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Sequential Common Consequence Effect and Incentives

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Abstract

Economics calls for monetary incentives to induce participants to exhibit truthful behaviour. This experiment investigates the effect of reducing incentives on dynamic choices, which encompass the individual and chance in a sequence of decisions. This experiment compares choices with the commonly used random lottery incentive system (RLIS) to hypothetical choices in the dynamic choice setting surrounding the common consequence effect (CCE), both horizontal and vertical. In addition, the RLIS is partially controlled for by eliciting with single choice individual preferences over the two horizontal CCE static choice problems. Results suggest that lessening incentives do not induce a systematic shift in preferences when emotional responses are not at stake.

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1. Introduction

Experimental economics mostly assumes Smith (1982)'s claim that experiments need monetary incentives to motivate participants to choose in consonance with their preferences (see, e.g., Charnes, Gneezy and Halladay, 2106). More particularly, experimental research on individual decision making under risk uses as main incentive mechanisms single choice and random lottery incentive system (RLIS). However, originally (e.g., Allais, 1953; Kahneman and Tversky, 1979) and nowadays occasionally (e.g., Dohmen, Falk, Huffman and Sunde, 2011), hypothetical choice is also used. This work contributes to the research on the effect of incentives on dynamic choices, where little has been reported except for Wilcox (1993), Beattie and Loomes (1997) and Baltussen, Post, van den Assem and Wakker (2012). Dynamic choice refers to a sequence of decisions, some made by the individual and some made by chance. This experiment investigates the effect upon dynamic choices of reducing monetary incentives from the RLIS to hypothetical choice. In addition, the RLIS is partially controlled for through eliciting single choice in a pair of static choices. That is, Harrison's (1994) dilution of incentives hypothesis is further investigated. If the RLIS dilutes incentives with respect to single choice, hypothetical choice dilutes incentives drastically. What are the effects on dynamic choices?

Standard dynamic choice theory (references) endorses some principles of rationality. The dynamic choice principles are theoretically linked to the paramount static choice theory, Expected Utility theory (EUT) (von Neumann and Morgenstern, 1947). Namely, the dynamic choice principles of dynamic consistency, separability and reduction of compound lotteries jointly imply EUT independence axiom. And hence, experimental research on the dynamic choice principles is also linked to the experimental evidence on the failure of EUT independence axiom. This study investigates this theoretical framework between EUT independence and the dynamic choice principles from a methodological-incentives perspective.

Specifically, individual preferences elicited by RLIS and hypothetical choices are compared with respect to: the common consequence property of EUT independence; independence for sure prospects; reduction of compound lotteries; timing independence[1] and separability. For the problems involved, I examine the possibility that hypothetical choice introduces a systematic shift in individuals' preferences.

[1] Testable analogue of dynamic consistency (see Ruiz-Martos, 2017a).

But there are theoretical arguments (see below) against the RLIS and for single choice in the elicitation of risk preferences. Thus, I also include a direct control of the RLIS with respect to single choice. Preferences are elicited over the problems involved in the common consequence effect (CCE) violation of EUT independence. In addition, following Starmer and Sugden (1991), this comparison allows to report a test of the strong argument against the RLIS posit by Holt (1986): basically, that one could observe a violation of EUT independence in single choice but not in RLIS.

The innovative presentation of the choice problems in this study has proven to be particularly good to illustrate sequential risk decision problems to subjects (Ruiz-Martos, 2017a); thus, this design permits to control and isolate differences, if there are, among RLIS and hypothetical choice in sequential choice problems.

The next section summarises the RLIS, and by extension hypothetical choice, advantages and disadvantages with respect to single choice and some of the recent evidence, in the context of individual decision making under risk[2]. Section 2 presents the experimental design and the hypotheses being tested. The description of the results come next and the chapter finishes with some conclusions.

2. Theoretical background

The individual has a true preference of one lottery, A, over another lottery, B, if he chooses A when he is asked to choose between these two lotteries for real and there is not any other choice problem for real (Starmer and Sugden, 1991, p. 971). The single choice design is meant to elicit individual's true preferences. However, the expensive cost of implementing the single choice design and the advantage of within-subjects comparisons incline experimental economists to use, instead, the RLIS.

The RLIS works by presenting each individual with a set of risk choice problems. The individual is asked to consider each problem as if it was the one and only problem answered for real, though he knows from the start that just one of these problems is randomly selected to be for real. The methodological issue at stake is to what extent the RLIS elicits individual's true risk preferences. That is: does the subject treat each choice problem in the RLIS experiment as if it

[2]See, for example: Holt (1986), Starmer and Sugden (1991), Wilcox (1993), Harrison (1994), Beattie and Loomes (1997), Cubitt, Starmer and Sugden (1998b), Harrison and Swarthout (2014) Add references.

were the one and only problem for real? The latter is assumed by the isolation principle of Kahneman and Tversky's (1979) editing stage in prospect theory.

2.1. Arguments Against the RLIS

An individual that is faced with several risk choice problems in a RLIS design may respond by increasing or decreasing his cognitive effort, which in turn may generate two basic and potential problems: cross-task contamination and dilution of incentives.

2.1.1. Cross-task contamination

Cross-task contamination refers to the possibility, Holt (1986), that the individual choice in each problem is affected by the nature of the other choice problems. Moreover, Holt (1986) hypothesizes a strong form of contamination. The individual interprets the whole RLIS experiment as a unique choice problem over compound lotteries, and maximises his preferences over this unique choice problem. The latter problem is the reduced form of the set of problems involved in the RLIS experiment, obtained by multiplying probabilities as postulated by the reduction of compound lotteries principle. If individuals actually apply this reduction procedure to a RLIS experiment and do not obey EUT independence, then the RLIS will not elicit individuals' true preferences. I will call this possibility the *RLIS-reduction procedure*. To test for the *RLIS-reduction procedure*, one needs to compare a single choice experiment and a RLIS experiment in terms of the failure of the EUT independence axiom (Starmer and Sugden, 1991). For the procedure to hold, one should observe a failure of EUT independence in single choice but not in the RLIS design. This test is included in the current study for the problems involved in the CCE.

But even if the individual does not deal with the RLIS experiment as a unique and reduced choice problem, the RLIS may systematically shift individual choices with respect to the preferences elicited by a single choice design. For instance, Davis and Holt (1993, p. 455) claim that contamination goes in the direction of increased risk seeking in the RLIS; parallelly to the finding by Battalio et al. (1990) that hypothetical choices exhibit more risk seeking than RLIS choices. In general, Davis and Holt (1993) suggest that risk aversion significantly decreases from single choice to hypothetical choice, with the RLIS lying midway.

2.1.2. Dilution of incentives

Assuming Smith's (1982) claim, the RLIS may reduce the impact of incentives. As a result, it reduces the cognitive effort by which the individual determines the option that maximises his preferences. Hence, with respect to single choice, the frequency of errors increases in the RLIS.

