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Jose Luis Pinto Prades (U. Pablo de Olavide)

Han Bleichrodt (Erasmus University)

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Department of Economics

A New Type of Preference Reversal

Han Bleichrodt, Erasmus University, Rotterdam.
Jose Luis Pinto, University Pablo de Olavide, Sevilla.

March 2005 **Abstract**

The classic preference reversal phenomenon arises in a comparison between a choice and a matching task. We present a new type of preference reversal which is entirely choice-based. Because choice is the basic primitive of economics, the preference reversal we observe is more troubling for economics. The preference reversal was observed in two experiments, both involving large representative samples from the Spanish population. The data were collected by professional interviewers in face-to-face interviews. Possible explanations for the preference reversal are the anticipation of disappointment and elation in risky choice and the impact of ethical considerations.

Keywords: Preference reversal, Choice behavior, Stochastic dominance, Disappointment and elation, Health.

ADDRESS CORRESPONDENCE TO**:** Han Bleichrodt, iMTA/iBMG, Erasmus University, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. Email: bleichrodt@bmg.eur.nl.

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A standard assumption in economics and decision theory is that preferences between options do not depend on the method used to elicit them. This assumption was challenged by the preference reversal phenomenon, first observed by S. Lichtenstein and P. Slovic (1971)) and H. Lindman (1971) and confirmed in many later studies (e.g. D.M. Grether and C.R. Plott, 1979; W.W. Pommerehne et al., 1982; A. Tversky et al., 1990; G. Loomes et al., 1991; R.P. Cubitt et al., 2004). The classic preference reversal arises in the comparison between a choice task and a matching task. This paper will present a new type of preference reversal that is entirely choice-based, i.e., it arises in comparisons between two choice tasks. Because choice is the basic primitive of economics, the preference reversal is more fundamental than previously observed preference reversals.

The study we performed was commissioned by a leading pharmaceutical company and aimed to assess the potential benefits of a new medicine for stroke. Hence, the reversal we observed is not just an intriguing curiosity with little practical relevance, but raises significant problems for health policy and economic evaluations of health care. The preference reversal was observed in two experiments and in a retest of the first experiment. Given the practical importance of our study question, we took great care in collecting the data. Both experiments used representative samples from the Spanish general population and the data from both experiments were collected by professional interviewers in personal interview sessions. The second interview was intended to test the robustness of the preference reversal by controlling for potential distorting factors in the first experiment. In spite of all the care we took, the preference reversal emerged in both experiments and appeared robust.

In what follows, Section 1 briefly reviews some earlier findings on preference reversals. Section 2 describes the first experiment and Section 3 its results. Section 4 describes the second experiment, Section 5 its results. Section 6 discusses our findings and reflects on possible explanations.

1. Background

The classic preference reversal arises in the comparison between two types of gambles with comparable expected values: a P-bet that offers a high probability of winning a relatively small amount of money and a $-bet that offers a low probability of winning a moderate amount of money. People generally choose the P-bet over the $-bet but assign a higher cash equivalent to the $-bet than to the P-bet. The opposite reversal, choosing the $-bet but placing a higher money value on the P-bet is relatively rarely observed.

The most common explanation for the preference reversal phenomenon is a change in information processing strategy across the two tasks (A. Tversky et al., 1988). When people make a choice between the two bets they tend to focus on the more important dimension of the bets. Several studies have suggested that people perceive the probability dimension as more important than the payoffs dimension (W.M. Goldstein and H.J. Einhorn, 1987; Tversky et al., 1988) which explains why the P-bet is chosen over the $-bet. When people determine the cash equivalent of a bet, the payoffs dimension is more prominent. Hence, when placing a money value on the two bets, people tend to focus on the payoffs dimension and therefore assign a higher cash equivalent to the $-bet than to the P-bet. In support of the hypothesis that the preference-reversal phenomenon is caused by a choice-matching discrepancy, R. Bostic

et al. (1990) found that systematic preference reversals disappeared when cash equivalents were determined through a series of choices rather than through matching.

