Centre for Decision Research and Experimental Economics

Discussion Paper

Discussion Paper Series

ISSN 1749-3293

CeDEx Discussion Paper No. 2005–07

Testing for feedback-conditional regret effects using a natural lottery

Steven J. Humphrey, Paul Mann and Chris Starmer

May 2005

The Centre for Decision Research and Experimental Economics was founded in 2000, and is based in the School of Economics at the University of Nottingham.

The focus for the Centre is research into individual and strategic decision-making using a combination of theoretical and experimental methods. On the theory side, members of the Centre investigate individual choice under uncertainty, cooperative and non-cooperative game theory, as well as theories of psychology, bounded rationality and evolutionary game theory. Members of the Centre have applied experimental methods in the fields of Public Economics, Individual Choice under Risk and Uncertainty, Strategic Interaction, and the performance of auctions, markets and other economic institutions. Much of the Centre's research involves collaborative projects with researchers from other departments in the UK and overseas.

Please visit http://www.nottingham.ac.uk/economics/cedex/ for more information about the Centre or contact

Karina Whitehead
Centre for Decision Research and Experimental Economics
School of Economics
University of Nottingham
University Park
Nottingham
NG7 2RD
Tel: +44 (0) 115 95 15620
Fax: +44 (0) 115 95 14159
karina.whitehead@nottingham.ac.uk

The full list of CeDEx Discussion Papers is available at

http://www.nottingham.ac.uk/economics/cedex/papers/index.html

Testing for feedback-conditional regret effects using a natural lottery

Steven J. Humphrey, Paul Mann and Chris Starmer [*]

We report the results of an experimental test for feedback-conditional regret effects using a naturally occurring gamble. The properties of this gamble are likely to engage decision-makers to a greater extent than conventional abstract laboratory gambles, and be more generally exhibited by real world objects of choice. We argue that this conveys a higher than typical degree of external validity on our findings. We observe that feedback on the outcome of foregone choices enhances the salience of regret as a decision motive.

Keywords: regret theory, outcome feedback, natural lottery, external validity

JEL classification: D81, C91

[*] Financial support from The Centre for Decision Research and Experimental Economics (CeDEx) is gratefully acknowledged. Correspondence to: Steve Humphrey, CeDEx, School of Economics, University of Nottingham, Nottingham NG7 2RD, UK. +44 115 951 5472.

1. Introduction

This paper is about the impact of regret on risky decisions. Loomes and Sugden's (1982, 1987) regret theory attracted a good deal of interest in the literature, stemming from the apparent empirical support for its distinctive predictions of systematic violations of expected utility theory. Subsequent empirical investigations, however, revealed some of these results to be spurious (e.g. Starmer and Sugden, 1993; Humphrey, 1995). This, at least amongst economists, has contributed to a decline in interest in regret theory. More recently, however, this interest has been rekindled by research which has emphasised the importance of feedback on the outcome of foregone acts to the anticipation of regret (see Zeelenberg (1999) for a discussion) [1]. If the decision-maker knows that they will never discover what the outcome of a foregone act would have been, there is arguably nothing to regret (e.g. with no such feedback, choosing a certain $50 over a 50-50 chance of $100 or zero provides insurance against the regret associated with choosing the gamble, winning zero and knowing that $50 has been foregone). If, however, the outcome of foregone acts will be revealed, considerations of regret become salient because the individual knows that they will be able to compare 'what is' with 'what might have been' (e.g. choosing the certainty no longer provides insurance against regret and may tend the decision-maker towards choosing the gamble).