From the standpoint that individuals' true preferences obey traditional choice theory, Harrison (1994) claims that individuals reduce cognitive effort in RLIS experiments. This reduced cognitive effort is their rational response to decreased costs of making mistakes. Mistakes appear when the individual uses simple decision heuristics to economize effort, and this -given his stance- ultimately results in a larger tendency to elicit violations of EUT. The RLIS actual cost of choosing a less preferred option in a particular problem is the difference in values between the most and the less preferred options multiplied by the random lottery probability of playing that problem for real[3]. Taken to the extreme, Harrison (1994) implies that the RLIS is as unreliable as hypothetical choice to elicit individual's true preferences. That is: we should observe a systematic increase in EUT independence violations as we move from single choice to hypothetical choice data, with the RLIS data in between. In the same line, Wilcox (1993) argues that the dilution of incentives implies that individuals are less willing to incur in decision costs which reduces the time they spend to determine their preferred options and induces them to use less accurate decision heuristics.

2.1.3. Isolation Principle or Dynamic Choice Principles

Any choice in a RLIS implies the precommitment to a choice before the RLIS, which entails a prior risk, is resolved. The dynamic choice principle of timing independence requires the before-resolution choice to equal the choice the individual would make once the RLIS has been resolved, i.e. the post-resolution choice. The dynamic choice principle of separability requires the post-resolution choice to equal the isolated choice the individual would make in a single choice design. Hence if both principles hold, the RLIS is valid. More concretely, "timing independence and separability are jointly sufficient for the validity of the" RLIS (Cubitt et al., 1998, footnote 8, p.1372). This argument is particularly strong in the case of experimentally testing the dynamic choice principles, which the authors strongly recommend against. Open question remains whether timing independence and separability are necessary for the validity of the RLIS (for a detailed discussion, see Ruiz-Martos, 2017b).

2.2. Arguments for the RLIS

[3]Subsequently, the larger the number of problems in the RLIS experiment, the more dramatic the decrease in the costs of mistakes (Wilcox, 1993).

The RLIS has clear advantages over the single choice design. It allows to do within-subjects comparisons without generating endowment effects[4] (Bardsley, Cubitt, Loomes, Moffatt, Starmer and Sugden, 2009) and to gather a considerable amount of data at a relatively low experimental cost (for instance, it reduces recruitment costs and permits the use of high stakes).

3. Some Experimental Evidence

For more comprehensive reviews of the incentives' effects on individual choice under risk see Camerer (1995), Beattie and Loomes (1997) and Camerer and Hogarth (1999). I will focus on those studies that relate to a particular line of criticism of the RLIS, namely that it converts the experiment into a dynamic choice problem.

3.1. Cross-task contamination in static choices: RLIS-reduction procedure and shift in risk-seeking

Starmer and Sugden (1991) test both forms of RLIS contamination suggested by Holt (1986): the *RLIS-reduction procedure* and the more general contamination effect of a systematic shift in individual preferences. They study the failure of the EUT independence axiom known as the horizontal CCE (see below) under a single choice and a RLIS designs. They report a horizontal CCE in the direction of fanning-out irrespectively of the incentive mechanism and no signs of systematic shift in risk preferences.

Cubitt, Starmer and Sugden (1998b) reports three experiments. The first two experiments test for the *RLIS-reduction procedure* and a preferences-shift in the context of the two typical violations of EUT independence axiom -horizontal CCE and common ratio effect (CRE)[5]- and a, not very typical, RLIS design over only two problems. However, they do not observe any of the effects in single choices and cannot accept or reject the *RLIS-reduction procedure*. In addition, for the choice problems involved, they do not observe any systematic shift in individual preferences. Their Experiment 3 is built around the CRE, a typical RLIS design over 20 choice problems and distinct expected value of the 18 no-CRE choices (to test Machina's (1982) fanning-out hypothesis)[6]. In total, the CRE is tested under single choice, RLIS and hypothetical choice. The results show the CRE in each incentive mechanism, being the effect more

[4] That appear whenever subject's choice is affected by the payment received from other choices.

[5]Both effects show individuals' tendency towards risk seeking as the lotteries became riskier for the decrease in either the value of the common consequence or the ratio of winning probabilities.

[6]Machina (1982)'s fanning out hypothesis implies that individuals' preferences over each of the CRE problems ae more risk averse when combined with high-expected value choice problems than with low-expected value ones.

pronounced in the RLIS, followed by, in this order, the hypothetical choice and the single choice. Moreover, their findings reject contamination effects for each of the CRE problems in the two RLIS treatments though support the fanning-out hypothesis for the no-CRE problems.

Hey and Lee (2005a) report two RLIS experiments -one over a complete ranking of 11 lotteries and another over 30 pairwise choices between those lotteries- to investigate if non-EU individuals tend to follow the isolation principle -which they refer to as the separation hypothesis- or the *RLIS-reduction procedure* -which they refer to as the sophistication hypothesis. The test is conducted using two measures (Selten's mesure of predictive success and a distance measure) that differ in whether they demand subjects answers to exactly conform or not to a particular generalisation of EUT[7]. Irrespectively of the type of subject, the measure and the experiment, individuals exhibit a tendency to follow the isolation principle.

Hey and Lee (2005b) analyse whether the individual's choice in one of the RLIS pairwise choice problems is affected by the individual's previous choices in that experimental design. Similarly to Hey and Lee (2005a), subjects preferences are examined under various generalised EUT models. The study distinguishes three possibilities. The baseline one is that individuals do not take into account previous decisions, i.e., that they apply the isolation principle; The other two, within the context of the *RLIS-reduction procedure*, differ in the weight given to the current decision in relation to the weight given to previous decisions -which are all equally weighted-. They specifically consider that the weight of the current decision may be: (i) exactly the same as the previous ones; or (ii) larger, but that tends to equalize the previous weight as the final decision approaches. The overall conclusion is that subjects treat each decision in isolation.

Supporting his views on EU violations and dilution of incentives, Harrison (1994) reports an experiment on the horizontal CCE. In the study, each subject faces the two pair of problems involved in the phenomenon and, thus, makes two choices. There are three treatments: hypothetical, binary choice with salient payoffs and binary choice with dominant payoffs[8]. The findings are that the percentage of EUT independence axiom violations drastically decreases as saliency is introduced[9]; and though adding dominance also reduces the percentage of violations, the difference with respect to the saliency effect is not significant. Burke et al. (1996) reache similar conclusions. On the other hand, Camerer’s (1995) review of the empirical

[7] In particular: disappointment aversion theory, prospective reference theory, rank-dependent utility theory with power weighting function, rank-dependent utility theory with Quiggin's weighting function and weighted utility theory.

[8]Harrison (1994) uses the Roth and Malouf (1979) and Berg, Daley, Dickhaut and O'Brien (1986) method to induce risk neutrality with respect to the reward medium (lottery tickets instead of monetary prizes).

[9] The result is not significant, as pointed by Camerer (1995, p. 634).

evidence on individual choice experiments under risk concludes that the increase in cognitive effort produced by incentives in the domain of money gambles does not seem to reduce the violations of EUT.