A different type of preference reversal was observed by M.H. Birnbaum et al. (1992) (see also M.H. Birnbaum and S.E. Sutton, 1992; B.A. Mellers et al., 1992). They observed that for $p \geq 0.90$ a majority of their subjects assigned a larger cash equivalent to the gamble giving a p% chance of $96 and a (1−p)% chance of $0 than to the gamble giving a p% chance of $96 and a (1−p)% chance of $24. Dominance implies that people will choose the second gamble over the first gamble and a preference reversal results. A dual finding was reported by Goldstein and Einhorn (1987), who found that replacing zero by a negative outcome increased the valuation of a gamble. It appears that this type of preference reversal is also caused by a choice-matching discrepancy. D. von Winterfeldt et al. (1997) found that the number of preference reversals was largely reduced when cash equivalents were determined through a choice-based procedure. The remaining reversals seemed attributable to the substantial variability in the estimates of the cash equivalents.

2. First Experiment

A. *Health States and Subjects*

The experiment was part of a study on quality of life after stroke. This study was commissioned by Pfizer Ltd. and aimed to examine the potential benefits of a new medicine for stroke. Six health states that are common after stroke were selected and were described by the Modified Rankin Scale, a psychometric scale frequently used to measure quality of life after stroke (J. Rankin, 1957; R. Bonita and R. Beaglehole, 1988). One of these health states was immediate death. The health states were printed

on cards. The health states were identified by a letter, which was printed at the back of the card. The health states other than immediate death are described in Appendix A.

A random sample of 300 subjects aged over 18 was drawn from adults in the Spanish population. The sample was split into two groups of 150 subjects with equal divisions according to age, gender, and educational level.

B. *Methods*

The interviews were conducted by professional interviewers, who had received special training for this study. They visited subjects at their home where a face-to-face interview was conducted. The interview was carried out in a single session averaging 50 minutes. The subjects received no payment for their participation. The instructions of the first experiment, including the instructions for the interviewers, are in Appendix B.

The interview started with a motivation for the study. Subjects were told that the health states correspond to common health states after stroke and that it is important for health policy to know people's perception of these health states. Each subject had to conduct several tasks, two of which are relevant for this paper. First, subjects had to perform an "extended ranking" of the health states. They were asked to rank the cards describing the health states in descending order of preference. Equal ranks were allowed. Then they were asked to rate the ranked health states on a scale that ranged from 0 to 100, where 0 corresponded to the worst imaginable health state and 100 to the best imaginable health state. Subjects were asked to rate the health states so that the distances between the health states reflected the differences in perceived level of severity. During the rating exercise, subjects were allowed to change the ranking of the health states. The rating exercise was meant to verify the ranking of the health states.

After the extended ranking, subjects were told that there exist two treatments after stroke, a high dose treatment and a low dose treatment, see Figure 1. Both treatments could either fail or succeed. For both treatments the success outcome was recovery to normal health. The failure outcome of the high dose treatment was death. The low dose treatment could not lead to death, but if treatment were ineffective the stroke would lead to permanent brain damage and as a result of the brain damage to one of the health states Q,R,X,Y, or Z . Subjects were then shown a card describing one of the health states Q,R,X,Y,Z and asked to choose between the high dose treatment offering a 75% probability of success (i.e. recovery to normal health) and a 25% probability of immediate death and the low dose treatment offering a 75% probability of success and a 25% probability of the displayed health state.

Figure 1: Question Format of the Choices Between the Treatments

High dose treatment		**Low dose treatment**	
Success Probability	**Probability of death**	**Success Probability**	**Probability of displayed state**
75%	**25%**	**75%**	**25%**

Both groups of subjects were asked to make three choices between the high dose and the low dose treatment. The first group of subjects made three choices between the high dose and the low dose treatment, one choice in which the failure outcome in the low dose treatment was R, one choice in which it was X, and one choice in which it was Z. The second group of subjects also made three choices between the high dose and the

low dose treatment, one choice in which the failure outcome in the low dose treatment was Q, one choice in which it was Y, and a third choice, which is not relevant for the present paper.