There is a substantial amount of evidence of feedback-conditional regret effects from experiments using conventional pairwise choice tasks between simple abstract lotteries (e.g. Zeelenberg *et* al., 1996). Zeelenberg (1999, p.99) suggests that whilst this paradigm allows the study of regret effects in their "purest form", results may have limited generality. He goes on to discuss regret effects in more naturalistic settings, such consumer decision-making (Simonson, 1992), sexual activity (Richard *et al.*, 1996) and driving violations (Parker *et al.*, 1996). Whilst the results of these types of studies have legitimate claims to greater external validity than lottery choice experiments, this is often (and inevitably) at the expense of some of the merits of the lottery choice paradigm, such as the close control of subjects' incentives. We suggest that it is possible to bridge the gap between the lottery choice paradigm and more naturalistic settings, and thereby benefit from the retention of control of the former *and* the improved external validity of the latter. To this end we conduct a controlled test of feedback-

[1] Loomes and Sugden's (1982, 1987) regret theory does not explicitly consider this.

conditional regret effects using a naturally occurring lottery. Millions of such lotteries are purchased each week around the world. We argue that the natural object of choice we use has two advantages over abstract experimental lotteries in conveying external validity on our findings. First, it possesses several important characteristics of real world decisions, which we elaborate in the next section. Second, we argue that subjects will be more engaged by a naturally occurring gamble than they would be by an abstract experimental lottery. If abstract and unfamiliar lotteries are less engaging than natural objects of choice, the revelation of the emotions which lead to choices may be hampered. Humphrey (2004, pp. 848-850), for example, shows that the feedback-conditional regret effects observed by Zeelenberg *et al.* (1996) reach 1% significance in one pairwise comparison of treatments, but do not reach 5% significance in two pairwise comparisons of treatments. The interpretation offered for these latter two cases is that they involve tasks which entail the potential for confounding feedback-conditional regret *and* rejoicing effects. We agree with other researchers (e.g. Beattie *et al.*, 1994) that since negative information generally exerts a greater influence on decisions than positive information, the impact on feedback will be greater on regret than on rejoicing. Given this, we propose that even in tasks where feedback may exert confounding influences on regret and rejoicing, feedback-conditional regret effects will emerge significantly *if* the task is sufficiently engaging to allow the full revelation of emotions which underpin choices. Our design tests this proposition. If we observe feedback-conditional regret effects, our test may provide a more accurate reflection of the importance of regret effects in real world decisions than that provided by abstract lottery choice tasks.

2. Experimental design

We test for evidence of feedback-conditional regret effects in a task which endows each subject with a simple *real world* lottery in the form of a UK National Lottery scratchcard called "The Hot One!". The rules of the game are printed on the reverse of the card and are as follows: The player scratches off six latex panels to reveal six sums of money (possible prizes on the game are £1, £2, £3, £8, £11, £14, £19, £27, £33, £36, £41, £47, £150 and £1000). If three matching sums are revealed then the player receives that prize, if a single 'chilli' symbol is revealed the prize is £8 and otherwise the prize is zero. The game does not provide information regarding the likelihood of each prize, but simply states that the overall odds of

winning a non-zero prize are approximately "1 in 4.89" (20.45%). Prizes up to £75 are claimed by presenting the scratchcard to a participating retailer. Prizes above £75 are claimable from The National Lottery (either by telephone or post).

The key idea behind our design is to give our subjects a scratchcard and offer to buy it back (at a price which falls within a specified range). We manipulate the feedback provided on the outcome of sold lotteries to see if this affects reservation prices in the manner consistent with feedback-conditional regret effects. The use of a naturally occurring lottery enriches the investigation in several ways. First, the lottery is likely to be more familiar to subjects than conventional abstract lotteries. For example, when the experiment was conducted (June, 2004) 'The Hot One' could be readily purchased for £1 from the network of 33,000 retailers used by Camelot (the lottery operator). In the financial year ending 31st March 2003 sales of scratchcards in the UK averaged more than £11 million per week (Camelot, 2003).[2] Second, since the lottery involves 15 possible outcomes it is substantially more complex than typically experimental lotteries. Complexity has been shown to influence decisions under risk (e.g. Huck and Weizsäcker, 1999). If abstract experimental lotteries entail only few outcomes, but decisions in the real world are significantly more complex, then experiments which employ relatively complex lotteries are likely to have greater external validity than those which do not. Third, 'The Hot One' is characterised by a high degree of uncertainty (a 79.55% chance of a negative outcome), an incompletely specified probability distribution and potentially very large outcomes. These are all properties inherent in many risky choices made in real world contexts to which experimental work often claims pertinence (e.g. stock market decisions). Fourth, despite the lottery being relatively complex, the familiarity of UK residents with this type of good simplifies the experimental design from the subject's point of view because there is no need to explain probabilities or experimentally induced payoffs. [3] Fifth, there is

[2] This figure is sales of scratchcard lotteries operated by Camelot and represents a substantial part of Camelot's £88 million weekly revenue during the same period. There are other operators of this kind of lottery in the UK.

