0.002		0.015	0.005**
	(0.002)		(0.012)	(0.002)
Head's Education, years	0.020	0.014	-0.050	0.006
	(0.028)	(0.017)	(0.171)	(0.034)
Head's Age, years	0.015	0.002	-0.027	-0.000
	(0.009)	(0.006)	(0.038)	(0.011)
Adult Female Education, years	-0.071**	0.001	0.039	0.020
	(0.029)	(0.018)	(0.107)	(0.037)
Adult subject's gender (Female=1)	0.151	0.112	2.443**	0.218
	(0.255)	(0.163)	(1.218)	(0.291)
Ln (value of assets in 2009)	-0.056	0.006	-0.151	-0.126
	(0.096)	(0.053)	(0.678)	(0.135)
Ln (land in 2009, hectares)	0.143	0.097	-0.109	0.080
	(0.127)	(0.071)	(0.538)	(0.148)
Land owner (dummy)	0.001	-0.002	-0.010*	0.000
	(0.003)	(0.001)	(0.006)	(0.002)
Grand child of Head	0.000	-0.216	2.196	-6.506***
	(0.359)	(0.205)	(1.725)	(0.880)
Niece-nephew of Head	-1.279**	-0.763***	-0.666	0.509
	(0.598)	(0.198)	(1.292)	(0.643)
Other relative of Head	-0.321	-1.039***	0.373	-4.563***
	(0.832)	(0.289)	(1.870)	(0.649)
Rain on the Day of Experiment (cm)		0.423**		
		(0.204)		
Temperature on the Day of the Experiment (C)		0.005		
		(0.153)		
Number invited from household		-0.062		
		(0.039)		
Inverse Mills ratio		1.673*		
		(0.924)		
Constant	2.941*	2.605***	-5.923	-4.325**
	(1.518)	(0.752)	(6.990)	(2.058)
Log likelihood	.	.	-1717	-503.2

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; 680 observations in each model distance to the school is associated with a lower drop out rate as is being the grandchild of the head or other relative. Measures of wealth and the variables for parental age and education are not linked to drop-out rates.[19] Children with higher levels of risk aversion and lower discount rates are less likely to drop out, which is intuitive. On the other hand, a higher present bias for the adult is associated with a lower probability of school drop out, while a higher adult discount rate is linked to dropping out. At the mean values of these two variables (1.006 and 50.54 respectively[20]) the net effect on drop-out probability is negative.

Having summarized the impact of statistically significant individual factors, we consider their quantitative influence on the dependent variables. The purpose of the exercise is to compare the relative effect size of changes in the preference variables with other, more standard variables. For instance, a one standard deviation increase in the age of the child leads to a rise in the probability of dropping out of 9.7%. In comparison, a one standard deviation increase in the child's risk aversion yields an estimated 2.8% fall in the probability of dropping out while a one standard deviation rise in the child's discount rate increase the probability of dropping out by 3.1%. For the years repeated equation, a one standard deviation increase in household size (which is actually 4 people here) yields a predicted mean increase of 0.29 years repeated. The corresponding estimate for male adult members is a reduction of 0.26 years. Applying the same procedure to the log of land cultivated in 2009 produces a figure of 0.12 years. If the child's risk aversion is raised by one standard deviation above its mean value, the predicted number of years repeated increases by 0.12 while a one standard deviation increase in the discount rate lowers years repeated by 0.16. In short therefore, the impact of the psychological factors in the models is not as large as some standard demographic factors such as age and household size, but it is of the same order of magnitude.

6. Conclusions.

Using an incentivized device, we measure risk attitudes amongst teenagers in Uganda and compare them to the attitudes of their parents. We

[19] In some cases children may be living with relatives in order to attend the school.

