

**An experimental investigation of asset market
bubbles and of the effects of regret and the illusion of
control in decision making**

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Abstract

This thesis extends existing research in two separate areas of experimental economics and contains three distinct experimental studies. The first two chapters are concerned with the bubbles that have long been observed in experimental asset markets and are inspired partially by real bubbles observed in the housing market. The first chapter reports an experiment designed to capture evidence of herding behaviour and the effects of regret on bubbles. The second chapter examines the impact of speculation on prices and considers how the nature of the fundamental value of the asset traded may be a possible cause of asset market bubbles. A single, lumpy asset is traded as a closer approximation to a house purchase than the multi-unit type of asset usually traded in experimental markets and the fundamental value is designed to rise rather than fall to better capture the usual direction of housing market fundamentals. In chapter one it is found that herding tendencies and fear of regret may have some impact upon bubbles and evidence of learning is also present. In chapter 2, the impacts of speculation and an increasing fundamental value do not provide the hypothesised outcomes, but bubbles are perhaps prevented by the quality of the information given to subjects. The third chapter contains an experimental exploration of the impact of regret and of illusion of control on decision making in an experimental setting using national lottery scratch cards to elicit the emotion of regret and the selection of coloured envelopes to provoke the illusion of control in subjects. It finds support for the notion that regret, particularly feedback conditional regret, impacts on decisions and specifically on the willingness to part with the card for a cash sum.

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All raw data available from the author

Introduction

Asset market bubbles are a regularly occurring phenomenon in real markets and also have been persistently created in a laboratory setting.

The first two chapters report results from two asset market experiments that aim to extend research in this already substantial area. The inspiration for the experiments contained in chapters one and two is the phenomenon of asset market bubbles occurring in the housing market though the experimental precedents for the research were inspired by stock market bubbles. The Assets 2 experiment considers the impact of herding behaviour and regret on asset markets and the Assets 3 experiment considers the impact of speculation and also of the nature of the fundamental value of the asset being traded. Both experiments vary the feedback given to participants in ways that can influence regret and the potential for herding behaviour.

A deeper examination of the power of regret on decision making follows in chapter three. Results are presented from an experiment where manipulation of the emotion of regret is shown to have an impact on behaviour in an experimental setting. The experimental design separates the effects on behaviour of feedback conditional regret from those of illusion of control using national lottery scratch cards. Previous studies have examined the influence of these factors separately, but in the experiment reported here the novelty lies in disentangling the effects that regret may exert on illusion of control. A large literature from the fields of both psychology and economics are brought together in order to design a novel experiment that provides evidence of a significant impact of regret on decision making.

CHAPTER 1

Assets 2 Experiment

1. Introduction

This chapter reports an experimental attempt to investigate the role of feedback conditional regret and herding behaviour in the creation of asset market bubbles, with particular relevance to those found in the housing market. It builds upon a large body of work in asset market experiments and, to a lesser extent, auction experiments. In asset market experiments there is a robust finding of bidding for assets in excess of their fundamental value; this being the defining characteristic of a bubble. In auction experiments, the phenomenon of the ‘winner’s curse’ has resulted in the price paid for an auctioned item being in excess of its true value.

There is convincing evidence that the housing stock in the UK is overvalued and that during booms the departure of house prices from fundamental worth becomes greater still (see for example Muellbauer and Murphy 1997 in the UK or Case and Shiller 2003 in the US), . If we accept the evidence that housing stock is overvalued and at times possibly significantly so, it rather begs the question ‘Why are people willing to pay more for an asset than it is worth?’

There is a substantial body of research from behavioural finance looking at the phenomenon of bubbles in asset markets with investor psychology being a factor such as Statman and Meir (1995), Barberis et al (1998), Hirshleifer 2001. Cognitive errors, regret aversion, framing effects and mental accounting are amongst many of the explanations for behaviour that goes against the predictions of standard theory and has been observed empirically and experimentally to affect prices. Housing markets, in contrast to financial markets, are inhabited to a significant degree by amateur investors whom one can imagine would only be more prone to cognitive biases and emotional factors than professional investors when making investment decisions. With fewer opportunities for learning than in most asset markets (as property is generally bought and sold less frequently than portfolio assets), it is

possible that the aforementioned behavioural anomalies could be more prevalent in housing markets. It is at least safe to say that the housing market must be at least as prone to these as other asset markets so the experiment reported here models this market more closely than the financial markets mimicked in previous experimental work.