Figure 1 shows the way the choices between the high dose and the low dose treatments were presented to subjects. The two treatments were printed next to each other so that subjects could easily compare them. The probabilities 75% and 25% were such that none of them is so small that it is likely that subjects would ignore them. After the choice problem was explained, subjects were asked whether they preferred the high dose treatment, the low dose treatment, or whether they were indifferent between the two types of treatment.

As a robustness check of the elicited choices, the interviewer next determined through a series of choices probabilities p and q such that the subject was indifferent between the high dose treatment offering a p% probability of success and a (1–p)% probability of immediate death and the low dose treatment offering a q% probability of success and a (1–q)% probability of the displayed health state. Throughout this choice-based elicitation, subjects were allowed to revise earlier answers including the choices that are analysed in this paper and the ranking of the health states. Therefore, if a subject thought at some later stage during the interview that he had made an error either in the ranking and rating of the health states or in the choice between the high dose and the low dose treatment, he could correct this error.

C. *Retest*

After the interview, subjects were asked whether they were willing to be interviewed again. The aim of this second interview was to test the reliability of the

data. About 50% of the subjects agreed to be re-interviewed. Fifty of these (twenty-five from each group) were chosen at random and re-interviewed 2-3 weeks after the original interview. The people who were re-interviewed were offered €12 for their participation. Most subjects (thirty-four) declined this offer. Experimental procedures in the second interview were identical to those of the first interview.

D. *Methods*

The choice between the high dose and the low dose also yields a preference ordering of health states. If the common outcome (full health), which is obvious, is cancelled (Kahneman and Tversky's (1979) isolation effect), a preference of the high dose treatment over the low dose treatment implies that the displayed health state was less preferred than death. Similarly, a preference of the low dose treatment over the high dose treatment implies that the displayed health state was more preferred than death. For each health state we determined whether it was better than, equivalent to, or worse than death both according to the ranking given and according to the choice between the high dose and the low dose treatment. This gave nine possible categories, six of which constituted a preference reversal, i.e. a difference in preference between the ranking task and the choice between the high dose and the low dose treatment.

3. Results of the First Experiment

Table 1 summarizes the results for health states R,X,Y, and Z. Because we observed no preference reversals for health state Q (all subjects indicated in both tasks that Q was better than death) we do not report the data for Q. The heading "treatment questions" refers to the choice between the high dose and the low dose treatment.

Shaded cells indicate preference reversals. The proportion of preference reversals was 9.3%, 24%, 43%, and 18% for health states R,X,Y, and Z respectively. The reversals were highly asymmetric: they were virtually always so that a health state was ranked above death but was considered worse than death in the choice between the high dose and the low dose treatment. The asymmetry was strongly significant for all health states ($P < 0.001$ in all cases).

Table 1: Categorization of responses

1A. Health State R

		Treatment Questions		
		Better	Equal	Worse
Ranking	Better	136		12
	Equal			2
	Worse			

1B. Health State X

		Treatment Questions		
		Better	Equal	Worse
Ranking	Better	100		35
	Equal	1		
	Worse			14

1C. Health State Y

		Treatment Questions		
		Better	Equal	Worse
Ranking	Better	52	9	49
	Equal		1	6
	Worse	1		32

1D. Health State Z

		Treatment Questions		
		Better	Equal	Worse
Ranking	Better	20		21
	Equal	1		5
	Worse			103

For health states X, Y, and, Z the probability of displaying a preference reversal was not related to age, gender or employment status. For health states X, Y, Z there was also no effect of level of education. For health state R, having at least elementary education significantly (p=0.02) reduced the possibility of displaying a preference reversal. There was no additional effect from having more than elementary education.

A. *Results of the Retest*

For all 50 subjects in the retest the ranking of the health states was identical to the ranking given in the first interview. The proportion of preference reversals was 0%, 16%, 28%, and 40% for health states R,X,Y, and Z, respectively. The reversals were, as before, highly asymmetric ($p < 0.001$) and such that the valuation of a health state relative to death was lower in the choice between the low dose and the high dose treatment. The pattern was therefore similar to that observed in the first experiment.