[3] Zeelenberg (1999, p.102) suggests that the more difficult a decision is, the greater influence regret is likely to be in making a choice. Decision difficulty causes people to "worry more about the consequences" of choices and compare them more carefully. This brings considerations of regret to the fore. The provision of complete outcome and probability information in conventional lottery choice experiments, he suggests, renders decision problems less difficult and thereby restricts the potential emergence of regret effects. The importance of regret effects in the real world may therefore be greater than results from lottery choice experiments suggest. Given the complexity and degree of uncertainty involved in the lottery employed by our design, this argument supports the suggestion that our findings may be more externally valid than those of other lottery choice experiments.

evidence to suggest that experimental tasks which endow agents with real objects of choice are more engaging than pairwise choices between abstract lotteries on a computer screen (e.g. Bateman *et al.* (in press) provide evidence in the context of loss-aversion). If risky choices in the real world are more engaging than abstract experimental lotteries, and if more engaging tasks are more likely to elicit human emotions which contribute to economically important behaviour, the external validity of our test is enhanced.

54 subjects were recruited to take part in the experiment by an e-mail shot to CeDEx's database of pre-registered volunteers from the undergraduate population at the University of Nottingham. All subjects were endowed with a scratchcard, allowed to handle it, permitted to read the instructions and probability information, consult the prize list and consider the task prior to making their decisions. We provided no additional information regarding the lottery to that which is printed on the scratchcard. Subjects were told that they could either keep the scratchcard (and keep any prize it yielded), or sell it back to the experimenters (and forego any prize it yielded). To this end the experiment posed each subject 30 questions, each of which asked whether they would rather sell the scratchcard for £v or keep it (where £0.05≤v ≤£1.50).[4] Incentive compatibility was achieved by randomly selecting one of the 30 questions at the end of the experiment and either buying the scratchcard from the subject or allowing them to keep it according to their stated preference in the task. This dichotomous choice design is a simple method of eliciting subjects' reservation prices for the lottery over a pre-determined set of prices. In this respect the incentive system can be viewed as a restricted form of the Becker-DeGroot-Marschak mechanism (Becker *et al.*, 1964) which makes it easier for subjects to understand the incentive compatible logic (c.f. Langford *et al.*, 1998).

Subjects were randomly assigned to one of two groups. *N*-group subjects (n=25) were told that if they sold the scratchcard they would be paid the sale price in cash, we would keep the scratchcard, they would leave the experiment and never discover the prize the scratchcard yielded. Subjects who sold the scratchcard in this condition were insured against experiencing ex post decisional regret (and rejoicing). *F*-group subjects (n=29) were told that if they sold the scratchcard, the experimenter would play it out in front of them to reveal what they

would have won had they not sold it. Thus *F*-group subjects received complete outcome feedback and were exposed to the possibility of ex post decisional regret. Subjects in either group who kept the scratchcard played it out to reveal their winnings.

Our design provides a simple controlled test of the impact of outcome feedback on decisions. Figure 1 shows a simplification of each decision problem in the experiment which captures the essential features of the choices facing subjects. If x and zero (where $x>v>0$) were the only outcomes of the scratchcard game then we could represent each decision facing the individual as a choice between a certain v and a probability mix of x and zero. [5]

Figure 1: Decision problem[a]

	Probability of state of the world	
	p	$(1-p)$
KEEP the scratchcard	x	0
SELL the scratchcard	v	v

[a] where p is approximately 0.2.