The experiment reported in this chapter adjusts the design of a standard asset market experiment to make subjects consider investing irreversibly in a single ‘lumpy’ asset and provides some evidence that a simple manipulation of emotions can impact upon bidding behaviour and market prices. The usual design includes an experimental market for many units of an identical asset (representative of a number of shares for sale in a financial market) whereas in the experiment reported here, subjects may bid for a single asset representing all, or a significant proportion of, their potential earnings from the experiment so any potential regret is focussed on a single decision, rather than many. Any regret-aversion is measurable in the difference in bidding activity between treatments where feedback on the final value of the asset is given to all participants and those where it is not. Two potential influences on behaviour, feedback conditional regret and non-rational herding tendencies are tested for in the decision making task.

Feedback conditional regret can be defined as the regret felt when one learns of the outcome of forgone choices and this may be significant in decision making in real asset markets as protection from experiencing regret is rare. By varying the feedback on their decisions, subjects in an experimental setting can be used to identify if their choices are influenced by the potential to experience regret.

Herding, as defined by some sort of collective irrationality, where decision makers somewhat blindly follow the actions of others without a rational justification for their actions could be at least partially responsible for bubbles. By providing feedback on the decisions of others, one can observe if the willingness to buy an asset and the price one is willing to pay is influenced by others facing the same decision task.

The experiment finds that both herding and FCR alter the mean bids made for an experimental asset and its market price.

2. Fundamental value

Stock market bubbles have attracted a substantial amount of both academic and media attention, though interest has also increasingly been focused on the housing market and fluctuations in house prices. The UK housing market, in common with many around the world, has experienced several decades of volatility.

If periods of rapid price rises followed by collapses in prices are indicative of bubbles in the housing market, this at least implies some cyclical detachment of house prices from fundamental value. Further, there is a widely held view that there is an endemic overvaluation of housing stock in the UK. An IMF model estimated the overvaluation to be something of the order of 30% at the start of 2004¹. If prices are on a long term upward trend, what evidence is there that this is caused by anything other than changes in the fundamentals that determine prices? Meen (1996) found the following variables to be significant in determining house prices in the long run: incomes, real interest rates, housing stock, demographic changes, credit availability and tax structure. However, he found that they only explained a proportion of the price increases during booms. The efficient markets hypothesis states that if a market is efficient, prices should reflect an asset's fundamental worth. Or, by another definition, arbitrage should correct any mispricing within the market. With limited opportunities for arbitrage or short selling that (in theory at least) may alleviate bubbles in financial markets mispricing appears to persist in the housing market with booms and slumps being the more dramatic symptoms.

There is some debate as to how one best calculates fundamental value. An accepted practice is to use some form of imputed rent (i.e. treat homeowners as though they were renting from themselves) as described by Muellbauer and Murphy (1997) and as used in the model of Weeken (2004), but there is general agreement that all methods of calculation are flawed in various ways.

It is this problem that provides strong justification for an experimental investigation of the topic. A central difficulty with the use of theoretical and empirical analysis to identify bubbles is that of establishing what the fundamental

¹ IMF 2003 Country Report 03/47

value of property is. One needs to identify a starting point in time when prices were at fundamental values from which to measure their departure. When prices, and therefore expected future returns, are driven by expectations and are self-perpetuating (as with many financial assets including housing), it is hard to state at any point in time what the fundamental value of the asset in question might be. However, in a laboratory setting fundamental value can be controlled and manipulated in any way the experimenter chooses. In the experimental design in this chapter, fundamental values decline in order to be consistent with the majority of previous experimental research. However, these declining values themselves have been scrutinised as having a role in the formation of bubbles so this is explored in the extension to the Assets 2 experiment reported in chapter 2. Trying to isolate the effects of herding, regret and declining fundamental values in a single experiment would render the task of interpreting results prohibitively complex, so the declining fundamental value design is adhered to.

