# An experiment on risky choice amongst households.

**by**

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**Abstract.**

A large number of experiments have examined theories of risky choice using individuals. However, many important economic decisions are taken within multi-adult households. This paper reports the results of the first economic experiment designed to test theories of *household* choice. We use a sample of established couples and face them individually and jointly with decision tasks involving monetary payoffs. We test whether their choices satisfy the axioms of expected utility. We find that choices made by couples exhibit the same kinds of patterns (e.g. the common ratio and common consequence effects) as are regularly recorded with individuals.

Keywords: Household choice, experiment, expected utility.

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## *Introduction.*

One of the most common models employed to understand economic behaviour is that of the expected utility-maximizing household. This *standard model*, which is used to investigate saving, insurance decisions, labour supply etc., involves two important assumptions. First, that the household acts as if it has a single set of preferences and secondly that these preferences conform to the axioms of expected utility theory (EUT). In recent years, the first of these assumptions has received a significant amount of scrutiny (e.g. Browning and Chiappori et al, 1998), but very little attention has been paid to the second assumption for households as opposed to individuals. In fact though there exists copious experimental evidence on how individuals choose, there has been very little experimental investigation into how multi-adult households or couples make their decisions.[1]

It might reasonably be supposed that the results of individual choice experiments should carry over into household decision-making but, leaving aside the issue of differences in subject pool, the decision-making environment of the household could eliminate the standard anomalies. For instance, with two people scrutinising probabilities rather than one, the kind of editing and framing effects which underlie Kahneman and Tversky's 1979 explanation of the Allais paradox might not apply. Conversely, even if individuals separately have preferences which satisfy EUT, the rule used to aggregate preferences within the household might produce choices for the household at variance with the predictions of EUT. So, the existing theory and experimental evidence on individual choice does not therefore imply much about how households make choices

[1] For instance in Starmer's recent (2001) survey of the field of risky choice, there is no discussion of evidence on household as opposed to individual behaviour. There is an interesting body of work by psychologists on this issue (see Corfman and Lehmann, 1983 for example), but the questions asked provide little insight into the applicability of economists' models of choice.

in risky situations and in particular, whether households conform to the standard model.

This paper therefore presents results of an experiment designed to investigate the following issue: to what extent do the decisions made by couples and the decisions made separately by individuals who are part of a couple conform to the axioms of expected utility theory? In outline the experiment is as follows: we use a sample of established couples[2] and present them with tasks involving binary choices between lotteries of the kind depicted in Figure 1. In the first section of the experiment the subjects are separated and face choices separately; in the second section they remain apart and must predict their partner's answers from the first section; in the third section they rejoin their partner and make choices as a couple.[3] The tasks are not all repeated in each section, though there is some overlap. Each lottery has possible monetary payoffs for each individual within the couple and these payoffs may be different.

[Figure 1 here.]

In the standard model of household choice referred to above, the household is assumed to be unitary - that is, the household is modelled as a single agent with a single set of preferences - either because there are no public goods local to the household and all members share the same

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[2] Meaning that the couple are in a relationship of at least one year's standing and live together.

[3] In terms of design, possibly the closest experiment to ours is reported by Bone et al, 1999, 2000. There are a number of significant differences between their work and ours, but two stand out. In their experiment, university students are paired at random whereas we are interested in the behaviour of pre-existing decision-making units – i.e. established couples. Secondly, in their design the pairs of students are given a collective payment and must decide how to divide it. Our lotteries assign payments to particular individuals (and our payment procedures reflect this), though this is not to deny the possibility of bargains being made or anticipated.

preferences or because the structure of incentives within the household align individual preferences with those of the decision-maker (as in, for instance, the 'rotten kid theorem', Becker 1974). Empirical testing (see Lundberg et al, 1997 or Alderman et al, 1996 for example) gives results largely hostile to the unitary model, particularly its prediction of income pooling (IP) which is the property that household behaviour may respond to changes in aggregate household income but not to who in the household earns that income. This has prompted a large number of alternative household models, but nevertheless IP remains a convenient modelling assumption in many contexts. For this experiment we design a mix of tests of EUT, some of which are conditional on households satisfying IP and some of which are not. One reason for having the conditional tests is that in many empirical situations it may not be possible to observe the sources of income in a household. We wish to see whether any departures from EUT are robust in the sense that they are still observable in the face of variation in the identity of the income recipient.