Table 2: Results of the Retest

Health State Pattern	R	X	Y	Z
C_1C_r	25	16	12	15
C_1PR_r	0	2	2	7
PR_1C_r	0	5	6	0

PR_1PR_r	0	2	5	3

Table 2 addresses the question whether subjects who exhibited a preference reversal in the first interview did so as well in the retest. C_1C_r denotes consistent in both the first experiment and the retest, C_1PR_r denotes consistent in the first interview, but a preference reversal in the retest, etc. Overall, about 50% of the subjects who exhibited a preference reversal in the first interview also exhibited a preference reversal in the retest. For health state R, there were no subjects in the retest who exhibited a preference reversal in the first interview. For health states X,Y, and Z, 28%, 45%, and 100%, respectively, of the subjects who exhibited a preference reversal in the first interview did so as well in the retest.

4. Second Experiment

A. *Background*

The second experiment aimed to test whether the observed preference reversal was robust. The principal aim of the second experiment was to examine whether the preference reversal could be replicated when both tasks were choice-based. Recall that the first task of the first experiment was to rank the health states, whereas the second task involved a choice between treatments. Hence, it may be that the preference reversal was due to a choice-ranking disparity. To rule out this possibility, both tasks in the second experiment involved only choices. If we still observed the preference reversal if both tasks were choice-based then this finding would be more troubling for economics because choice is the basic primitive of economics.

A second possibility that we wished to rule out was that the reversal was due to a framing effect. In the choice between the two treatments, we had labelled one treatment

the high dose treatment and the other the low dose treatment. Even though the treatments only differed in the outcome that obtained when treatment failed, these labels may have led to a framing bias. For example, high dose may have a more positive connotation, leading some subjects to simply choose based on the labels. In the second experiment we, therefore, used the neutral labels treatment 1 and treatment 2 and we varied which treatment was treatment 1 and which was treatment 2.

B. *Subjects*

Subjects in the second experiment were a random sample of 100 members aged over 18 from the Spanish general population. The sample characteristics were similar to those of the first experiment except that educational level of the second sample was higher.

C. *Design*

The design of the second experiment was the same as that of the first except for the following. We did not split the sample and all subjects answered the same questions. Subjects had to perform fewer tasks in the second experiment and, hence, the duration of the interviews was less than in the first experiment, on average 30 minutes. The instructions of the second experiment, to the extent that they differ from those in the first experiment, are in Appendix C.

As mentioned above, in the first task we did not use ranking but choice. Subjects were shown cards with 7 health states, which they were told are common after stroke. These health states were the five health states of the first experiment and normal health and death. They were then told to imagine that they had had a stroke and we asked them

in which of the 7 states they would choose to be. After subjects had chosen this state we removed the card of this health state and asked them to choose between the remaining health states. We continued this process until only one card remained. So the first task, to which we will refer henceforth as the *riskless choice task*, was close to ranking, but involved choices and hence involved revealed preference. The reason we included normal health among the health states was to make the first choice easy and to test whether subjects understood the procedure. Indeed, all subjects chose normal health in the first choice.

After the riskless choice task, subjects had to make five choices between treatments. The treatments were as in the first experiment: one offered a 75% probability of normal health and a 25% probability of death, the other offered a 75% probability of normal health and a 25% probability of one of the health states Q,R,X,Y, or Z. As mentioned before, the treatments were anonymously labelled treatment 1 and treatment 2 and which treatment was 1 and which was 2 varied across subjects. Except for the labelling, the display of the choices was as in Figure 1. Contrary to the first experiment, after a choice was made we did not proceed to determine the probabilities for which subjects were indifferent between the two treatments. Contrary to the first experiment, we did not do a retest in the second experiment.