List and Haigh (2005) follow Starmer and Sugden (1991) to study the horizontal CCE with single choice and RLIS and with students and professional traders. In single choice, both traders and students exhibit the horizontal CCE, fanning out. However, in RLIS, students exhibit the horizontal CCE, suggesting they not obey the reduction of compound lotteries axiom; but professional traders seem to behave as prescribed by the *RLIS-procedure*.

Huck and Müller (2012) test the horizontal CCE with low-hypothetical and low-real incentives[10]. They find a significant increase in violations with real incentives, consistent with the reduction procedure, in a representative sample of the Dutch population but not with the typical students' lab sample.

Harrison, Martinez-Correa and Swarthout (2013) do not find a significant difference in risk taking when moving from single (treatment A) to RLIS (treatment C). Harrison and Swarthout (2014) find support for the isolation effect, from single to RLIS, when inferring risk preferences from binary choices among simple lotteries under EUT.

Cox, Sadiraj and Schmidt (2015) also report tests of the CCE and the CRE under single and RLIS, and thus of the *RLIS-reduction procedure*, but do not observe these effects in any incentive system (similarly to Cubitt et al., 1998b). In addition and strikingly, for the choice problems involved, they observe significantly more risk aversion under RLIS than single choice.

Brokesova, Deck, and Peliova (2015) compare behavior on a single risk-taking binary choice task in the lab and the field, on a RLIS over five risk choices in the lab, and on a single choice in the lab when participants have only a small probability of being selected for payment. They find no differences in risk-taking behavior among treatments.

3.2. Sequential choices and RLIS

Wilcox (1993) investigates the effect of incentives on single stage lotteries and on the distributionally equivalent two-stage lotteries. Two RLIS treatments differ in, what Wilcox calls, the decision benefit variable, which measures the RLIS probability of a choice problem to be selected: some problems are more likely than others. For single stage lotteries, decision benefit does not affect risk aversion. However, for two-stage lotteries, decision benefit shifts

[10] Also with high-hypothetical payoffs as in the original Allais (1953).

choices towards the lottery with the higher expected value, independently of whether this lottery is the riskier or the safer option. Indeed, his results show that the choice percentage of riskier lotteries depends on the decision benefit variable: higher decision benefits shifted choices towards riskier lotteries with higher expected value and away of riskier lotteries with lower expected value. Finally, the failure of the reduction of compound lotteries principle decreases as decision benefits increase; which goes in consonance with Harrison's (1994) claim.

Beattie and Loomes' (1997) study incorporates four choice problems: two typical CRE problems; a choice problem that exploits regret considerations; and a choice problem over four options: a sure amount of money, a single stage lottery, a two-stage lottery and a three-stage lottery. There are six different experimental treatments: hypothetical, RLIS over the four choice problems, and four single choice treatments for each of the problems. Their results define two different domains for the role of incentives: single stage and more than one stage. For the CRE pair of choice problems, there is a significant CRE irrespectively of the incentives mechanism; which contradicts the dilution of incentives problem by Harrison (1994) in favour of Camerer's (1995) conclusion, and also rejects the reduction procedure by Holt (1986). In addition, there is no support for Davis and Holt's (1993) claim that risk seeking may increase as the salience of incentives decreases. With respect to the "regret effect" choice problem, the incentive system does not significantly alter individual choices. However, they find that incentives do play a systematic and significant role on the choice problem over four options: the choices of the two-stage and three-stage lotteries dramatically decrease as the salience of incentives increases.

Baltussen, Post, van den Assem and Wakker (2012) study a version of the TV game show "Deal or No Deal" in the lab and elicit subjects' choices, among other designs, in single choice and in a RLIS where participants play the game 10 times with resolution of prior tasks. Results show a similar degree of risk taking, thus no contamination, and carry-over effects from prior tasks in their RLIS design.

Harrison, Martínez-Correa and Swarthout (2015) study the reduction of compound lotteries principle in both RLIS and single choice and find evidence of its violation in RLIS but not in single choice, in consonance with the strong form of contamination predicted by Holt (1986).

Finally, most dynamic choice studies (Busemeyer, Weg, Barkan, Li, and Ma, 2000; Johnson and Busemeyer, 2001; Ruiz-Martos 2017b) show that the RLIS leads to the same general patterns of dynamic choice behavior than the RLIS and find similar results to the pioneer single choice experiment by Cubitt et al. (1998a). In particular, the CRE violation seems to be related to the violation of dynamic consistency and reduction of compound lotteries holds.

4. Experimental design and hypotheses

The analysis of incentives described in this chapter is part of the comprehensive dynamic choice experiment thoroughly described in Ruiz-Martos (2017a). That experiment presented subjects to a total of 13 risk choice problems and 36 knowledge tasks: where 9 risk choice problems were related to the dynamic study of the CCE and the other 4 risk choice problems were devoted to the quasi-replica of Cubitt, Starmer and Sugden (1998)'s dynamic study of the CRE (Ruiz-Martos, 2017b). With the purpose of facilitating the discussion here, figure 1 depicts the CCE dynamic choice theoretical background.

[Insert figure 1 here]

Figure 1 represents the sequence of choice problems that conform the CCE dynamic choice framework. The first row depicts the decision tree representation of the high-medium-low common consequence -H_1, M_1 and L_1- choice problems, equivalent to each other by the common consequence property. The decision trees -H_2, M_2 and L_2- represents the two-stage lottery choice problems that are equivalent to the single stage lottery problems in the first row by the reduction of compound lotteries axiom. Segal (1987, 1989, 1990)'s procedure to deal with two-stage lotteries, based on the reduction by substitution of certainty equivalents and the independence for sure prospects principles, implies that the problems H_2, M_2 and L_2 are equivalent. Timing independence requires that the decision trees Hp, Mp and Lp are equivalent to the corresponding two-stage lottery versions. The separability principle entails that the problems Hp, Mp and Lp are equivalent to each other. Finally, standard individual choice theory under risk implies the equivalence of all of the 9 choice problems. The parameters in this experiment are: c_1=10, c_2=7, p=0.25 and λ=0.8. That is, the same parameters as Starmer and Sugden (1991) and List and Haigh (2005).

The study had 3 treatments that differed in the incentive system. The baseline treatment is a RLIS over the 13 risk choice problems and the 36 knowledge tasks. The other two treatments start by a single choice for either the MCC or the LCC choice problems (both in the CCE sequence), followed by the 36 knowledge tasks and hypothetical choices for the 12 remaining risk choice problems; they are labelled as "Single MCC+" and "Single LCC+" treatments. Tables 1 and 2 summarise the treatments and the order of the tasks in each treatment. Knowledge tasks, instructions and procedures are in the appendix.

[Insert Table 1 here]

[Insert Table 2 here]

Consequently, the horizontal CCE is examined under single choice, RLIS and hypothetical choice; which allows to test both the extreme form of contamination suggested by Holt's (1986) reduction procedure -if there is a horizontal CCE in single choices- and the Davis and Holt's (1993) claim that, for the four choice problems involved, there will be a decrease in risk aversion as the strength of incentives reduces from the single choice to the hypothetical choice designs. We can also test Harrison (1994)'s views and see if the percentages of EUT violations are negatively related to the strength of incentives.