3. Literature Review

3.1 Asset market experiments

This ability to control fundamental value was an important rationale for asset market experiments designed to investigate stock market bubbles. The seminal paper by Smith, Suchanek and Williams (1988) (henceforth SSW) has provided the design template for a host of further experiments. Subjects act as both buyers and sellers. They are endowed with multiple units of an asset (referred to as X) and an amount of working capital. In some experiments, a mixture of asset units and capital is given. In SSW, X pays a dividend each round and is worthless by the end of the experiment (though in some of their experiments X also carries a final buy-out value) so participants' final earnings are based upon dividends and remaining capital balances. Dividend amounts are unknown but take one of four randomly drawn values. The fundamental value of X at any point in time can be calculated by working out the expected dividend value per round multiplied by the number of rounds remaining. Participants are free to trade in X over 15 rounds by posting bids and asks in a

computerised double auction. In SSW bids and asks were entered by participants and the highest bids and asks only in each round were displayed on their computer screens. The theoretical prediction is that prices should track fundamental value as participants backwardly induct and base bids in each round upon expected dividend flows from remaining rounds. In SSW and other experiments that followed there is a robust finding of sustained bidding above the fundamental value of the asset particularly after the first few rounds and a ‘crash’ back to fundamental value towards the final round. Further examples of the phenomenon can be found in Van Boening, Williams and LaMaster (1992), Camerer and Weigelt (1990) Porter and Smith (1995) and a complete survey of the literature is provided by Sunder (1992). There is a consistent finding that bubbles disappear with experience; typically by a third repetition participants in experiments learn to track fundamental values. Explanations abound for the phenomenon. A few subsequent experiments that sought to further explain the laboratory bubbles are particularly relevant to this chapter.

Smith et al. (2000) examined the impact of the frequency of dividend payments. In a broadly similar design to that of Smith, Suchanek and Williams, they compared three treatments: A1 where a single randomly determined dividend is paid at the end of the trading horizon; A2, where payments are on a per round dividend basis (as in the seminal 1988 paper) and A3, which employs a mixture of the two. As hypothesised, bubbles were most prevalent in A2 and least so in A1, with A3 falling in between the two. The A1 treatment all but eliminated bubbles; this was attributed to subjects holding common expectations about value. It would appear from this study that bubbles may have some of their origins in divergent expectations about asset value created by the frequent dividend payment design and yet, outside the laboratory, we observe bubbles in markets with infrequent pay-outs such as the housing market.

Noussair, Robin and Ruffieux (2001) tested the hypotheses that either the frequent dividend pay-out or the declining fundamental value of the asset is the cause of bubbles. Their subjects received per-round dividend payments as in SSW but, in addition, they introduced a fixed and known buy-out value for their units of asset X at the end of the final round. They concluded that frequent dividend payments, coupled with a finite time horizon, increase the number of possible

outcomes by continuously altering the fundamental value, causing divergent expectations and allowing bubbles to form more easily. Of significance also, was their conclusion that a constant fundamental value, whilst possibly reducing the magnitude of bubbles, was not sufficient to eliminate them.

Lei, Noussair and Plott (2001) carried out an experimental test of the idea that bubbles are caused by speculation fuelled by a lack of common knowledge of rationality (i.e. the idea that some ‘sucker’ will buy the asset for more than you did so one can pay above the fundamental value and still expect to make a profit). Treatments in which subjects were allocated roles of seller or buyer and where there was no opportunity to re-sell the asset were compared to a baseline along similar lines to the Smith, Suchanek and Williams seminal work. Further, the ‘active participation hypothesis’ (that much trading activity is inspired by protocol or takes place because subjects have nothing else to do) was explored by having a dual market set-up in some treatments where a resale market operates parallel to the no-speculation one and subjects are able to participate in both, one or neither of the markets. Their results provided evidence that speculation, whilst amplifying bubbles is not the only cause of them. Giving subjects a choice of activity did reduce trading volume though it did not eliminate bubbles. Irrationality, rather than a lack of common knowledge of rationality, was identified as the cause for bids above FV in the non-speculation treatments.

Ackert et al (2002) found that an asset with lottery characteristics (i.e. a small chance of a large payout/large chance of a small/zero payout) will trade further above fundamental value than an asset with more standard characteristics (i.e. less skewed payoffs).