## *II Theory.*

For simplicity we consider a two-person household. Denote agents within a given household by i=1,2 and let states of the world be s=1,…,S. Let agent i receive payment $m_{is}$ in state of the world s. A typical lottery p (or q, r or s) is then a vector $(p_1, \ldots, p_S)$. The standard sign, $\underline{\mathbf{f}}$ denotes the weak preference relationship for the household (with strict preference, $\mathbf{f}$, and indifference, ~, constructed in the usual manner.

A household obeys expected utility theory (EUT) in its joint choices if there exists a strictly increasing function $w(m_{1s},m_{2s})$ such that the household ranks lotteries according to, $W(p) \equiv \sum_{s=1}^{s=S} p_s w(m_{1s}, m_{2s})$ . In other words $W(p) \geq W(q) \leftrightarrow p \ \underline{\mathbf{f}} \ q$. In a similar manner it is also possible to define utility functions, $W^i$ (p) i=1,2, for the two individuals. Note that the relationship

between the $W^i$s and W depends on the household aggregation rule. So the fact that the household choices conform to EUT does not imply that the $W^i$s satisfy the axioms of EUT - or vice versa.

We shall say that the household *income pools* (IP) or that it is an *income pooler* if $w(m_{1s},m_{2s}) = w(m_{1s}',m_{2s}')$ whenever $m_{1s}+m_{2s} = m_{1s}'+m_{2s}'$ for all s. There are other important special cases for w: for instance the additive form, $w = w^1(m_{1s},m_{2s}) + ?w^2(m_{1s},m_{2s})$ where $w^1$ and $w^2$ are the private utility functions of the two individuals; and the additive form with efficient ex-post transfers: $w \equiv \max_{t_s} w^1(m_{1s} - t_s) + lw^2(m_{2s} + t_s)$. The first of these forms occurs if the household is unable or unwilling to engage in state-dependent transfers of income. In the second case, there is efficient risk-sharing between the partners.

Although w has two arguments rather than the one that is typical of individual choice, nevertheless for the household or individual which maximizes W(.), preferences between lotteries should have the familiar properties of EUT. Figure 2 shows a standard unit probability triangle representing lotteries involving three possible values of w: $w_1$, $w_2$ and $w_3$, with $w_3 > w_2 > w_1$. In the figure, the solid line connecting a and e is parallel to that between c and d.

[Figure 2 here.]

In the unit probability triangle, EUT predicts that indifference curves are straight, parallel lines. However, individuals frequently fail to conform to the predictions of EUT in a number of ways. Possibly, three of the most robust anomalies (see Starmer, 2001 for a comprehensive survey) are the *common ratio* effect, the *common consequence* effect and failure of the *betweenness* property. In the first, individuals tend to choose the safer option represented by choosing a out of the pair {a,e} and then the riskier option d out of the pair {c,d}. In the second a is chosen out of {a,b} and then d is picked from {c,d}. In the third case, EUT implies that individuals who choose b out of {a,b} should choose e out of {a,e}, whereas often individuals choose b and a. Indifference curves in the triangle therefore seem to be more like the broken lines

depicted in figure 2, than the straight and parallel lines implied by EUT. The experiment is designed to see if couples have similar revealed preferences.

### *III Experimental Design.*

We ran two almost identical experiments, A and B using the format summarised in figure 3 (n=10 in experiment A and n=12 in experiment B). The experimenters used a script and subjects received summary instructions separately for each section of the experiment. Appendix B (available from the authors) shows the written summary given to subjects in the first section of the experiment.

[Figure 3 about here.]

To indicate roles, each member of the pair was given one from a pair of cards ('wave' or 'triangle') at random at the start of the experiment. After briefly introducing the experimenters, one half of the subjects were led to a separate room for the first two sections of the experiments.

The instructions for the first section explained the nature of the lotteries that were the focus of the experiment. Recall Figure One where each depiction of the typical lottery was composed of three elements: ranges of numbers along the top; payoffs for the subject below and then payoffs for their partner.[4] The subjects were informed that the numbers along the top corresponded to numbered discs in a bag of one hundred discs shown to them by the experimenters. Subjects were told that at the start of the third section, each couple would choose a small envelope which would contain a number to be revealed at the end of the experiment. If the number matched one of the question numbers for section 1, then they would play out their chosen

[4] For the joint choice questions, the triangle partner's payoffs were always shown first. We found no evidence that this order gave triangle partners more or less influence in the joint decisions.

lottery from that question.[5] They would choose a disc from the bag yielding the corresponding payoffs for them and their partner.