In addition, the study compares RLIS choices and hypothetical choices with respect to the vertical CCE (when comparing the HCC problem with either the MCC or the LCC problem) and the independence for sure prospects principle by Segal (1987). We will also see if, for the problems involved, the results support either or both of Davis and Holt (1993) or Harrison (1994) predictions.

Furthermore, this chapter contributes to the line of research by Wilcox (1993) and Beattie and Loomes (1997), which analyses the effect of incentives upon multi-stage lotteries, by comparing the RLIS and hypothetical choice designs with respect to the dynamic choice principles of reduction of compound lotteries, timing independence and separability in the framework provided by the CCE (figure 1). Here too, we will find out if as we move from RLIS choices to hypothetical choices there is a larger tendency to risk seeking -in consonance with Davis and Holt (1993)- and/or the violations of the principles are more extreme -in consonance with Harrison (1994).

5. Results and discussion

I will describe first the results on the CCE side of the study and defer until later the CRE side results. A total of 176 subjects were randomly recruited from the CeDEX data base to take part in the experiment, which was conducted across 25 sessions on December 2006 and February 2007 at the University of Nottingham. Subjects and sessions were randomly assigned to each treatment, there were: 78 participants and 15 sessions for the RLIS treatment; 50 subjects and 5 sessions for the "Single MCC+" treatment; and 48 participants and 5 sessions for the "Single LCC+" treatment.

5.1. Treatments and Tendencies in Risky Choices

Table 3 summarises the number of risky choices for each problem in each of the three treatments.

[Insert Table 3 here]

The matrix presentation of table 3 resembles the display of the problems in figure 1. One can distinguish three main submatrices with the same structure. The first submatrix shows the risky choices for the common consequence property problems - HCC, MCC and LCC- with the RLIS, "Single MCC+" and "Single LCC+" treatments, respectively, in rows four, five and six. The second submatrix does accordingly for each of the two-stage lottery problems –HCC2, MCC2 and LCC2-; and the third submatrix for the prior risk choice problems -priorHCC, priorMCC and priorLCC-. Each problem has two columns that show the number, on the left, and the percentage, on the right, of risky choices.

An unfortunate consequence of one of the design features from my point of view, the unique and public resolution of the prior risks per session, is that for the prior risk choice problems priorHCC, priorMCC and priorLCC there are just the following observations (in parenthesis in the submatrix), respectively: 9, 19 and 37 in RLIS; 29, 10 and none in "Single MCC+"; and, surprisingly, none at all in "Single LCC+".

A quick look at the first submatrix gives a good hint of the results to be reported. Irrespectively of the treatment, there is a decreasing tendency in risk taking in the high common consequence choice problem, HCC, with respect to either MCC or LCC. The second submatrix reveals, irrespectively of the treatment, that there are almost no differences in the percentages of risky choices of the two-stage lottery problems MCC2 and LCC, but there is an important decrease in risk taking in problem HCC2. The lack of observations in the prior risk choice problems will restrict the analysis of the incentives with respect to the dynamic choice principles of timing independence and separability to problems priorHCC and priorMCC. The corresponding chi-square test of independence of the incentives treatment and the risky choices, with a value of 52.368 and 16 degrees of freedom, rejects the null hypothesis of independency. But a one by one analysis of each problem will be much more informative. The histogram in figure 3 offers a visual description of the main behavioural tendencies summarised in table 3.

[Insert Figure 3 here]

5.1.2. Horizontal CCE (MCC and LCC problems): Single Choice, RLIS and Hypothetical

Table 4 summarises the results. The first column lists the incentive system. The second and third columns show the percentatge of risky choices in problems MCC and LCC. Please notice that the single choice data for the MCC problem belong to treatment "Single MCC+" whereas the single choice data for the LCC problem belong to the "Single LCC+" treatment; as only after the subjects had made their choice for real they were told of the knowledge tasks or hypothetical risk tasks, this is the relevant comparison. There is no horizontal CCE irrespectively of the treatment. This is in contrast to Starmer and Sugden (1991) which reports a significant effect with these parameters under single choice and RLIS; though it accords with the mixed nature of the empirical evidence on the horizontal CCE (Cubitt, Starmer and Sugden, 1998b; Blavastkyy, 2013; Blavastkyy, Ortmann and Pachencko, 2015). However, I find some tendency towards the effect in hypothetical choices (and in the direction of fanning-in)[11]. The critical values of the z statistic are: ±1.96 (1.65 for one-sided test) at 5% significance level and ±2.58 (2.35 for one-sided test) at 1% significance level. The results do not allow to test, subsequently, Holt (1986)'s reduction procedure and do not support Harrison (1994)'s views either.

[Insert Table 4 here]

Note that the test of the horizontal CCE in hypothetical choices -the hypothetical row in table 4- compares the hypothetical risky choices in problem MCC in the "Single LCC+" treatment and the hypothetical answers to problem LCC in the "Single MCC+" treatment. These treatments differ on the payment per each correctly answered knowledge task, which makes the chi-square test more appropriate than the z-statistic. A corresponding p value of 0.101 fails close to rejecting the null hypothesis of independence at 10% significance. A potential explanation, rather than randomness, could be that the MCC responses in the "Single LCC+" treatment are viewed "more hypothetical" by the subjects because of the high-reward for the knowledge tasks in this treatment (whilst in the "Single MCC+" treatment the knowledge tasks worth very little); which generates the higher tendency to take risks in problem MCC hypothetical choices. There might be some contamination between the knowledge tasks value and the risk tasks (see below).

[11]With the corrected significance levels, this tendency falls further away from the corrected critical value.

The lack of horizontal CCE in single choices excludes the test of the strong version of contamination predicted by Holt (1986), but not the tests of a more general form of contamination in terms of levels of risk taking for problems MCC and LCC. This analysis requires the chi-square test given the differential rewards for knowledge tasks.

For problem MCC (a certainty is at stake), the chi-square test ($\chi^2_{(1)}$ =4.392, p=0.036) rejects the null hypothesis that the level of risk taking is independent of the treatment -RLIS versus single choice-, and the difference supports Davis and Holt (1993)'s prediction. However, the increase in risk seeking from the RLIS choices to the hypothetical choices is not statistically significant. Consequently, the chi-square test also rejects the independency of risky choices between single and hypothetical choices ($\chi^2_{(1)}$ =4.961, p=0.026).

For problem LCC, there is not a significant increase in risk seeking as we move from single choice to RLIS ($\chi^2_{(1)}$ =0.574, p=0.448); and from RLIS to hypothetical choices there is a, non-significant ($\chi^2_{(1)}$ =2.064, p=0.15), decrease in risk seeking (contradicting Davis and Holt, 1993). The chi-square test also does not reject the independency of risky choices between single and hypothetical choices ($\chi^2_{(1)}$ =0.363, p=0.547).

5.1.3. RLIS and Hypothetical Choice

Two main arguments justify my interest of studying hypothetical data: (i) it is even cheaper than the RLIS; (ii) it is another way of investigating Harrison (1994)'s dilution hypothesis.