Feedback-conditional regret theory predicts that, at each price v, a lower proportion of *F*-group subjects will sell the scratchcard than *N*-group subjects. The formalities of this prediction are presented in the Appendix. To understand the intuition behind the prediction consider a subject who is inclined to sell the scratchcard at price v. If this subject were in the *N*-group they would be insured against the experience of regret under the state of the world which occurs with probability p, because they will never discover if this state of the world has occurred. If the subject were in the *F*-group they would have no such insurance and so would demand a regret premium. The regret premium will increase the average reservation price of the scratchcard for *F*-group subjects in relation to *N*-group subjects. Therefore, at each price v, a lower proportion of *F*-group subjects will be inclined to sell the scratchcard than *N*-group subjects. Note that in feedback-conditional regret theory, feedback does not affect the

[4] Each question took the form, "Would you sell the scratchcard for v pence [ ] or keep it [ ] ?". Choices were made by checking the appropriate box.

[5] Given the outcome profile of 'The Hot One' and the range of reservation prices available to subjects, the task they face is more complex than that illustrated in figure 1. The simplified problem in figure 1 captures the essential characteristics of the task where for any available reservation price v, there will be at least one state of the world which offers a larger outcome and at least one state of the world which offers a smaller outcome.

influence of the state of the world which occurs with probability 1-*p*. Selling the scratchcard under this state of the world would expose the individual to rejoicing. Existing evidence reveals that although feedback-conditional *rejoicing* effects may exist and exert an influence on behaviour which conflicts with feedback-conditional regret effects, it is the latter which dominate (e.g. Zeelenberg, 1999). The strong version of feedback-conditional regret theory presented in the Appendix is therefore proposed in this spirit; concentrating on the influence of feedback on regret alone, rather than on the indeterminate influence of feedback on both regret and rejoicing (see Humphrey (2004) for further discussion of this assumption).

3. Results

The null hypothesis is that there will be no difference between the behaviour of *F*-group and *N*-group subjects (i.e. the provision of feedback on the outcome of foregone acts will not affect the decision to sell (or keep) the scratchcard). The alternative hypothesis is provided by strong feedback-conditional regret theory; at each price level, more subjects will keep the scratchcard when there is feedback on the outcome of foregone acts.

Table 1: Percentage of subjects keeping the lottery at each price.[a]

Price (*v*)	*N*-group	*F*-group	Price (*v*)	*N*-group	*F*-group
5	96	100	80	76	86.2
10	96	100	85	80	86.2
15	96	100	90	76	86.2
20	96	100	95	76	86.2
25	92	100	100	*76*	*75.9*
30	96	100	105	*68*	*62.1*
25	96	100	110	*64*	*62.1*
40	92	100	115	*64*	*62.1*
45	88	100	120	56	62.1
50	80	96.6	125	52	62.1
55	88	93.1	130	44	62.1
60	84	93.1	135	44	62.1
65	88	93.1	140	32	62.1
70	80	89.7	145	28	58.6
75	76	89.7	150	16	41.4

[a] n=25 for *N*-group and n=29 for *F*-group.

Table 1 shows that in 26 out of 30 cases the proportion of subjects keeping the lottery in the *F*-group is greater than the corresponding proportion in the *N*-group. These 26 observations are consistent with the prediction of strong feedback-conditional regret theory.

A Mann-Whitney U-test rejects the null in favour of the alternative at the 5% significance level (W=797). Recall that the experiment restricts the range of selling prices to a maximum of £1.50. An additional test which may mitigate the influence of the restricted range of prices is to compare the proportions of subjects in each group who choose to keep the scratchcard at *all* price levels (16% for the *N*-group and 37.9% for the *F*-group). A test of difference in sample proportions based on the normal distribution yields Z=-1.888. The null hypothesis can be rejected in favour of the alternative with 5% significance.

The data in table 1 also reveal that as the selling price increases *N*-group subjects are steadily more inclined to sell the scratchcard. Whilst the same is generally true of *F*-group subjects, their behaviour displays a notable range of prices (£1.05-£1.40) where supply is completely inelastic. Over this range the supply of scratchcards in the *N*-group more than doubles from 8 to 17 units (Z=-2.7285, p=0.0033). It appears that not only does foregone act resolution have an overall dampening effect on supply, it also contributes to restricting the price elasticity of supply. This observation is intuitively plausible in the context of regret aversion. Feedback on the outcome of foregone acts renders it necessary that increments in price exceed a threshold in order to override the enhanced salience of the regret of selling the ticket to subsequently discover that it yielded a positive (possibly substantial) prize.