D. *Standard gamble questions*

We also added a new risky choice in the second experiment in which only one of the treatments involved risk. Such questions in which a riskless option is compared with a risky option are widely used in health utility measurement and are in the health literature referred to as *standard gamble questions*. As we will explain later, the

standard gamble questions also led to a preference ordering of the health states relative to death. We included the standard gamble questions to further test the robustness of the preference reversal and to test whether theories of the gambling effect (P.C. Fishburn, 1980; U. Schmidt, 1998; R.D. Luce and A.A.J. Marley, 2000; E. Diecidue et al., 2004) could explain the preference reversal. According to these theories people use different utility functions v and u to evaluate outcomes that are riskless and outcomes that are risky respectively. In the ranking and riskless choices, all outcomes are riskless and the riskless utility function v is applied. In the choices between the treatments, all outcomes are risky and the risky utility function u is applied. If v and u do not order outcomes identically, i.e. there are outcomes x and y such that $v(x) > v(y)$ but $u(x) < u(y)$, then the gambling effect models can explain the preference reversal we observed. However, the gambling effect models cannot explain the reversals between the riskless choices and the standard gamble questions if we add the restriction that for all outcomes v exceeds u. The latter restriction is necessary for the gambling effect models to be consistent with the certainty effect such as in the Allais paradox (Diecidue et al., 2004).

Subjects were asked five standard gamble questions. For each of the health states Q,R,X,Y, and Z, subjects were asked to make a choice between that health state for sure and a treatment offering a 5% of normal health and a 95% probability of death. If a subject chose the treatment then we asked him to choose between the health state for sure and a treatment offering a 0.1% of normal health and a 99.9% probability of death.

E. *Methods*

The first task, the riskless choice questions, yielded a preference relative to death for each health state. As in the first experiment, we could also derive the preference of

each health state relative to death from the choice between the two risky treatments. In the choice between a health state for sure and a risky treatment a preference for a health state relative to death was derived as follows. If a subject preferred the health state for sure in at least one of the two question then the health state was preferred to death. If the subject preferred the treatment in both questions then death was at least as preferred as the health state. Strictly speaking, it was possible that a subject would choose the health state for sure for a probability of success less than 0.1%. This preference would be very weak, however, and by approximation our inference about preference could be assumed to hold.

5. Results of the Second Experiment

Table 3 presents the results from the second experiment. We do not report the data for health state Q because in all three tasks all subjects preferred Q to death and hence we observed no preference reversals for Q. The row Riskless > Death > Risky shows for each health state how many subjects preferred the health state to death in the riskless choice task, but preferred death to the health state in the choice between the two treatments. The table clearly shows that in spite of the changes in the experimental design the preference reversal that we observed in the first experiment re-emerges. The proportion of reversals was comparable to that in the first experiment. Again, the reversals are highly asymmetric. The asymmetry was significant ($p = 0.039$ for health state R, $p < 0.001$ for all other health states).

Table 3: Preference Reversals in the Second Experiment

	R	X	Y	Z

Riskless > Death > Risky	10	23	33	22
Risky > Death > Riskless	2	0	0	4
Riskless > Death > SG	2	24	42	23
SG > Death > Risky	0	0	0	2
Risky > Death > SG	2	7	13	3
SG > Death > Risky	8	6	4	0

The table also shows that a similar preference reversal was observed when we compared the riskless choices with the choices in the standard gamble questions. Except for health state R, we observed for all health states a considerable amount of preference reversals and there was a pronounced asymmetry in the observed preference reversals: they were nearly always such that the health state was preferred to death in the riskless choices but death was preferred to the health state in the standard gamble questions. The asymmetry was significant for health states X, Y, and, Z ($p < 0.001$ in all cases).

The final two rows of Table 3 show that preference reversals were much less common in the comparison between the choices between the two treatments and the standard gamble questions. What is more, there appears to be no clear asymmetry in those preference reversals. Only for health state Y is the asymmetry in the number of preference reversals significant ($p = 0.049$). For all health states and for all three comparisons, the probability of displaying a preference reversal was not related to age, gender, educational status, or employment status.

6. Discussion

A. *Main findings*

Several studies have observed that preferences can reverse across different tasks. The common explanation for these reversals is a choice-matching discrepancy: people's information processing strategy changes across tasks. In this study we observed a new type of preference reversal that cannot be explained by a choice-matching discrepancy. In the first experiment the reversal occurred between a ranking and a choice task, but the second experiment in which the ranking was made choice-based and, hence, only choices were used, showed that this difference in response modes cannot explain the findings. The reversal resembles the one observed by Birnbaum and colleagues, but is more troubling for economics because, at least in the second experiment, it only involved choices, the basic primitive of economic theory. The implication of the observed preference reversal for economic applications in the health domain are clearly worrying: our findings suggest that even the assumption that people have an invariant preference relation over health outcomes is untenable.