3.2 Auctions and the winner’s curse

A further influence on the experiment reported here is the body of research on auctions and, in particular, experimental work with first-price sealed bid, common value auctions. Common value auctions are those in which the value of the auctioned item is the same to all bidders but is unknown at the time bids are placed.

First price, sealed bids auctions are those in which bids are given privately and the highest bidder wins the item, paying a price equal to his bid. Reminiscent of findings about prices in excess of fundamental value in asset market experiments, participants in auction experiments consistently bid above the Risk Neutral Nash Equilibrium (RNNE). This is often ascribed to ‘The Winner’s Curse’ and has been found in experiments such as those of Kagel and Levin (1986) Lind and Plott (1991) Goeree and Offerman (2002). The winner’s curse arises in Common Value Auctions with incomplete information because the person who generally wins the item being auctioned is the one who holds the highest estimate of its value. If one assumes that it is the average estimate of value that will be most accurate, the winner usually overpays. In a housing market, it may not always be that the highest bidder wins as other factors (such as the circumstances of the buyer) may override price offered, however it may occur sufficiently frequently to cause an upward momentum in prices and may certainly be a factor in other asset market bubbles. This adverse selection phenomenon has been frequently found to persist even with experience. See for example Kagel (1989).

Cox, Roberson and Smith (1982) and Cox et al (2001) looked at common value auctions with the option of a ‘safe haven’ (a certain pay off that subjects can choose to accept rather than participate in the auction) to eliminate experimenter demand effects. This is clearly reminiscent of the two-market treatments used by Lei, Noussair and Plott to control for the active participation hypothesis. The winner’s curse was much reduced by the inclusion of a positive income safe haven leading them to conclude that the occurrence of the winner’s curse in auction experiments is, in part, fuelled by experimenter demands and a lack of alternative profitable activity.

3.3 Herding

When faced with decisions under conditions of uncertainty, it has been shown that people display a tendency towards herding behaviour. There is a division made in the literature between rational, informational herding and more irrational

emotional herding behaviour and it is the latter that my experiment is concerned with.

Informational herding was the theme of seminal works by Banerjee (1992) and Bickshandani, Hirshleifer and Welch (1992) which have been built upon theoretically and experimentally, particularly in the field of behavioural finance. Banerjee constructed an elegantly simple model to illustrate how copying the actions of others can be rational under conditions of uncertainty. He uses the example of the decision faced by people choosing between two restaurants and shows how it can be rational to copy the decisions of others rather than using one's own prior information regarding which is the better place to eat. A large proportion of work on herding has centred around this form of herding for example the model of Chamley and Gale (2004) or experiments such as those of Sgrou (2003), Anderson and Holt (1997) and Allsopp and Hey (2000). Although the general approach is to model a situation of asymmetric information concerning the worth of an asset or commodity, Hey and Morone 2004 identified such herd behaviour in a market setting using an asset with a known fundamental value. However, this 'rational' herding will not be the focus of the design here. All participants will have the same information about the final value of the asset and therefore have no rational reason to follow the behaviour of others.

Collective irrationality rather than the informational herding demonstrated by Banerjee is blamed for volatility in stock markets in many studies. See for example Shiller (1984) and (2000). It is not far-fetched to hypothesise that herding behaviour of this less refined, more emotion-led type will also manifest itself in the housing market. Gibler and Nelson (2003) discuss how social pressure impacts upon housing decisions and can override preferences. Baddeley (2005) in her theoretical and empirical work on behaviour in the housing market distinguishes between rational and non-rational herding. Her definition of non-rational herding allows for it to be a very basic human instinct to imitate and it is this very simple form of imitative behaviour that the experiment reported in this chapter aims to provoke. She is not able to separate which of the two her empirical study supports, but concludes that she finds evidence of the presence of some form of herding behaviour in the UK housing market as she finds that housing transactions respond positively to house price inflation. Smith (2011) found that subjects beliefs about prices in experiments tend to converge, whether closer to or further away from fundamental values. He

concludes that this is evidence of herding and clearly not of learning in an experimental setting. Herding, for the purposes of this experiment, is taken to be following of the actions of others when there can be no rational grounds for thinking one is better off for doing so.