Parallel to my argument for using the RLIS rather than the single choice on grounds of economy, the (i) argument would suggest using hypothetical choice if I could get the same responses/patterns of effects. However, it is not clear ex-ante whether this will be the case. A crucial issue is whether hypothetical choice stimulates individuals' affective experiences when they play a significant role in risk behaviour. The (ii) argument is that if the RLIS dilutes incentives, relative to single choice, hypothetical choice must dilute incentives still further. Thus, any difference, between the RLIS and single choice caused by dilution ought to be magnified, as we move to hypothetical choice; and the effect Harrison (1994) conjectures between RLIS and single choice should presumably also be present (if he is right) between hypothetical and RLIS. Let the data speak for themselves.

(a) Two sources of Hypothetical Data.

I need to discuss, first, if I can reasonably pool the two sources of hypothetical data. The table below summarises the results of the RLIS, the hypothetical choices from the "Single MCC+" and "Single LCC+" treatments, and the pooled hypothetical data, with respect to the descriptive status of the RCLA and the principles of independence for sure prospects, timing independence and separability on those problems in which data is available.

[Insert Table 5 here]

The RCLA is not rejected under any treatment for problems HCC-HCC2. However, there seems to be a tendency towards rejection in the "Single MCC+" treatment ($\chi^2_{(1)}$ =6.179, p=0.013) and in the pooled hypothetical data ($\chi^2_{(1)}$ =3.56, p=0.059). This tendency goes in the direction that decreasing the strength of incentives increases the tendency to violations of standard theory (Harrison, 1994). Note, however, that in the "Single MCC+" treatment the relevant comparison entails problem MCC single choice data and problem MCC2 hypothetical data, so both cross-task contamination and dilution of incentives may play a role. On the other hand, the Pooled Hypothetical test for problems LCC-LCC2 compares the" Single MCC+" hypothetical data for problem LCC and the pooled hypothetical data for problem LCC2.

The available data on the two-stage lottery problems allow us to study the three cases of the independence for sure prospect principle. It does not fail between the two-stage lottery problems M_2 and L_2 in any treatment or in the pooled hypothetical data; and it fails, irrespectively of the treatment and in the pooled hypothetical choices, between problems H_2 and M_2 and between problems H_2 and L_2 -though the significance level decreases to the 5% in the "Single L_1+" treatment[12]. These results support the idea that the strength of incentives is not related to subject's obedience of one axiom, in this case, of the independence for sure prospects principle.

Please recall the small sample sizes of problems Hp and Mp that may affect the results on timing independence and separability. Timing independence fails between H_2-Hp in RLIS at 1% significance[13], and in "Single M_1+" at 5% significance[14], but not in the pooled hypothetical data; and it only fails between problems M_2-Mp in the RLIS treatment. In terms of the prior problems Hp-Mp, the separability principle is only rejected at the 1% significance level in RLIS.

Let examine if the distributions of risk/safe choices in problems H_1, H_2, M_2 and L_2 are independent of the treatment that provides the hypothetical choices. Table 6 summarises the

[12]In this treatment, the failure between problems H_2 and M_2 persists only under a False Discovery Rate correction to a 5% significance level; and it does not, but only just not, persist between problems H_2 and L_2.
[13]Robust to the Bonferroni correction to a 5% significance level (one sided-test).
[14]This result does not hold under the corrected significance levels.

chi-square tests' results. The chi-square value of 3.979 with p=0.046 reveals that for the HCC choice problem, H_1, where there is not a zero monetary consequence, the two distributions are not independent at the 5% significance level; note that we have exactly the same phenomenon in problem M_1-where the "Single L_1+" hypothetical choices are more risk seeking than the "Single M_1+" hypothetical choices-, which could have been caused by the differential rewards for knowledge tasks. Problem H_2 is close to the border line; and the independence of the distributions for problems M_2 and L_2 is not rejected.

[Insert Table 6 here]

(b) Pooled Hypothetical Data.

Notwithstanding the reservations discussed above, from now onward I will focus on comparing the RLIS data with the pooled hypothetical data. Table 7 -same structure as table 3- summarises the percentages of risky choices with the pooled hypothetical data[15].

Looking at the first submatrix in table 7, the levels of risk taking are approximately the same for problems H_1 and M_1; interestingly, there is a decrease in risk taking when we move to the hypothetical data in L_1. The second submatrix reveals that hypothetical choice elicits more risk taking in H_2, but almost the same in M_2 and L_2. The last submatrix shows, though the numbers are small, that hypothetical choice seems to reduce risk taking in Hp but to dramatically increase it in Mp.

[Insert Table 7 here]

Let examine now some more general effects on risk taking. Table 6.8 summarises the average percentages of risky choices in RLIS and hypothetical data aggregating for problem type: single-stage lottery problems, the two-stage lottery problems and the prior risk problems. There are minor changes as the strength of incentives decreases, but one can still observe: a tendency to decreasing risk taking in single-stage lotteries; to increasing risk taking in the two-stage lottery problems; and, though minimal, to increasing risk taking in the prior risk problems.

[Insert Table 8 here]

Table 9 presents the results when the risky choices are aggregated for problems with a given level of common consequence. It stands out that there is not a common pattern of increase/decrease in risk taking as we move from RLIS to hypothetical data, in particular: for the three problems with a high CC, risk seeking decreases; for the three problems with the medium CC, risk seeking considerable increases; and for the three problems with a low CC, risk seeking considerably decreases.

[15]Please notice that the last submatrix, devoted to the prior risk choice problems, has no pooling of hypothetical data.

[Insert Table 9 here]

One step further is provided by the aggregation of all the nine problems. Overall, there is a 44.02% of risk taking in the RLIS data and a 44,04 % of risk taking in the hypothetical data. Thus, I can reasonably assert that hypothetical choice does not seem to increase the level of risk taking in all the risk problems involved in the CCE framework. The diagram in figure 3 illustrates the above discussion.

[Figure 3: RLIS versus Hypothetical data in CCE's framework]

Next, I will describe the impact of incentives on the descriptive adequacy of each of the principles considered in the study. Table 10 starts this discussion by presenting the results for the problems involved in the vertical CCE. The first column lists the incentives systems. The second and third columns present the percentage of risky choices in the HCC and the MCC choice problems. The fourth column shows the z-test value. And the last row shows the corresponding p-values of the chi-square tests of contamination[16]for each problem. First, the significance of the vertical CCE, in the fanning-out direction, is independent of the incentive system. In addition, the small differences in the percentages of risky choices in each problem under the two incentives systems predict what the chi-square tests confirm: there is no contamination in any of the two problems.

[Insert Table 10 here]

Let examine the problems involved in the independence for sure prospects principle. Table 11 summarises the results with the same structure as table 8. Columns two, three and four show, first, the percentages of risky choices in the two-stage lottery problems H_2, M_2 and L_2 and, on their last row, the p-value of the chi-square tests of contamination. The last three columns present the z statistic of the principle by pair of problems. Although there is more tendency to risk seeking in hypothetical choices for problems H_2 and M_2, and, surprisingly, the opposite tendency in problem L_2; the chi-square does not support that there is contamination and this is very interesting because we are in the complex domain of two-stage lotteries. With respect to the independence for sure prospects principle, whether it holds or not is independent of the incentive system.