The reversal we observed is a violation of elementary stochastic dominance. While violations of stochastic dominance have been observed before in choice tasks (Tversky and Kahneman, 1986; Loomes et al., 1992; Birnbaum and J.B. Navarrete, 1998; J.W. Leland, 1998), they were restricted to choices where the violation was not obvious. Violations of elementary stochastic dominance, i.e. violations in choices where dominance is evident, had not been observed (Starmer, 2000). It appears that our study is therefore the first to find systematic evidence of such choice-based violations of elementary stochastic dominance.

B. *Possible objections*

It might be argued that the preference reversal we observed is just a violation of the independence axiom, because all health states are necessarily risky and, hence, the riskless choices were not really riskless. A similar reasoning could be applied to any outcome, however, even monetary outcomes. After all, money is purely instrumental for further decisions which may, again, involve risk. Hence if one adopts this point of view then the whole idea of an outcome becomes arbitrary and any test important preference properties like monotonicity and dominance becomes impossible (see von Winterfeldt and W. Edwards, 1986, pp.65-66 and I.H. LaValle, 1992, pp.111-112 for a more elaborate discussion of these issues). We do not concur with such an extreme position.

It seems unlikely that the reversals we observed were entirely due to response error. First, the preference reversal is highly asymmetric, which contradicts random error. Second, we used personal interviews to obtain high-quality data. Third, as noted in section 2, in the first experiment the choices between the two treatments were followed by a series of choice questions to determine probabilities for which subjects considered the treatments equivalent. If subjects had made an error they were likely to discover this during these additional questions and correct their earlier response. Finally, a sizeable proportion of the subjects who had displayed a reversal during the interview did so as well in the retest of the first experiment.

We neither believe that the preference reversals were due to the hypothetical nature of the questions. Several studies have addressed the question whether response patterns differ between questions with hypothetical outcomes and questions with real outcomes; see R. Hertwig and A. Ortmann (2001) for an extensive review. These studies used moderate monetary amounts as outcomes. The general conclusion from these studies is that the effect of real incentives varies across decision tasks. For the

kind of taks that we asked our subjects to perform, there appears to be no systematic difference in the general pattern of responses (Mellers, R. Weiss and Birnbaum (1992) found that the reversal observed by Birnbaum et al. (1992) did not depend on whether subjects were financially motivated.

We observed that the introduction of financial compensation might actually do more harm than good in health valuation experiments. When we offered subjects in the retest of the first experiment financial compensation for their participation most of them declined. This suggests that people have an intrinsic motivation to participate in health valuation experiments because they feel that they are contributing to society. Offering financial compensation might negatively affect ("crowd out") this intrinsic motivation. Comparable examples of crowding-out effects include R.M. Titmuss (1970) and W.E. Upton (1973), who found that people's willingness to donate blood decreased after they were offered financial compensation, J.M. Poterba et al. (1998), who found that government subsidies reduced private donations and charitable funds, B.S. Frey and F. Oberholzer-Gee (1997), who found that payment for locally unwarranted projects reduced the willingness to accept these projects, and (U. Gneezy and A. Rustichini (2000), who found that pupils collecting donation for charity performed worse when given moderate rather than no payment.

A difference between the riskless choices and the risky choices (the choices between the treatments) and the standard gamble questions was that in the riskless choices the initial choice set consisted of 6 health states and death, whereas the other two tasks involved only two health states and death. Empirical evidence suggests that the presence of other alternatives in the choice set may affect the evaluation of alternatives relative to each other (Tversky and I. Simonson, 1993; D.H. Wedell, 1991).