Two questions designed to test understanding were placed at the end of the briefing for the first section. After all subjects had answered these questions satisfactorily, they were instructed to answer the choice questions in their own time. When all subjects in the group had completed all the questions for section 1, they were led through the instructions for section two, including those concerning incentives (see below). At the end of the answer sheets for the second section was a short questionnaire with questions and age, gender, number of children and domestic financial arrangements. Once all subjects in both groups had completed this as well as their prediction questions they rejoined their partners for the final section of the experiment.

The experimenters removed the envelopes from sections 1 and 2 and gave each couple one small envelop and one large envelop. The large one contained the instructions and answer sheet for section three. Meanwhile, the couples were invited to choose a small envelope from a shuffled pile placed in front of them and told not to open it until instructed. No prompts were given as to which partner should make the choice. Inside the small envelope was the number that would determine which question would be 'for real' at the end of the experiment. Lottery ticket numbers from 1-3n had been allocated at random to the small envelopes.

Before opening their large envelopes, the subjects were given more explicit details of how the payout procedures would operate at the end of the experiment. They were then led through the instructions for the final section and asked to complete their final set of answers. Once all subjects had completed the tasks, we began the task of opening the small envelopes, executing lotteries and making payoffs.

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[5] Subjects were not told at that stage what would happen if any other number was in the envelop.

The incentive system was as follows: for ticket numbers from 1 to n, the triangle partner played his or her choice for that question and the wave partner received £0.50 for each correct prediction she or he had made.[6] For numbers between n+1 and 2n, the wave partner played his or her choice while the triangle partner was paid £0.50 for each correct prediction. For numbers from 2n+1 to 3n, the couple played their choice for that question; no money was paid for predictions.[7] This random lottery system is incentive compatible if individuals are selfish (and make no binding agreements on ex-post trade), but it would be usual to suppose some degree of other-regarding preferences within couples. As a result, it is conceivable that an altruist might view the first two sections of the experiment as an exercise in co-ordination and possibly choose so as to maximize the predictive success of his or her partner. We aimed to guard against this possibility in three ways. As a first measure, when recruiting and when we met the subjects, we gave them no information about the details of the experiment before they were separated from their partners. We just made brief statements to the effect that the experiments were aiming 'to help us understand how couples make decisions'. As a second measure the prediction section always came after the separate choice section. We also saved the briefing for section 2 until all subjects in a session had completed section 1. So, subjects therefore had no reason to anticipate that they should answer in section 1 so as to raise the possible payoffs of their partner. As a final measure we kept the payments for prediction to a relatively small fraction of the payments associated with the choice sections. The payments obtainable from the choice section ranged from £0 to £40, whereas the range for the prediction section was only £0 to £n/2. And in the choice sections, the expected

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[6] The wave partners saw questions in the order n+1 to 2n (choice) and then 1 to n (prediction).

[7] Cubitt et al 1998 provide evidence that random lottery schemes are a reliable means of eliciting preferences even when subjects are not EUT maximizers.

values of the two options on offer always differed by more than £0.50. This means that a risk neutral income pooling agent (for example) would not make an expected gain from switching choices in order to improve the predictive success of their partner.

We went to some trouble to preserve the confidentiality of the answers from sections 1 and 2. Partners were paid sequentially and separately with any payments placed in envelopes. The payment process occurred in another room or in a position which masked any payments made. Subjects were not informed of their partner's answers in section 1 of the experiment and they were not given information about the accuracy of their partner's predictions.[8] Now, theories of the household are rarely explicit on whether individuals are privy to the patterns of consumption and income of their partners. However, there is plenty of empirical evidence of asymmetric information within the household. For instance, in a survey of spending habits in UK households, Pahl, 1983 reports that 'typically, husbands over-estimated the amounts wives spent on leisure, while wives under-estimated how much their husbands spent', p. 132. (Woolley, 2000, provides similar evidence for Canada and see also Treas, 1993 for US evidence.) It is reasonable to expect theories to be robust in the face of such possibilities. However, our main reason for confidentiality is as follows: Many economic theories of the household relate collective choice to individual preferences over goods. To test such theories we normally require data about individual preferences over commodities. Revealing choices to partners might instead produce information on preferences over actions. In particular it might create incentives for individuals to choose so

[8] In our incentive system, if one partner predicted perfectly (or scored zero), then provided she or he had perfect recall of the questions, that subject could deduce a partner's choices. However, no participant raised this possibility with us during the conduct of the experiment and no individual achieved perfection in their predictions (or scored zero).

as to avoid recrimination or garner approval from their partners. Such motives may actually be an important source of household behaviour, but they are not typically the objects of preference in economic theories of the household. So, we opted for confidentiality in our design.