Braga Humphrey and Starmer (2009) found limited evidence of ‘price following’, a tendency for participants in experimental auctions to adjust their bids to previously observed prices. The definition of herding employed here closely matches this description of behaviour so it is interesting to see if the design employed by this experiment creates the conditions necessary for the manifestation of this tendency to occur. In the herding treatments, there is certainly the opportunity to observe the bids of others.

3.4 Emotions

There is well established literature marrying psychology with economics signposted by seminal works such as prospect theory Kahneman and Tversky (1979). Prospect theory was preceded by their work on biases affecting decision making Kahneman and Tversky (1974). Loewenstein and Lerner (2003) provide a thorough examination of the effect of emotional factors on economic decision making as do Camerer and Loewenstein (2003) in their extensive paper on behavioural economics.

Though emotion driven behaviour such as herding has not traditionally been accounted for in mainstream economics, its role in decision making is the subject of a significant body of work. Loewenstein and Lerner (2003) and particularly George Loewenstein (2000) provide convincing arguments for the inclusion of psychological factors in economic models. Loewenstein draws attention particularly to immediate emotions, visceral factors that impact upon economic decision making rather than only anticipated emotions such as regret.

‘Visceral factors are transient, but the behaviors they produce have long-lasting and important consequences both for individuals and society. In part

because visceral influences cause people to take extreme actions, and in part because important decisions induce powerful emotions in decision-makers, many of life's most important decisions are made under the influence of intense visceral states'.

The purchase of a house is intensely emotional and one imagines both anticipated and immediate emotions play a role in the decision making process. In my own personal experience, both of these can override or alter ones pre-conceived ideas about what their actions will be². Behavioural finance has included a significant amount of research on the role of psychological influences on investor decisions. The literature is well surveyed in Barberis and Thaler (2003).

Some work on psychological biases has also been carried out specifically with regard to housing markets such as an experimental exploration of anchoring effects Northcraft and Neale (1987) and empirical work on loss aversion in sellers Genesove and Mayer (2001), but it is not well explored terrain. In a report on the UK housing market Farlow (2004) cites a number of biases that he believes home buyers fall prey to; momentum reasoning, over-optimism and illusion of control to name but a few. Generally they are the same biases that have been found in the behaviour of traders in financial markets. Given that most house buyers are complete or relative novices, and will not have not gained the experience that has been shown experimentally to dissipate bubbles, one can only imagine the housing market providing even more fertile ground for such psychological factors to influence behaviour than financial markets. Importantly, Farlow notes that it is over optimistic buyers that determine prices in the housing market. Clearly, potential exist for house

² My first experience of house buying was during a time of rising prices. Several buyers were bidding on the same property and consequently the process went to sealed bids. I ended up bidding well over my original budget by a considerable margin, both due to the fear of regret that I might kick myself for missing out by a small margin and to more immediate emotions of panic, feelings of competitiveness with other bidders, a sheer desire to win. I also had decided to buy because prices were rising and am sure was swept up in a feeling that it was 'time' to buy because others were doing so.

buyers to fall victim to a ‘winner’s curse’ on a grand scale. Hogarth et al (2011) conducted a field study of the relationship between emotional state and risk perception and found that states of arousal could reduce risk perception. This correlation was found to be stronger in a real world setting than in an experimental one.

In addition, there have been recent studies of the effect of manipulated emotions on prices in experimental markets.

Andrade, Lin and Odean (2012) model their experiment on that of Smith, Suchanek and Williams, but show emotion-inducing videos to subjects before participation in the market. They find that videos which induce excitement produce bubbles of greater magnitude than those designed to induce fear or sadness or to induce no emotional changes. Lahav, Yaron and Meer (2012) conducted similar research using videos to provoke either a positive or neutral mood and found that a positive mood led to larger experimental bubbles. Guiso, Sapienza and Zingales (2011) conversely found that a fear-inducing clip from a horror film shown to subjects prior to trading increased risk aversion.

It would appear, therefore, that the emotional state of a buyer may be a significant factor in determining his offer for a house and, whilst investigation of this is not in the remit of the experiment reported here, any potential influence of the task on the mood of subjects must be accounted for in the design.