[Insert Table 11 here]

Table 12 below summarises the analysis of the reduction of compound lotteries principle . In this case, the decrease in the strength of incentives does induce some changes in terms of the principle between problems H_1-H_2 and L_1-L_2, in the direction suggested by Harrison (1994); nevertheless, the axiom still fails to be rejected by a two-tail test in hypothetical choices.

[Insert Table 12 here]

The timing independence principle compares each two-stage lottery problem -H_2, M_2 and L_2- to, respectively, each prior risk choice problem -Hp, Mp and Lp-. Here, please recall that there are very little hypothetical data for problems Hp and Mp. Look at table 13. With respect to the

[16]The null hypothesis states that the problem is treated equivalently in both incentives sytems.

contamination problem, the Fisher's Exact test (equivalent to the chi-square test with small samples) rejects that problem Mp is treated equivalent under both incentives systems as risk seeking dramatically increases in hypothetical choices -in line with Davis and Holt (1993)-. With respect to the principle, it tends to fail under RLIS data -any case- but not under hypothetical data. I know that the numbers are small, but if this result is robust, it supports the argument for using incentives (see Cubitt and Sugden (2001); Cubitt, Starmer and Sugden (2004)) when relevant effects are to be stimulated. One account of the violation of timing independence is that it stems from unanticipated affective experiences. Maybe, when there are no incentives at all, these affective responses do not occur. If so, one should not necessarily expect timing independence to be violated with hypothetical incentives.

[Insert Table 13 here]

[Insert Table 14 here]

Table 14 summarises the information for the principle of separability where we can only compare the incentives systems between problems Hp and Mp. It seems that the contamination in problem Mp, discussed in the previous paragraph, affects the test of the principle which holds in hypothetical data but not in RLIS data; which contradicts Harrison (1994)'s claim. But also the same argument stated in the previous paragraph may apply[17].

5.2. Knowledge tasks

Are there any interactions between subjects' performance in the knowledge tasks and the strength of incentives? Recall that each correct answer was paid at 10 pence in the RLIS, 4 pence in the "Single M_1+" and 30 pence in the "Single L_1+".

Harrison (1994) basically argues that subjects perform better when incentives are stronger -in the sense of larger penalties for "error"-, because they put in more effort. One difficulty with testing this claim is that there is no satisfactory measure of "performance". For the present pursposes, consider a risk task: is it "high performance" to take or not take the risk?[18]One advantage of the knowledge tasks is that there is an unambiguous measure of performance. Given the random assignment of subjects to incentive treatments, I could reasonably assert that any significant difference in performance across incentive systems is evidence of different levels of effort. Another feature of the knowledge tasks is that they allow an alternative conception of dilution/concentration of incentives, besides that of reduction/increase in the probability of being for real. The latter is subject to a complication that any effect of dilution necessarily interacts with non-linearity in risk attitude; whereas the effect of scaling the reward per correct response does not.

[17]In this case, why should I feel "unlucky" at losing the best consequence, if I am going to get zero anyhow?

[18]But even equating high performance with conformity to "economic theory", the test of the Harrisonian hypothesis is conditional on a questionable view about what the "true" "economic theory" is.

The table below summarises the results. The first column lists the average, the mode and the percentage[19] of correct answers. Columns two, three and four show the results for the RLIS, "Single M_1+" and "Single L_1+" treatments. The distributions are very similar though one can appreciate a slight decrease in performance of those subjects taking part on the "Single M_1+" treatment. The chi-square test of the distributions of the averages correct and incorrect answers per treatment gives a p value of 0.95.

[Insert Table 15 here]

It is really quite striking that scaling the reward per correct answer by a factor of seven has very little effect on performance. This seems to contradict the Harrisonian view and to favour the alternative view that, for knowledge tasks at least, subjects have an intrinsic motive to perform the tasks set them. If this conclusion could be generalised to risk tasks (which, admittedly is a further step), it might suggest why, despite the presence of EUT violations, I do not find much evidence that the RLIS is misleading. Basically, subjects try to do the tasks set them. It tends to be only when subjects themselves can not anticipate how they would do the tasks with stronger incentives that weaker incentives are misleading.

6. Conclusions

Given the total set of 13 choice problems that conforms the comprehensive study of the CCE and the CRE dynamic choice frameworks described in chapters 4 and 5, individuals preferences are elicited by means of the RLIS and hypothetical choices. In addition, individual choices over the two choice problems involved in the horizontal CCE are also elicited by the single choice system, which allows to control, to some extent, the RLIS. Thus, the study permits to examine the strong version of contamination predicted by Holt (1986) -that is, that there is a horizontal CCE in single choice but not in the RLIS choices- and a more general contamination problem -a systematic shift in preferences- as we move from RLIS to hypothetical choice in the 13 choice problems.

CCE sequential framework

There is not a horizontal CCE under either single choices, RLIS or hypothetical choices. That single choice results do not exhibit a horizontal CCE excludes the test of Holt's (1986) reduction procedure; but not the possibility of testing for cross-task contamination. There is a significant increase in risk seeking from the single choice to the RLIS (as predicted by Davis and Holt (1993)) in the medium common consequence choice problem -where a certainty is at stake-; however, there is no contamination in the low common consequence choice problem. The lack of incentives in hypothetical choices, with respect to the RLIS, does not seem to generate contamination in any of the two horizontal CCE problems.

[19] Calculated as the total number of correct answers per treatment divided by (36 tasks × number of participants).

The results show a significant vertical CCE under both RLIS and hypothetical choices and no signs of contamination in the problems involved. On the two-stage lottery problems, there are no signs of contamination and the descriptive accuracy of the independence for sure prospects principle is independent of the strength of incentives. However and despite the reduction of compound lotteries axiom fails or holds independently of the incentive system, one can observe some changes in the direction predicted by Harrison (1994): i.e., as the incentives strength reduces, the z-statistic dangerously increases.

The limited available data on the prior risk choice problems, particularly under hypothetical choice, suggest that the principles of timing independence and separability fail in the RLIS but not in hypothetical choices. That could be related to the significant contamination -with more risk seeking- in the hypothetical answers to the medium common consequence prior risk problem. Following Cubitt and Sugden (2001) and Cubitt, Starmer and Sugden (2004), another potential explanation is the need to use incentives when subject's affective responses are relevant for risk behaviour.

Knowledge tasks

There are not significant variations in subjects' performance under the three strength of incentives, despite the large difference in the value of correct answers across treatments. It seems that subjects are intrinsically motivated to perform knowledge tasks correctly.

Overall remarks

Therefore, the absence of incentives plays a role in those risk choices for which there is evidence that individuals' affective experiences may condition behaviour and there are grounds for suggesting that hypothetical choices do not stimulate affective responses, as suggested by Cubitt and Sugden (2001) and Cubitt, Starmer and Sugden (2004).