Such context effects are unlikely to have caused the preference reversal we observed. Recall that we observed the preference reversal for the three least attractive health states. The empirical evidence on context effects suggests that the presence of more attractive health states in the choice set would have the effect of making the less attractive health states less appealing compared to death. Hence, context effects predict that if preference reversals exist they are such that the health state is preferred to death in the choice between the treatments but less preferred to death in the riskless choice task. This is the opposite of what we observed. Hence, if context effects were present they only attenuated the preference reversal we observed; without them the preference reversal would be even more pronounced.

C. *Explanations*

Several of the theories that allow violations of stochastic dominance, like subjectively weighted utility (J. Handa, 1977; P.C. Fishburn, 1978), prospect theory (Kahneman and Tversky, 1979) and regret theory (Loomes and Sugden, 1982; J. Quiggin, 1990), cannot explain the findings of this paper. Because we observed in the second experiment that the preference reversal also arose in the comparison between the riskless choices and the standard gamble questions, the gambling effect models do not offer a satisfactory explanation for the preference reversal either.

Configural-weight theory (Birnbaum, 1974; Birnbaum, G. Coffey, Mellers and Weiss, 1992) can explain our findings if we make the restrictive assumption that subjects give more weight to outcome of successful treatment when death is the outcome of treatment failure. It is questionable whether this assumption holds. Death is not a neutral outcome, like receiving nothing in a monetary gamble, and several studies

indicated that the possibility of death makes people extremely risk averse (L. Lundberg et al., 1999; L.A. Lenert et al., 2001).

A possible explanation for our findings can be the anticipation of disappointment and elation in risky choice (Loomes and Sugden, 1986). In the comparison between the two risky treatments subjects may have anticipated feelings of disappointment when the treatment that offered normal health with 75% probability and a worse health state with probability 25% failed. In case the treatment involving a 25% risk of death failed such feelings of disappointment play no role because the subject would be dead anyway. The presence of disappointment in the evaluation of one treatment but not in the other may have caused the preference reversal between the riskless choice and the risky treatments. In the standard gamble questions subjects may have anticipated feelings of elation when the treatment, in spite of its poor prospects, would be successful. This anticipation of elation may have explained that some health states, which were considered better than death in the riskless choices, were nevertheless less attractive than a treatment offering only a 0.1% of success.

There is another, ethical, explanation for our findings. It may be that in the riskless choices, the choice between a bad health state and death raised ethical problems that disappear when risk was introduced. In the riskless choices, the choice of death could be related to such issues as euthanasia or the value of life per se. When risk is introduced such ethical concerns are less prominent, because the choice of a treatment involving a risk of death cannot be so easily related to the same ethical considerations. If such ethical considerations affect preferences, the answer which method to use to elicit preferences in economic evaluations of health care then depends on which role we ascribe to these ethical considerations in health policy.

Appendix A: The Five Health States Used in the Experiments

Health state Q

The patient has symptoms as a result of a health problem; symptoms can include numbness, minor problems with movement, or some difficulty with reading or writing. The symptoms do not interfere with the patient's usual activities to any appreciable extent, but they may affect the patient's enjoyment of aspects of his daily life.

Health state R

As a consequence of the health problem the patient is restricted in participation in a major aspect of life that he engaged in previously. He may be unable to work or look after his children if these were major roles before; he may have restricted social and leisure activities; or he may have experienced significant disruption of close relationships. He can look after his own affairs (preparing meals, household chores, shopping in the neighbourhood, looking after his financial situation…) and can attend to his bodily needs (such as washing, going to the toilet, and eating) without problems.

Health state X

As a consequence of their health problem the patient is unable to live independently. He is unable to travel alone or shop without help if he did these things previously; and he is unable to look after himself at home for some reason (for example he may not be able to prepare a meal, do household chores, or look after money). …). He can attend to his bodily needs (such as washing, going to the toilet, and eating) without problems.

Health state Y

As a consequence of his health problem the patient needs assistance with some basic activities of daily living or needs help from another person with walking. Basic activities of daily living include attending to bodily needs such as washing, going to the toilet, and eating.

Health state Z

As a consequence of the health problem the patient is bedridden, and unable to move from bed without assistance. He may be incontinent, and needs someone present all the time to look after him.