3.5 Feedback Conditional Regret (FCR)

Since the work of Loomes and Sugden (1982) and Bell (1982) formalised regret theory, there has been a growing experimental literature in the area.

Feedback conditional regret predicts that behaviour will be different under circumstances where feedback on a decision task is given than when it is not. Moreover, people may act in such a way so as to protect themselves from being able to experience regret from their decision. The idea that people alter their behaviour in the present in anticipation of the regret they may feel if the outcome of their decision

is revealed in full (i.e. the path they chose as well as the path or paths that they did not) has convincing evidence behind it e.g. Zeelenberg (1996) Humphrey (2004) Humphrey et al (2005).

As regret is a negative and unpleasant emotion, it is natural to assume (and indeed it has been frequently observed) that people are regret-averse and may even be prepared to pay to avoid it. The notion that people will pay an added amount for something in order not to have to experience regret was labelled by Bell (1983) as a 'regret premium'. Larrick and Boles (1995) attempted to measure the level of regret aversion by calculating this premium, arriving at a figure of 10% in their experiment. One can think of several opportunities for regret conditional on finding out what might have been in the process of purchasing an asset such as a house and a feasible willingness to pay a premium to avoid experiencing the emotion. For example, it is conceivable that one would pay a premium to avoid experiencing the regret of witnessing another buyer who offered a fraction more than you and getting the house of your dreams. It is the emotion of regret that is intended to be evoked by the experimental design used here.

In the experiment that follows, FCR could be experienced in 'regret' treatments where the final value of the traded asset 'X' is revealed to all participants. If a participant who bids too low and does not manage to acquire an X discovers he would have been better off had he bid more and bought an X, he may subsequently increase his bids as there are three identical stages to participate in. Conversely, a subject who buys an X and then discovers he would have been better off not buying it and opting for the 'safe haven' asset Y (with a fixed and known pay out) may experience regret that alters his bids downwards in subsequent stages. Of course it may be the case that subjects buy an X and discover that they are better off having done so, or may have chosen not to buy it and discovered that they would have been worse off had they bought one. The potential to 'rejoice' is certainly acknowledged in FCR theory but as it is regret that has been shown to be more greatly influenced by feedback, the comparisons of subjects' decisions between treatments in the experiment that follows are based solely upon the impact of feedback on regret.

4. The Experiment

4.1 Experimental Design

The Assets 2 experiment retains some of the framework of the standard asset market experiment and therefore, as with asset market experiments, it has an auction mechanism to decide ownership of assets. Subjects are endowed with an amount of working capital (in experimental currency) and their final earnings are dependent upon how they use this. They participate in three identical stages to give learning opportunities and each stage comprises seven rounds. The experiment has a dual market design with two assets offered for sale, Asset X and Asset Y. X (in common with assets traded in many asset market experiments) can take one of four randomly determined amounts with equal probability and this is the amount for which X will be bought from participants who own one at the end of the experiment. There are no dividend payments, just this final buy out value. Rather than a double auction, where participants take the roles of buyers and sellers, participants are only allocated the role of buyer. Sellers are effectively computerised and, as there are eight participants in each session and only seven rounds in which it is possible to buy an X, if all subjects in a stage opt to buy, one will not get an X. There is no minimum bid, though a strong hint is given in the instructions as to how subjects might wish to calculate the fundamental value of X.

Participants were given 20 units of experimental currency at the beginning of each new stage. Asset X was an asset which was determined to be worth one of four amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X were: 9, 7, 3 or 1 unit(s) of currency. There was an equal (one in four) chance of X being worth each one of these amounts as the value of X was chosen randomly by computer. Asset Y expired at the end of each round. That meant that it had no value from one round to the next or at the end of the experiment. It had a fixed cost of 1 unit of currency per round and only one asset Y could be purchased by each participant in each round. In each round, participants needed to choose whether to make an offer to buy an asset X or whether to buy an asset Y. This applied in each round unless they became an owner of an asset X. If they chose to make an offer for an asset X, they were then asked to state how much