Following a successful pilot session, the experiments were carried out from December 2002 to March 2003. Many of the sessions were held at lunchtime or after work in one hour time slots designed to accommodate the time constraints on our subjects, most of whom were in paid employment and/or had children. Subjects were recruited from the city of Norwich and rural Norfolk via email, through community groups and using posters. Session sizes varied from two to ten couples and were held at a variety of venues, including a village hall and the experimental economics laboratory at the University of East Anglia. In recruiting we required all individuals to be over 21, to be living with their partners and to have been together as a couple for at least one year. We asked subjects to bring evidence of their relationship and made random checks.

Twenty-four questions were common to experiments A and B - we added six and replaced six when it became clear that the experiment could accommodate more questions in the one hour time slot. We took the opportunity to drop some questions associated with hypotheses which were quickly rejected by the accumulating data. The data from part A and part B is also routinely pooled after standard statistical tests indicated no significant differences between the data for the questions common to both sub-samples.

## *IV Results.*

We recruited 76 couples - 42 couples for A and 34 for B. Average payoffs were just under £17 per individual - more than twice the median hourly post-tax wage for a UK adult in 2002. Ages ranged from 22 to 70, with a mean of just over 37.3. On average couples had been together

for 11 years, with a maximum of 46 and a minimum of 1.[9] Seventy-three percent of individuals stated that they were married to their current partner and all the couples in our sample were heterosexual. The average number of children was 1.1 per couple - with peaks in the distribution of children per person at zero and two. Overall therefore, without being representative of the UK adult population the subjects were generally older and more diverse than the typical sample of university students used in choice experiments.

In what follows, the tasks are labelled. Their details can be found in the Appendix, where the letter T indicates a task faced by triangle subjects, W stands for tasks faced by wave subjects and J indicates tasks put jointly to couples in the final part of the experiment.[10]

For both joint and separate choice we included questions such as the one shown in Figure 1 where one option first-order stochastically dominates the other. For these four questions (T13, J11, W13 and W14) the dominated option was chose in just under 6% of observations.

Recall that IP is a feature of what we termed the standard model. We had seven tasks where one of the options dominates the other, for subjects whose choices satisfy IP (but not necessarily otherwise). In 90% of cases the choice is in conformity with IP and the accordance is stronger for the choices made jointly than for those made when the individuals are separated. Suppose we hold the null hypothesis that in all cases subjects mean to choose the IP dominating option, but make a mistake in 6% of cases (i.e. the rate of 'error' in the choices with one dominating option discussed above). With the exception of one task (T11), the pattern of choices

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[9] Less than 7% of couples had been together for just one year. Evidence included passports, photos, bills to the same address and, in three cases, children.

[10] 'Groups' are sets of tasks which are equivalent from the perspective of a chooser who satisfies IP. The task numbers do not match the order of questions, but are purely for reference purposes.

is consistent with this null hypothesis, suggesting that IP is a reasonable assumption in the context of this experiment. We also had a number of tests of IP based on pairs of tasks which are equivalent when faced by a chooser who satisfies the IP property. That data is more mixed in the conclusions it produces.[11] So, given the evidence for IP in our data is not overwhelming we conduct tests of EUT both with and without its presence as an auxiliary assumption.

Tables 1-3 summarise the main results of the paper. All the comparisons shown are within subject. In these three tables, entries labelled CR represent common ratio tests - i.e. comparisons between choices in pairs of tasks similar to {a,e} and {c,d} in Figure 2. Entries marked CC represent common consequence tests – i.e. comparisons between choices in pairs of tasks similar to {a,b} and {c,d} in Figure 2. BB represents tests of the betweenness property of EUT (comparisons between choices in pairs of tasks similar to {a,b} and {a,e}). The next column states whether the comparison is conditional on the assumption of the IP property. If it is, then this means that pairs of tasks can only be plotted in the same unit probability triangle if IP holds. In the two proportions columns, the numbers represent the fraction of the sample choosing the safer option. According to EUT, the fraction should be the same across the relevant tasks. This is always the null hypothesis. According to the typical results of individual choice experiments the proportion in the task 2 column should be lower. This is always the alternative hypothesis. Across all the tables, none of the proportions in the task 2 column are higher than their counterparts in the task 1 column. In the final column we report probability values (to three significant figures) for the null hypothesis that the sample proportions are equal, using a paired, one-sided z-test. For CR, CC and BB, a large number of these comparisons are statistically significant; in many cases at levels of significance well below 0.1%.

[11] For details see Bateman and Munro, 2003, which focuses on the IP issue.