Appendix B: Instructions in the First Experiment. Interviewer Instructions are in Italics and Between [...].

This survey is part of a study conducted under the supervision of Pompeu Fabra University. The objective of the study is to know people´s point view about different health problems. We are going to ask you hypothetical situations, that is, that you do not face in practice but it would be of much help if you could tell us what you would do in these situations. Take into account that there are right or wrong answers. We just want

to know your opinion. Please, ask any question that you may have during the interview. Thanks.

Stroke is a health problem caused by the placement of blood clots in the brain. Health state after stroke can vary greatly between patients. I am going to describe 6 possible health states after stroke. I am going to ask you to consider also death as a potential consequence of stroke. I would like to know how good or bad these health states are for you. Please rank the six cards from the most to the least preferred.

** **Instruction for the interviewer**: give the subject the six cards that describe the health states including the one with death. Cards are identified with a letter **in the back** (to avoid people classifying the health states following alphabetic order). Let the subject read the cards.* Wait *until the subject ends with the ranking and then read next sentence.*

In order to help you to express your opinion about how good or bad are the 6 health states we give a scale similar to a thermometer. In this thermometer 100 is the number associated to the best health state you can imagine. 0 is the worst health state you can think of. We would like you to place in the thermometer each of the 6 health states taking into account that when comparing two health states, the more preferred has to receive a higher number than the less preferred and the distance has to show how much better or worse it is.

Treatment questions

When somebody has a stroke it is very important to provide medication as soon as possible to remove the blood clot. Otherwise, there can be permanent injuries in the brain that may create important chronic health problems. However, the best treatment (or better said the best dose) is not clear. In general, there are two ways of dealing with this problem. The doctor can give to the patient two different doses, namely, high or low. The problem of the high dose is that in some patients can lead to death. The low dose cannot cause death but in some patients can be ineffective and then the stroke can cause brain damage and the patient can have health problems the rest of his life.

Now we are going to show you several hypothetical situations and we would like you to tell us which dose you think it would be better for you.

Appendix C: Instructions in the Second Experiment. Interviewer Instructions are in Italics and Between [...].

Stroke is a health problem that is produced by a blood clot in your brain. The consequences for your health can be quite different. I am going to describe you several situations that you might have after a stroke.

Assume you may have a stroke. Assume that you can remain, for the rest of your life, as follows [*interviewer, show the cards*]

If you had had a stroke and you could be as one of those patients, which one would you choose to be?

P1. I would choose to be …… [*interviewer, if the subject does not say 'patient N' there is a mistake. Please, check that the subject has understood the question*]

This is right, the ideal thing would be to be patient N, that is, to be totally well after the stroke. However, in some occasions this does not happen. Patients will remain, for the rest of their life in a health state that is worse that the one they were enjoying before the stroke. Now, we ask you to make a choice between the rest of patients, according to your preferences. That is, if you could not be patient N, which one would you rather choose to be?

P2. If as a consequence of a stroke I could not be as patient N (normal health), I think I would choose to be patient……

Please go on with the rest of patients, by order of preference until the one that you think is the worst off.

Standard gamble questions

Finally, we are going to ask you to assume that you are as one of the above patients as a consequence of a stroke, but there is only one treatment available. You have to choose whether to accept the treatment or not. The problem is that this treatment is only effective in very few occasions (just around 5%) and in the rest of cases it leads to death.

Assume that as a consequence of a stroke you are going to be as patient R the rest of your life and you are offered the treatment that in 5% of cases allows you to go

back to the situation you had before the stroke and in 95% of cases produces the death of the patient.

Do you think that you would follow the treatment or you would accept to remain as patient R for the rest of your life? (we do not know what will happen in the future but assume that there is not going to be a better treatment available in the future).

a. I would take the treatment *[interviewer go to next question]*

b. I prefer to stay as R for the rest of my life.

Do you think that you would follow the treatment if you were informed that it only worked very rarely, say in 1 out of 1000 people?

a. I would take the treatment *[interviewer go to next question]*

b. I prefer to stay as R for the rest of my life.

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