[20] It is often reported that hypothetical questions often result in relatively high revealed discount rates (Coller and Williams (1999)) .

find that the children are much less risk averse than their parents. At the same time they are slightly more loss averse. As a result, children are more likely to accept risky bets, compared to their parents when all the outcomes are gains. In contrast, when there is some chance of losses, the difference between adults and their offspring is small. The disparity in choices is incompatible with a simple, risky rotten kid model of household distribution in which pre-committed parents control exposure to risk through ex-post transfers. It is also incompatible with no-commitment and constant absolute risk aversion or quadratic utility. It is compatible with some other stories, such as overprotective parents,[21] but here we are being speculative since as we noted in the theory section there are actually a number of ways in which changes to a simple intra-household model could leave to differences in revealed attitudes to risk. However it is important to stress that the difference between children and adults does not appear to be explicable in terms of their different ages (or education or any other obvious environmental variable). Rather it is suggestive of a world in which being head of the household is associated with individuals being more risk averse.[22] Standing back from the data, our results of weak within household correlation are in line with the results reported for public good games in Germany by Cipriani et al. (2013) but at variance with some twins studies for Sweden and China. The lack of a close correlation between teenager's revealed preferences and those of their parents suggest that it may be important to elicit both sets of parents when trying to understand real-world choices in which both parties would normally have some influence. This last point is particularly relevant when we look at the relationship between risk and time preferences and measures of schooling, where we can see that child preferences have as strong a link to outcomes as parental preferences.

The policy implications of the results are not transparent, beyond the obvious point that adults are not the only influential agents when it comes to the educational decisions of teenage children. To the extent that children's preferences are manipulable and that our results show causation, it would

[21]Since the children had similarly cautious attitudes to lotteries involving losses as their parents, it suggests that the protectiveness of adults might involve some pooling of losses, but allowing children to keep their gains.

[22]This of course is not necessarily causal: it may be that risk averse individuals are more likely to be household heads. On the other hand in this locality, the default head is usually the male spouse and most males eventually become married.

appear that making children more patient (i.e. lowering discount rates) might lead to lower rates of school drop-outs though it also might lead to more repeated years of education. However there is not much evidence in our data set that altering loss aversion or present bias would have a significant impact on education.

Appendix: The Four Risk Tasks and an Example of a Discounting Task.

R1 ver.2

	A	B		Do you prefer A or B?
	①②③④	①②	③④	
1–1	4,000	4,000	2,000	
1–2	4,000	5,500	2,000	
1–3	4,000	6,000	2,000	
1–4	4,000	7,000	2,000	
1–5	4,000	8,000	2,000	
1–6	4,000	8,000	3,000	
1–7	4,000	8,000	3,500	
1–8	4,000	8,000	4,000	

R2

ver.2

	A	B		Do you prefer A or B?
	①②③④	①②③	④	
2–1	4,000	4,000	2,000	
2–2	4,000	4,500	2,000	
2–3	4,000	5,000	2,000	
2–4	4,000	5,500	2,000	
2–5	4,000	6,000	2,000	
2–6	4,000	7,000	2,000	
2–7	4,000	7,000	3,000	
2–8	4,000	7,000	4,000	

R3

ver.2

	A	B		Do you prefer A or B?
	①②③④	①	②③④	
3–1	4,000	4,000	2,000	
3–2	4,000	7,000	2,000	
3–3	4,000	10,000	2,000	
3–4	4,000	13,000	2,000	
3–5	4,000	16,000	2,000	
3–6	4,000	16,000	3,000	
3–7	4,000	16,000	3,500	
3–8	4,000	16,000	4,000	

R4 ver.2

	A		B		Do you prefer A or B?
	①②	③④	①②	③④	
4–1	6,000	-500	6,000	-4,000	
4–2	4,000	-500	6,000	-4,000	
4–3	1,000	-500	6,000	-4,000	
4–4	500	-500	6,000	-4,000	
4–5	500	-500	6,000	-3,000	
4–6	500	-1,000	6,000	-3,000	
4–7	500	-1,000	6,000	-2,000	
4–8	500	-1,000	6,000	-1,000	

T4 ver.2

	A	B	Do you prefer A or B?
4–1	12,000 in 2 months	10,000 today	
4–2	14,000 in 2 months	10,000 today	
4–3	16,000 in 2 months	10,000 today	
4–4	18,000 in 2 months	10,000 today	
4–5	18,000 in 2 months	8,000 today	
4–6	18,000 in 2 months	6,000 today	
4–7	18,000 in 2 months	4,000 today	
4–8	18,000 in 2 months	2,000 today	

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