[Table 1 here]

Table 1 summarises results for the cases involving separate choice. All the CR and BB comparisons are statistically significant at the 10% level or lower. For two CC cases where the test is not conditional on IP, the difference in responses to the two tasks is not statistically significant.[12] So, broadly speaking the evidence for a common ratio effect and for failure of the betweenness property is stronger than that for the common consequence effect. In terms of the stylised indifference curves in Figure 2, it suggests that the section between a and b is roughly parallel to the curve between c and d, but that the indifference curves show increasing risk aversion (i.e. become steeper) between b and e. It is worth noting that this pattern persists across the variety of tasks listed in the table – for some of these tasks all the payoffs are to the choosing agent, but for many tasks both partners might possibly receive payment and in several cases it is only the partner that might receive payments. Nevertheless the pattern of choices is consistent.

Table 2 presents the data from the prediction section of the data. Note that though the tasks are the same as those in Table 1, it is the other partner who is doing the predicting. All the comparisons are statistically significant, even with the CC examples. So, the results suggest that prediction deviates significantly from EUT. When we look at the prediction data in detail we find that partners predict correctly in 65% of cases. This is significantly better than fifty-fifty; it is also better than the success rate if they supposed (as a benchmark example) that their partner was a risk neutral income pooler. However, if individuals predict according to how they themselves choose and preferences are not correlated within couples then the predicted success rate is 64.7% - which

[12] It is also possible to use some Wave responses to create a between-subject CC comparison. When this comparison is made a proportion 0.53 choose the safer option out of {a,b} while 0.43 pick the safer option out of {c,d}. This is significant at the 10% level (p=0.095).

is not statistically significantly different from the actual value.

[Table 2 here].

The fact that, when separated, individual partners depart from the standard model in their choices does not mean that those individuals have non-EUT preferences. They may be altruists who believe that their partners have non-EUT preferences. Similarly, in the absence of common knowledge, it cannot be deduced that individuals who predict anomalous behaviour in their partners actually believe that their partners have non-EUT preferences. If, though, this was the case, then we would expect the possibilities for communication afforded by the joint decision-making responsibility of section three to iron out any misunderstandings. In fact, as we can see from Table 3, the joint choice data exhibits the same patterns as the prediction and separate choice data. This is true with and without the auxiliary assumption of IP. Moreover, as with the separated choice, the evidence for common ratio effects and for the failure of the betweenness property is stronger than that for the common consequence effect. This suggests that the departure from EUT observed in the separate choice and predictions data is not simply due to misconceptions about the preferences of partners. Rather, it seems to be a persistent feature of choice in the context of multi-person households.

[Table 3 here].

## *V Discussion.*

The fact that the preferences of two individuals separately conform to the assumptions of EUT does not imply that their collective decisions will always conform to the same axioms. Conversely, depending on the household decision process, it is possible that two individuals with non-EUT preferences can produce collective choices that do satisfy the predictions of EUT. It follows that tests of whether the decisions of established couples conform to EUT are logically separate from the issue of whether individual decisions satisfy the theory. Nevertheless, in this

experiment the main result is that couples show the same patterns in their risky choices as have been frequently observed in individual choice experiments. When separated from their partners, individuals who are part of a couple also show the same patterns and predict the same patterns in their partner's choices. The results of the experiment also suggest that the results are robust in the face of changes in the identity of who in the household receives the payoffs.

In the face of individual choice anomalies, a number of alternative theories of risky choice have been put forward (e.g. regret theory, prospect theory etc.). To a significant degree, these theories have been motivated by ideas drawn from the psychology of the individual. It is not clear that the same ideas automatically apply in the household, where decisions are typically made in an interactive fashion; other forces may be at the root of the results found here. For instance, we found a surprisingly high incidence of examples where, separately both individuals chose the risky option in an identical task, but as couples chose the safe option. Anecdotal evidence from participants suggested a 'fear of recrimination' as a significant factor influencing joint choices, making some participants reluctant to be seen to be the individual pressing for the risky option. If such forces are regularly at work in households it suggests that behavioural models of collective decision-making may be quite different to their individual decision-making counterparts.