4. Conclusion

The experiment reported here has revealed significant regret effects stemming from a manipulation of feedback on the outcome of foregone courses of action. By retaining the close control of the lottery choice paradigm but using a naturally occurring gamble rather than abstract lotteries, our findings extend the existing literature in important respects. First, the lottery we employed has a broad range of outcomes and incomplete information regarding the associated probabilities. Our design did not require individuals to consult this information, but merely pointed out that it could be consulted if desired. Making complex decisions under uncertainty (rather than risk) is a closer approximation to decision making in real world contexts. In relation to abstract lottery choice designs (such as Zeelenberg *et al.*, 1996), our use of a more engaging object is also likely to more accurately reflect the importance of regret effects in real world contexts. Recall that our task is similar to some of

Zeelenberg *et al.s* (1996) tasks in being open to potentially confounding feedback-conditional regret and rejoicing effects. We also use a similar, relatively modest, sample size. Yet we observe feedback-conditional regret effects with 5% significance and, in the comparable cases, they do not. This suggests that the importance of feedback-conditional regret effects in real world decision-making may be understated by observations which stem from purely abstract experimental designs. Our findings should therefore be of interest to those working in the emerging field of behavioural finance. Kahneman and Riepe (1998) and Zeelenberg (1999) argue that feedback-conditional regret effects are influential in the context of trading in financial assets, where feedback on the outcomes of both chosen and foregone courses of action is readily available and used by decision-makers.

Second, although there exists no formal mechanism to sell National Lottery scratchcards back to retailers (or a more general second hand market), there are clear real world analogues to the design we employ. For example, players of the twice weekly National Lottery Lotto game frequently choose the same six numbers (house numbers, birthday dates etc.). In this case the decision not (or forgetting) to buy a ticket does not provide insurance against the regret of not playing the game and discovering that the usual six numbers won the jackpot. Choosing a 'lucky dip' ticket which randomly selects six numbers at the point of purchase, on the other hand, does provide insurance. The evidence reported here suggests that the lottery operator could extract additional rent from consumers of lucky dip tickets in relation to consumers who repeatedly purchase the same numbers.[6]

Finally, the observation that foregone act resolution appears to contribute to price inelasticity of supply may be related to the observed amplified preference for current states of affairs embodied in status quo effects (e.g. Samuelson and Zeckhauser, 1988). Since these and other real-world phenomena - such as brand loyalty - can all be interpreted in terms of choosing certainties over risky alternatives in order to avoid regret (as in selling the scratchcard in the absence of foregone act resolution), it may be timely to further investigate these behaviours in market-like experimental institutions.

[6] Our findings also suggest a rationale for the National Lottery operator's provision of the facility to automatically and repeatedly purchase tickets (with pre-specified numbers) via a direct debit from a bank account. This insures individuals against the regret of not having a ticket when their usual numbers are drawn.

References

Bateman, I., Kahneman, D., Munro, M., Starmer, C. and Sugden, R. (in press). Testing competing models of loss aversion: An adversarial collaboration, *Journal of Public Economics*.

Beattie, J., Baron, J., Hershey, J.C. and Spranca, M.D. (1994). Psychological determinants of decision attitude, *Journal of Behavioral Decision Making* 7, 129-44.

Becker, G., DeGroot, M. and Marschak, J. (1964). Measuring utility by a single-response sequential method, *Behavioral Science* 9, 226-232.

Camelot (2003). Annual Report and Financial Statements 2003. http://www.camelotgroup.co.uk/downloads/Camelot_annual_report_2003.pdf

Huck, S. and Weizsäcker, G. (1999). Risk, complexity, and deviations from expected-value maximization, *Journal of Economic Psychology* 20, 699-715.

Humphrey, S.J. (1995), Event-splitting effects or regret-aversion: More evidence under risk and uncertainty' *Journal of Risk and Uncertainty* 11, 263-274.