they were willing to pay for the asset X in that round. One asset X was available in each round, making a total of 7 available during each stage. Participants could only own one asset X in each stage but once an X was bought they were not required to buy any more Y, nor could they make any further offers for an X for the remainder of that stage. If participants chose to buy an asset Y or failed to bid enough to secure the X that was for sale and hence bought a Y by default, 1 unit of currency was deducted from their currency holdings. They could offer as much or as little of their currency holdings as they wished and the highest offer for X was the one that was accepted. In the event of a tie in any round (that is, if two or more participants made identical, highest offers for asset X), then the participant who received it was randomly chosen by computer. At the end of the experiment, the value of X was determined by computer and one of the three stages was randomly chosen to count for real. Hence, participants were paid according to their final currency holdings *for that stage only*. At the end of the experiment, currency holdings for the stage that was chosen for payment were converted to cash on a 1 for 1 basis, i.e. each unit held was worth £1.

Participants were required to buy either an X or Y in each round unless or until they succeed in buying an X, at which point they need do no more for the remaining rounds. This is how the declining fundamental of X was achieved in this design; the sooner an X is purchased the more will be saved by not having to purchase a Y in all subsequent rounds, hence the more valuable the X asset is in earlier rounds. Its value declines by the cost of Y in each round

Built in to this design, there is a safe haven option of not bidding on an X and simply buying a Y in each round and accepting a fixed and known payoff equal to the initial endowment less the cost of one Y in each of the seven rounds. The payoff from buying Y throughout is exactly equal to the expected payoff from buying an X at its fundamental value in any round. All participants receive the same information about the possible value of X and, from this information, the expected value of X is straightforward to calculate³. A key decision faced by subjects is whether to buy a Y

³ $EVX = (p)x_1 \cdot x_1 + (p)x_2 \cdot x_2 + (p)x_3 \cdot x_3 + (p)x_4 \cdot x_4$

From this, the fundamental value of X can be seen to be

in each round and accept a fixed payoff or whether to use some of their endowment to buy an X of uncertain value. If opting to buy an X, the decision becomes twofold; when to buy and how much to offer.

Many features that are suspected of creating laboratory bubbles or of exacerbating the winner's curse phenomenon are largely absent from this design. There are no dividends paid in each round, just a final buyout value and these values are not lottery style highly skewed payoffs; there is an equal probability of gaining each one of four modest amounts rather than a small chance of a large amount. The research that found declining fundamental values exacerbated bubbles is taken into account in the design. Although fundamental value is declining due to the decreasing amounts to be 'saved' by not being obliged to purchase further units of Y, the amount by which it falls is very stable and clear and most importantly the expected value of X remains the same throughout. This, and the fact that all subjects receive identical information about the value of Asset X, gives no reason to expect divergent expectations about value although errors in calculation are of course possible. There is no resale market as such. The X is bought by the computer effectively and the expected value of the buyout is fixed. This is not quite the same as experimental asset markets where divergent expectations were due to a lack of common knowledge of rationality and the belief that human error, irrational behaviour may allow one to re-sell an asset for an amount in excess of its fundamental value. The dual market design provides a 'safe haven' option of purchasing Y throughout the experiment so that subjects do not feel they are forced to purchase an asset X to gain a higher payoff.

The novelty of the design used here lies in the use of a single asset rather than multiple units, rendering the decision to enter the market an irreversible one. The purchase of asset X could be said to represent the decision therefore to make a house purchase and the purchase of Y the decision to rent. Of course by default one generally rents whilst not a homeowner and this fact is captured in the enforced purchase on one of the assets in each round. The overall aim is to investigate whether the potential to experience regret positively affects what participants are

$FVX = EVX + Y(r)$ where r is the number of rounds remaining.

willing to pay for an asset and whether the opportunity to see what others are doing leads to a tendency to copy the highest bidder. The aim is not to recreate experimental bubbles that have been so frequently observed, but rather to see if the described manipulations affect decisions in a way that may suggest regret and herding behaviour could be contributing factors in bubbles. As an implied consideration, it asks whether these psychological factors can in part explain the tendency for asset values (such as house prices) to detach from fundamentals.

The experiment employs a 2 x 2 factorial design, allowing between session comparisons. There are four treatments: Baseline, Regret, Herding and HerdReg.

Regret

Herding

	BASELINE	REGRET
	N, N	N, Y
	5 Sessions	5 Sessions
	HERDING	HERDREG
	Y, N	Y, Y
	5 Sessions	5 Sessions

A description of the treatments follows⁴.