Economists tend to think of incentives as devices to stimulate effort by subjects. My results suggest that this may not be the only, or the most fruitful, approach. In particular, the results of my knowledge tasks do not sit well with this approach and my findings on risk tasks support the view of Read (2005) that incentives work as "emotional triggers" rather than inducers of "cognitive exertion" (Read (2005), p.266).

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Figure 1. Common Consequence Effect Sequence of Choice Problems

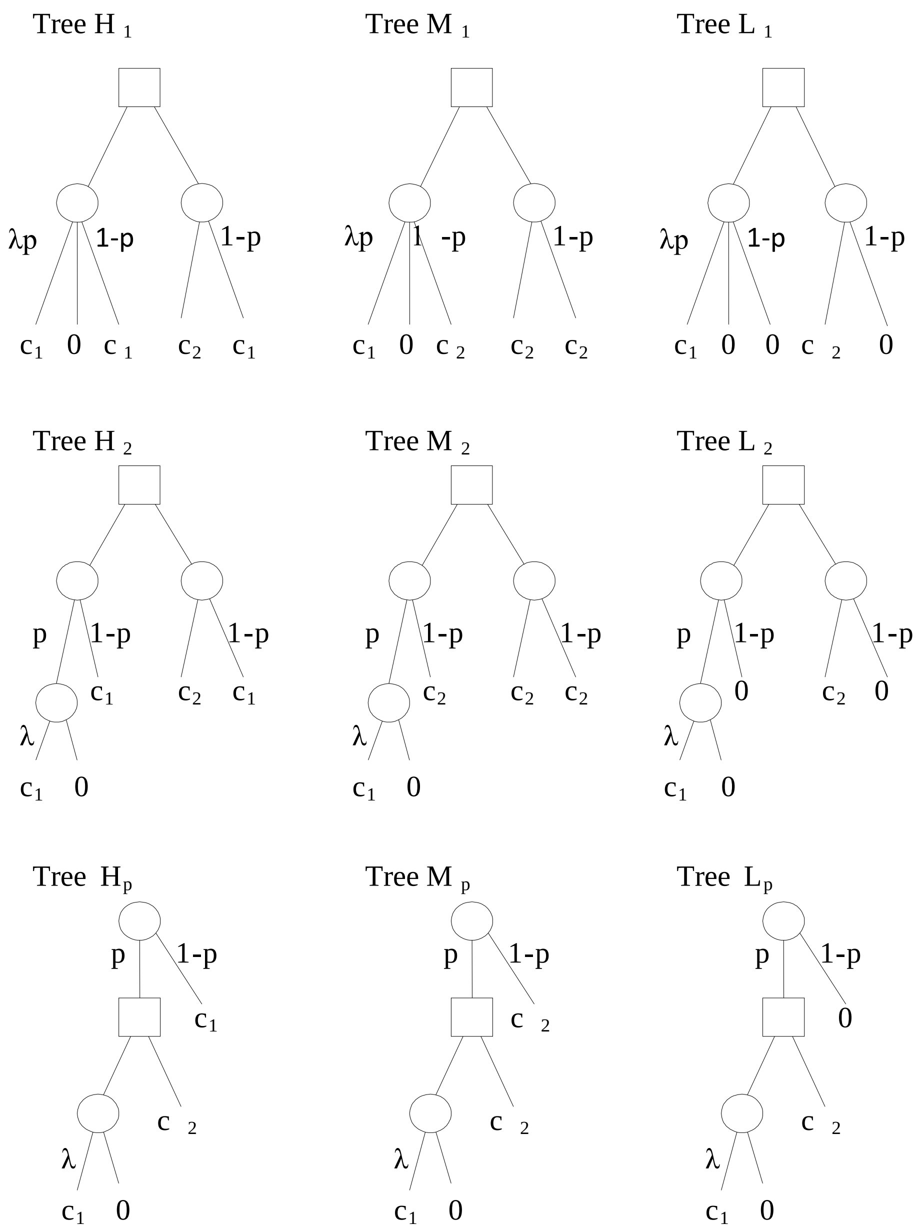
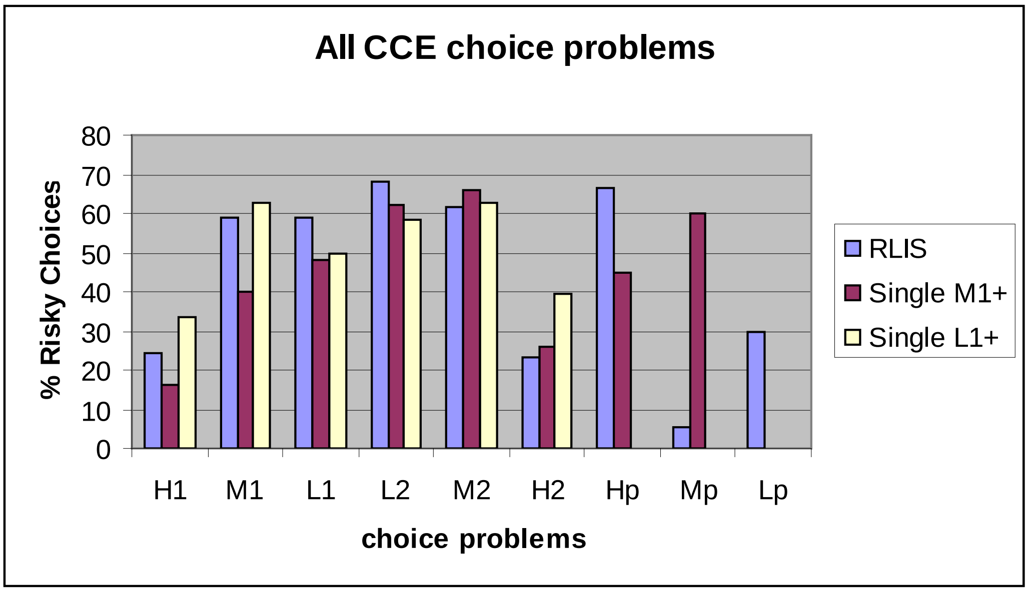


Figure 3. Treatments and Percentages of Risky Choices in the CCE sequence



Make new figure with different order of the choice problems so that they resemble the figure and table presentations.