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Table 1. Tests of EUT using Separate Choice Data

| N | Type of comparison | IP assumed? | Task 1 | Task 2 | Proportion choosing safer option, Task 1 | Proportion choosing safer option, Task 2 | Probability |
|---|---|---|---|---|---|---|---|
| 76 | CR | No | T8 | T10 | 0.66 | 0.43 | 0.000*** |
| 76 | CR | Yes | T8 | T5 | 0.66 | 0.54 | 0.073* |
| 76 | CR | Yes | T3 | T10 | 0.83 | 0.43 | 0.000*** |
| 76 | CC | No | T1 | T10 | 0.50 | 0.43 | 0.190 |
| 34 | CC | No | W8 | W5 | 0.53 | 0.53 | 0.500 |
| 34 | CC | Yes | T2 | T10 | 0.53 | 0.32 | 0.055* |
| 34 | CC | Yes | W2 | W5 | 0.71 | 0.47 | 0.028** |
| 76 | BB | No | T8 | T1 | 0.66 | 0.50 | 0.048** |
| 34 | BB | Yes | W9 | W8 | 0.71 | 0.56 | 0.042** |
| 76 | BB | Yes | T3 | T1 | 0.83 | 0.50 | 0.000*** |

*** indicates difference significant at 1% level, 1 tailed test; ** indicates significant at 5% level; * indicates significant at 10% level.

Table 2. EUT and Prediction Data

| N | Type of comparison | IP assumed? | Task 1 | Task 2 | Proportion predicting safer option | | Probability |
|---|---|---|---|---|---|---|---|
| | | | | | Task 1 | Task 2 | |
| 76 | CR | No | T8 | T10 | 0.70 | 0.43 | 0.000*** |
| 76 | CR | Yes | T8 | T5 | 0.70 | 0.59 | 0.051* |
| 76 | CR | Yes | T3 | T10 | 0.88 | 0.43 | 0.000*** |
| 76 | CC | No | T1 | T10 | 0.62 | 0.43 | 0.011** |
| 34 | CC | No | W8 | W5 | 0.47 | 0.32 | 0.078* |
| 34 | CC | Yes | T2 | T10 | 0.68 | 0.41 | 0.024** |
| 34 | CC | Yes | W2 | W5 | 0.68 | 0.32 | 0.002*** |
| 76 | BB | No | T8 | T1 | 0.70 | 0.62 | 0.068* |
| 34 | BB | Yes | W9 | W8 | 0.71 | 0.47 | 0.009*** |
| 76 | BB | Yes | T3 | T1 | 0.88 | 0.62 | 0.000*** |

*** indicates difference significant at 1% level, 1 tailed test; ** indicates significant at 5% level; * indicates significant at 10% level.

Table 3. Tests of EUT using Joint Choice Data

| N | Type of comparison | IP assumed? | Task 1 | Task 2 | Proportion choosing safer option, Task 1 | Proportion choosing safer option, Task 2 | Probability |
|---|---|---|---|---|---|---|---|
| 34 | CR | Yes | J3 | J5 | 0.94 | 0.59 | 0.000*** |
| 34 | CR | Yes | J8 | J5 | 0.88 | 0.59 | 0.000*** |
| 34 | CR | No | J7 | J5 | 0.73 | 0.59 | 0.013** |
| 34 | CC | No | J1 | J5 | 0.71 | 0.59 | 0.110 |
| 34 | CC | Yes | J2 | J5 | 0.71 | 0.59 | 0.130 |
| 34 | CC | Yes | J6 | J10 | 0.44 | 0.06 | 0.000*** |
| 76 | BB | No | J3 | J1 | 0.94 | 0.64 | 0.000*** |
| 34 | BB | Yes | J8 | J1 | 0.88 | 0.71 | 0.006*** |
| 34 | BB | Yes | J3 | J2 | 0.94 | 0.71 | 0.002*** |
| 34 | BB | Yes | J8 | J2 | 0.88 | 0.71 | 0.016** |

*** indicates difference significant at 1% level, 1 tailed test; ** indicates significant at 5% level; * indicates significant at 10% level.

***Question 2*** **Option A**

| For numbers: | 1-50 | 51-100 |
|---|---|---|
| You receive | **£20** | **£0** |
| Your partner receives | **£0** | **£20** |