Humphrey, Steven J. (2004). Feedback-Conditional Regret Theory and Testing Regret Aversion in Risky Choice. *Journal of Economic Psychology* 25, 839-857.

Kahneman, D., and M.W. Riepe (1998). Aspects of investor psychology, *Journal of Portfolio Management* 24, 52-65.

Langford, I.H., Bateman, I.J., Jones, A.P. Langford, H.D. and Georgiou, S., (1998) Improved estimation of willingness to pay in dichotomous choice contingent valuation studies, *Land Economics* 74, 65-75

Larrick, R.P. and Bowles, T.L. (1995). Avoiding regret in decisions with feedback: A negotiation example, *Organizational Behavior and Human Decision Processes* 63, 87-97.

Loomes, G. and Sugden, R. (1982). Regret theory: An alternative theory of rational choice under uncertainty, *Economic Journal* 92, 805-24.

Loomes, G. and Sugden, R. (1987). Some implications of a more general form of regret theory, *Journal of Economic Theory* 41, 270-87.

Parker, D., Stradling, S. and Manstead, A.S.R. (1996). Modifying beliefs and attitudes to exceeding the speed limit: An intervention study based on the theory of planned behavior, *Journal of Applied Social Psychology* 26, 1-19.

Richard, R., van der Plight, J. and de Vries, N.K. (1996). Anticipated regret and time perspective: Changing sexual risk taking behaviour, *Journal of Behavioral Decision Making* 9, 185-199.

Samuelson, W. and Zeckhauser, W. (1988). Status quo bias in decision making, *Journal of Risk and Uncertainty* 1, 7-59.

Simonson, I. (1992). The influence of regret and responsibility on purchasing decisions, *Journal of Consumer Research* 19, 105-118.

Starmer, C. and Sugden, R. (1993), Testing for juxtaposition and event-splitting effects, *Journal of Risk and Uncertainty* 6, 235-254.

Zeelenberg, M. (1999). Anticipated regret, expected feedback and behavioral decision making, *Journal of Behavioural Decision Making* 12, 93-106.

Zeelenberg, M., Beattie, J., van der Plight, J. and de Vries, N.K. (1996). Consequences of regret aversion: Effects of expected feedback on risky decision making, *Organizational Behavior and Human Decision Processes* 65, 148-58.

Appendix

$M(x_{ij}, x_{kj})$ is a set of modified utility functions defined over pairs of acts A_i and A_k, each of which describe the modified anticipated utility of having x_{ij} under the chosen act (A_i) and foregoing x_{kj} under the alternative act (A_k) in state S_j. Modified utility is the utility derived from the first argument and incremented or decremented depending on the sign of x_{ij}-x_{kj}. $x_{ij}<x_{kj}$ implies regret and $x_{ij}>x_{kj}$ implies rejoicing. The decision-maker compares *what is* under a particular state having chosen a particular act with *what might have been* under the same state and the alternative act, and decides according to expression (1), where '$\succ$' and '$\sim$' denote strict preference and indifference, respectively:

$$A_i \begin{matrix}\succ \\ \sim \\ \prec\end{matrix} A_k \Leftrightarrow \sum_{j=1}^{n} p_j M(x_{ij}, x_{kj}) \begin{matrix}> \\ = \\ <\end{matrix} \sum_{j=1}^{n} p_j M(x_{kj}, x_{ij}) \qquad (1)$$

In feedback-conditional regret theory there are two modified utility functions: $m^f(x_{ij}, x_{kj})$ and $m^n(x_{ij}, x_{kj})$. Which of them is applied to evaluate a state of the world depends on whether feedback is provided on both the outcome of the chosen act and the act forgone, or only on the outcome of the chosen act. This feedback may be provided by the outcome received revealing the state of the world which has occurred (and therefore the outcome of the foregone act), or by foregone acts being independently resolved. $m^f(x_{ij}, x_{kj})$ is applied where the outcome of the chosen act x is *fully revealing of the state of the world*. In this case receiving x_{ij} reveals that the outcome of the foregone act is x_{kj}. $m^n(x_{ij}, x_{kj})$ is applied where having x_{ij} will *not be fully revealing of the state of the world*. In this case, the decision-maker has anticipated a state of the world under which they will receive x_{ij} and forego x_{kj}, but actually receiving x_{ij} does not reveal x_{kj} (as opposed to some other outcome x_{lj}) as the outcome of the foregone act. Feedback-conditional regret theory captures the influence of feedback on regret and rejoicing by imposing two restrictions on the relationship between $m^f(x_{ij}, x_{kj})$ and $m^n(x_{ij}, x_{kj})$ which, using simplified notation, are as follows:

Restriction [1]: For all x, y such that $x>y$: $m^f(y, x) < m^n(y, x)$

Restriction [1] says that the anticipated modified utility of having y and foregoing x is greater (the anticipated regret is smaller) when having y does not reveal the state of the world than

when it does. For example, in figure 1, if regret is anticipated upon selling the scratchcard and the state of the world in *p* occurring, then the knowledge that the experience of regret will potentially be realised by resolution of the foregone act enhances the influence of the potential regret in choice.

Restriction [2]: For all *x*, *y* such that *x*>*y*: $m^f(x, y) = m^n(x, y)$

The anticipated modified utility of having *x* and foregoing *y* (rejoicing) is not affected by whether having *x* fully reveals the state of the world or not.

Corollary [1]: For all *x*, *y* such that *x*>*y*, $m^n(y, x) - m^f(y, x) > m^f(x, y) - m^n(x, y) = 0$

Corollary [1] follows from restrictions [1] and [2]. It reflects the observation (Beattie *et al.* 1994; Larrick and Boles, 1995) the foregone act resolution influences the salience of regret more than the salience of rejoicing.[7]

Strong feedback-conditional regret theory predicts that in the problem in figure 1 *F*-group subjects will be less inclined to sell the lottery at each level of *v* than *N*-group subjects. An application of strong feedback-conditional regret theory to the decision problem in figure 1 for *N*-group subjects yields:

$$\text{SELL} \succ \text{KEEP} \Rightarrow p\boldsymbol{m}^n(v, x) + (1-p)\boldsymbol{m}^n(v, 0) > p\boldsymbol{m}^f(x, v) + (1-p)\boldsymbol{m}^f(0, v) \quad (2)$$

In expression (2) selling the scratchcard is evaluated against $\boldsymbol{m}^n(\,.\,,\,.\,)$ on the left-hand side of the inequality because there is no feedback on the outcome of keeping the scratchcard. Keeping the scratchcard is evaluated against $\boldsymbol{m}^f(\,.\,,\,.\,)$ because the foregone act is a certainty and therefore always provides outcome feedback. Following similar logic, feedback-conditional regret theory predicts that *F*-group will sell the scratchcard if:

$$p\boldsymbol{m}^f(v, x) + (1-p)\boldsymbol{m}^f(v, 0) > p\boldsymbol{m}^f(x, v) + (1-p)\boldsymbol{m}^f(0, v) \quad (3)$$

If *F*-group subjects are less inclined to sell the lottery than *N*-group subjects the equality in (2) should be stronger than that in (3). Note the right-hand sides of the inequalities in

[7] The proposition (in Restriction [2] and Corollary [1]) that foregone act resolution does not influence rejoicing is interpreted in terms of an arbitrary indexation of the impact to zero (rather than the literal interpretation that rejoicing is behaviourally unaffected). This retains consistency with the observation that foregone act resolution affects regret more than rejoicing, but also retains the predictive power that the weaker version of the theory lacks due to the confounding influence of feedback on regret and rejoicing. For a detailed discussion of this and related issues, see Humphrey (2004).

expressions (2) and (3) are the same and that the terms in (1-p) on the left-hand sides are equal by restriction [2]. Subtracting the left-hand side of (3) from the left-hand side of (2) and should leave a positive expression (4):

$$p[\boldsymbol{m}^{n}(v, x)\text{-}\boldsymbol{m}^{f}(v, x)] > \quad 0 \qquad (4)$$

Expression (4) holds by restriction [1] and strong feedback-conditional regret theory predicts that, at each price, a higher proportion of *F*-group subjects will keep the scratchcard than *N*-group subjects.