Tables

Table 1: Treatments and Tasks				
	Risk Tasks		Knowledge Tasks	
Treatment	Initial	Remaining	Total	Payoff
RLIS	any	(13 – "any")	36 (3×12)	10 pence
Single MCC +	MCC	(13 - MCC)	,,	4 pence
Single LCC +	LCC	(13 - LCC)	,,	30 pence

Table 2: Treatments and Time-Line				
Treatment	Initial Task	Second Task	Third Task	Onward
RLIS	any risk	3 first Knowledge	any of (13-initial)	alternatively
Single MCC +	MCC	3 first Knowledge	any of (13-MCC)	,,
Single LCC +	LCC	3 first knowledge	any of (13-LCC)	,,

Table 3: Risky Choices per Treatment						
Treatment	Number	(%)	Number	(%)	Number	(%)
	HCC		**MCC**		**LCC**	
RLIS (78)	19	24.4	46	58.9	46	58.9
Single MCC+ (50)	8	16	20	40	23	46
Single LCC+ (48)	16	33.3	30	62.5	25	52.1
Totals (176)	43	24.4	96	54.5	94	53.4
Treatment	**HCC2**		**MCC2**		**LCC2**	
RLIS (78)	18	23.1	48	61.5	53	67.9
Single MCC+ (50)	13	26	33	66	31	62
Single LCC+ (48)	20	41.6	32	66.6	30	62.5
Totals (176)	51	28.9	113	64.2	114	64.7
Treatment	**priorHCC**		**priorMCC**		**priorLCC**	
RLIS	6 (9)	66.6	1 (19)	5.3	11 (37)	29.7
Single MCC+	13 (29)	44.8	6 (10)	60	-	-
Single LCC+	-	-	-	-	-	-
Totals	19 (38)	50	7 (29)	24.1	11 (37)	29.7

Table 4: Horizontal CCE				
Incentives System	**(%) Risky Choices**		**Test Statistic**	
	Problem MCC	**Problem LCC**	**z**	**χ^2(p value)**
Single Choice	40	52.08	-1.21	-
RLIS	58.97	58.97	0	-
Hypothetical	62.5	46	-	p=0.101
Pooled Data	54.5	53.1	0.2138	-

			Table 5: Principles and Treatments (two-tail z-statistic)					
Treatment	RCLA		Indep. Sure Prospects			Timing Independence		Separability
	HCC-HCC2		H_2-M_2	M_2-L_2	H_2-L_2	H_2-Hp	M_2-Mp	Hp-Mp
RLIS	0.188		-5.278	-0.839	-6.303	-2.654	7.481	3.71
SingleM_1+	-1.2369		-4.38	0.417	-3.89	-1.692	0.35	-0.84
SingleL_1+	-0.855		-2.565	0.431	-2.11	-	-	-
All Hypo	-1.423		-3.92	0.486	-4.17	-1.072	0.373	-0.841

	RCLA			
Treatment	**HCC-HCC2**	**MCC-MCC2**	**LCC-LCC2**	**(MCC+LCC)-(MCC2+LCC2)**
RLIS	z=0.188 (p=0.849)	z=-0.327 (p=0.741)	z=-1.164 (p=0.246)	z=-1.049 (p=0.294)
Single MCC+	z=-1.228 (p=0.219)	$\chi^2_{(1)}$ =6.179 (p=0.013)	z=-1.65 (p=0.107)	$\chi^2_{(1)}$ =8.863 (p=0.003)
Single LCC+	z=-0.843 (p=0.401)	z=-0.427 (p=0.667)	$\chi^2_{(1)}$ =1.064 (p=0.302)	$\chi^2_{(1)}$ =1.071 (p=0.300)
Pooled Hypo	$\chi^2_{(1)}$ =2.004 (p=0.157)	$\chi^2_{(1)}$ =0.208 (p=0.648)	$\chi^2_{(1)}$ =3.56 (p=0.059)	$\chi^2_{(1)}$ =2.856 (p=0.091)

Table 6: "Single M_1+" and "Single L_1+" Hypothetical Choices				
Test Statistic	Problem H_1	Problem H_2	Problem M_2	Problem L_2
χ^2	3.979	2.691	0.005	0.03
p	0.046	0.1009	0.943	0.9563

Table 7: Risky Choices per Incentive System						
	Choice Problem					
Incentives System	Number	(%)	Number	(%)	Number	(%)
	H_1		M_1		L_1	
RLIS (78)	19	24.4	46	58.9	46	58.9
Hypo (98)	24	24.5	30	62.5	23	46
Totals	43	24.4	76	60.3	69	53.9
Incentives System	H_2		M_2		L_2	
RLIS (78)	18	23.1	48	61.5	53	67.9
Hypo (98)	33	33.7	65	66.3	61	62.2
Totals	51	29	113	64.2	114	64.7
Incentives System	Hp		Mp		Lp	
RLIS (78)	6 (9)	66.6	1 (19)	5.3	11 (37)	29.7
Hypo (98)	13 (29)	44.8	6 (10)	60	-	-
Totals	19 (38)	50	7 (29)	24.1	11 (37)	29.7

Table 8: Frequency of Risky Choices per Problem Type	
Incentives System	Choice Problem
	Single-Stage Lottery Problems
RLIS	47.4
Hypo	44.3
Totals	45.85
Incentives	Two-Stage Lottery Problems
RLIS	50.83
Hypo	54.1
Totals	52.46
Incentives	Prior Risk Problems
RLIS	33.86
Hypo	34.93
Totals	34.4

Table9: Frequency of Risky Choices per CC			
Incentives System	Choice Problem		
	High CC	Medium CC	Low CC
RLIS	38.03	41.9	52.12
Hypo	34.3	62.9	36.1
Totals	36.2	52.42	44.12

Table 10: Vertical CCE			
Incentives System	% Risky Choices		Vertical CCE
	Problem H_1	Problem M_1	z
RLIS	24.36	58.97	-4.68
Hypothetical	24.5[20]	62.5[21]	-4.62
p (χ^2)	1	0.695	-

Table 11: Independence for Sure Prospects Principle						
Incentives	% Risky Choices			z statistic		
System	H_2	M_2	L_2	H_2-M_2	M_2-L_2	H_2-L_2
RLIS	23.08	61.54	67.95	-5.278	-0.839	-6.303
Hypothetical	33.67	66.32	62.24	-3.92	0.486	-4.17
p (χ^2)	0.1236	0.51	0.619	-		

Table 12: Reduction of compound lotteries Principle			
Incentives System	z statistic		
	H_1-H_2	M_1-M_2	L_1-L_2
RLIS	0.188	-0.327	-1.169
Hypothetical	-1.423	-0.392	-1.893

Table 13: Timing Independence Principle						
Incentives System	% Risky Choices			z statistic		
	Hp	Mp	Lp	H_2-Hp	M_2-Mp	L_2-Lp
RLIS	66.6	5.3	29.7	-2.654	7.481	4.161
Hypothetical	44.8	60	-	-1.072	0.373	-
Fisher's Exact Test (p)	0.447	0.026	-	-		

[20]There are 98 hypothetical data in total and 24 risky choices for problem H_1.

[21]There are only 48 hypothetical choices for problem M_1, 30 of them were risky choices.

Table 14: Separability Principle		
Incentives System	z statistic	
	Hp-Mp	Mp-Lp
RLIS	3.71	-2.69
Hypothetical	-0.841	-

Table 15: Knowledge tasks and Incentives			
Correct Answers	RLIS	Single M_1+	Single L_1+
(out of 36)	(10 pence)	(4 pence)	(30 pence)
Mean	15.7	14.6	15.6
Mode	17	13	17
Standard Deviation	3.17	3.62	4.31
Percentage (%)	43.7	40.6	43.3