| For numbers: | |
|---|---|
| You receive | |
| Your partner receives | |

I choose (***tick one***): Option A ☐

**Figure 1. A typical question from section 1 of the experiment.**

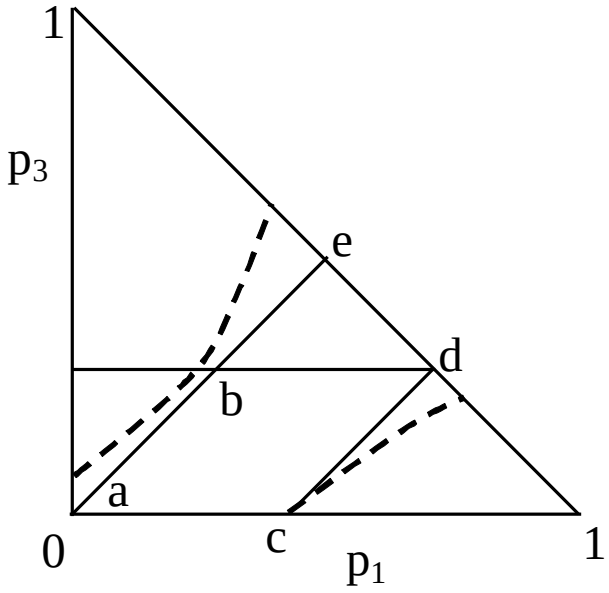


**Figure 2. Tests of EUT in the unit probability triangle.**

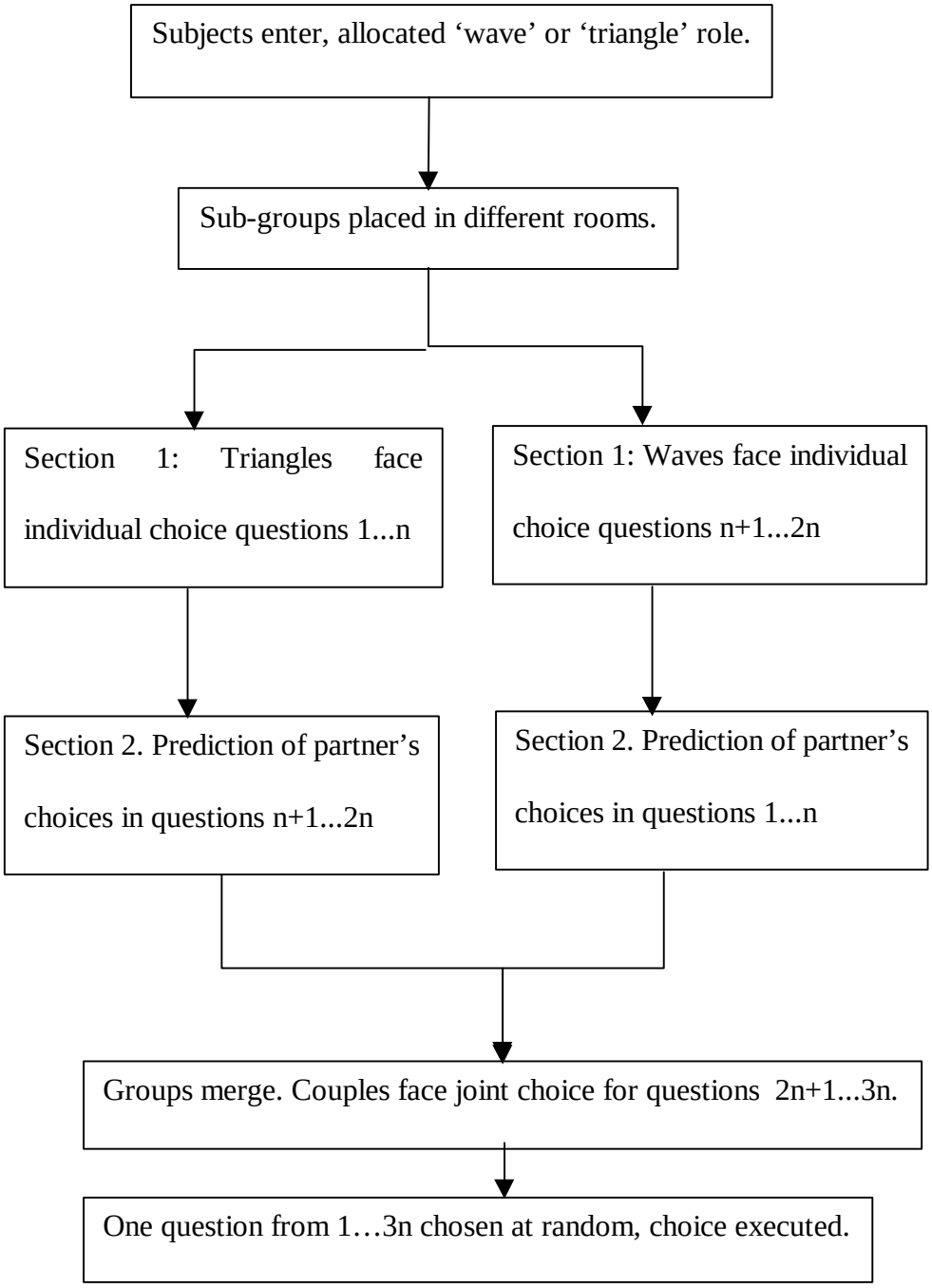


**Figure 3. Experimental Procedure.**

Appendix A. The tasks.

| | | Lottery 1 | | | | Lottery 2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Triangle | | Wave | | Triangle | | Wave | |
| | | £20 | £40 | £20 | £40 | £20 | £40 | £20 | £40 |
| Group 1 | Set 1: T1, W1, J1 | 1-100 | - | - | - | 21-70 | 71-100 | - | - |
| | Set 2: T2, W2, J2 | 21-100 | - | 1-20 | - | 21-100 | - | 71-100 | - |
| | W8 | - | - | 1-100 | - | - | - | 21-70 | 71-100 |
| Group 2 | Set 3: T3, W3, J3 | 1-100 | - | - | - | - | - | - | 41-100 |
| | W9, J8 | 1-50 | - | 51-100 | - | 41-100 | - | 41-100 | - |
| | T8 | 1-100 | - | - | - | - | 41-100 | - | - |
| Group 4 | Set 5: T5, W5, J5 | - | - | 51-100 | - | - | - | - | 71-100 |
| | T10 | 51-100 | - | - | - | - | 71-100 | - | - |
| Group 5 | Set 6: T6, W6, J6 | 1-100 | - | 1-100 | - | 1-100 | - | 21-70 | 71-100 |
| Group 6 | Set 7: T7, W7, J7 | - | - | 1-100 | - | - | 1-70 | - | - |
| Group 7 | T11, J10 | 51-100 | - | 1-50 | | 1-100 | - | - | 71-100 |
| | W11 | 31-100 | - | 1-30 | - | - | 71-100 | 1-100 | - |
| Other | T13, W13, J11 | 1-50 | - | 51-100 | - | 1-50 | 51-100 | 51-100 | - |
| | W14 | 1-70 | - | 21-70 | 71-100 | 71-100 | - | 1-70 | - |
| | J13 | - | 71-100 | 1-70 | - | 1-60 | 61-100 | - | - |
| | J14 | - | - | 21-70 | 71-100 | 1-40 | - | - | 71-100 |

Note: in this table the numbers shows the ranges of disc values for which the corresponding payoffs were awarded. To save space, we omit the numbers for states of the world where the payoff was zero. We also omit those tasks (e.g. Group 3) which are not relevant for this paper.

Appendix B (Not for publication). The first two pages of the section 1 booklet for triangle subjects.

**Section 1.**

- In this section you will face a series of twelve different choices involving options like example 1 shown be
- Each choice will involve two options, labelled A and B.
- For each question your task is to choose the option you would prefer to have.
- At the end of the experiment, one question number from 1-36 will be drawn at random.
- If one of these questions is selected at the end of the experiment you will play out the option chosen by yo
- You will be asked to draw a number from 1-100 from a bag containing 100 discs.
- You will receive your prize corresponding to that number and your partner will receive their prize corres
- Your choices are confidential - we will not reveal them to your partner.

The options you will face are similar to the one shown in Example 1.

**Example 1.**

| For numbers: | 1-20 | 21-70 | 71-100 |
|---|---|---|---|
| You receive | **£0** | **£0** | **£40** |
| Your partner receives | **£0** | **£20** | **£40** |

The row beginning 'For numbers' has three ranges of numbers, corresponding to the numbers in the bag. Below ea
for your partner.

For instance, under the range 21-70 you can see a prize of £0 for you and a prize of £20 for your partner. These a
option and you pulled a number between 21 and 70 from out of the bag.

[please turn over]

Appendix B (Not for publication). The first two pages of the section 1 booklet for triangle subjects.

Example 2 shows choices as you will see them. In each case you must choose ONE option by ticking the appropr

***Example 2.***

**Option A**

| For numbers: | 1-60 | 61-100 |
|---|---|---|
| You receive | **£20** | **£20** |
| Your partner receives | **£0** | **£20** |

| For numbers: | 1-20 |
|---|---|
| You receive | **£0** |
| Your partner receives | **£0** |

I choose (***tick one***): Option A ☐

For instance, suppose you chose Option B by ticking the relevant box, then if the number 25 was pulled from the b
receive nothing and your partner would get £20.

***Check your understanding.***
Suppose that in the example question you had chosen Option B and that this question was picked at the end of th

What would you receive if the number 80 was picked from the bag? (***tick one***) **£**

What would your partner receive if the number 20 was picked from the bag? (***tick one***) **£**

## To sum up, for each question your task is to choose the opt