Treatment 1 - Baseline

Participants were asked to buy one of either asset X or asset Y in each round, unless or until they had purchased an X asset. If an X asset were purchased, there were no further decisions required during that stage. In every round where an asset X was not owned, a deduction was made from the participant's experimental currency to pay for the purchase of a Y asset.

Participants were not informed of the drawn value of X for any stage until the end of the experiment, nor were they given any information about the actions or bids of any of the other participants. Only participants who purchased an X were given feedback as to its value. Therefore participants were only informed as to whether they had bought an X at the end of each round and of their balance of experimental currency.

Treatment 2 - Regret

The decision between purchasing an X or a Y asset was the same as in the baseline treatment. However, participants were informed of the value of X at the end of each stage regardless of whether they had bought one or not. This meant that they were able to ascertain whether they may have been better off buying X if they did not do so (though this also depend upon what they would have paid for it). It also clearly allowed those who did buy an X to discover if they had made the right decision, i.e. were better off from doing so. Opportunities for both regret and rejoicing exist in this treatment and participants should be aware of the potential to experience either as it was clear in the instructions that the state of the world (value of X) would be fully revealed.

Treatment 3 - Herding

Participants were kept informed on their screens of all offers made for X assets, so at the beginning of each round, they were able to observe all offers made by other

⁴ For full instructions see appendix 2

participants during the previous round. As in the baseline treatment, the value of X is not revealed until the end of the experiment.

Treatment 4 – HerdReg

This is a combination of treatments two and three. Participants are informed both of all participant' offers for X in each rounds and also of the drawn value of X at the end of each stage whether or not they had bought one.

4.2 Experimental procedure

The experiment was run on campus at the University of East Anglia during June 2008. Participants were all students, recruited by email from an array of disciplines and numbered 160 in total, divided into groups of 8 to a session. 20 sessions were run in total comprising 5 sessions of each of the four treatments.

Average payments were around £16 and sessions lasted about an hour.

Participants were endowed with 20 units of experimental currency which converted to £s in a 1 to 1 ratio so effectively they were endowed with £20. X took one of the four following buyout values £9.00, £7.00, £3.00 or £1.00 so the expected value of X was £5.00 in each stage of every treatment and Y, which expired at the end of each round, cost 1 unit of currency. At the end of each experimental session, one of the stages was randomly selected to be the payment stage and count 'for real' so participants had an incentive to behave optimally in every stage. Subjects completed a pre-experiment questionnaire on paper to check their understanding of the experimental task⁵. The experiment was programmed and conducted with the software z-Tree (Fischbacher 1999)

⁵ See appendix 1

5. Hypotheses

Hypothesis 1- Learning

As there are opportunities for learning in this design and bubbles have been repeatedly shown to dissipate with repeated markets then bids and market prices should be progressively lower through the three stages in all treatments. Even in the baseline treatment, some very limited feedback is given in that participants know if they succeeded in buying an X in every round if they bid for one.

Hypothesis 2 – Baseline treatment

In treatment one, the baseline treatment, there is neither feedback on one's own actions nor any information about what others are doing. Given that all suspected causes of laboratory bubbles have been eliminated from the design, the expectation is that this treatment will not give rise to bids or market prices for asset X above fundamental value.

Hypothesis 3- Feedback Conditional Regret

One would expect that if there is a regret effect and people are prepared to pay a 'regret premium' mean offers for X and market prices in this treatment should be greater than those in the baseline treatment. The nearness of bids and prices to fundamental value or the amount by which this premium takes bids or market prices above fundamental value and into bubble territory will reflect the magnitude of anticipated regret when compared to bids and market prices for X in the baseline treatment. It is predicted that a regret effect will result in higher mean bids and market prices in the treatments with regret than in those without.

Hypothesis 4 - Herding

The predictions for the herding treatment are less clear cut. One could expect to see a rapid convergence towards low bids, particularly after the first stage if subjects begin to collude, but nevertheless, the hypothesis is for there to be a tendency towards higher bids and prices overall than the baseline as some subjects follow the

highest bidders who win the X in early rounds and are motivated to raise their own bids. There is a theoretical possibility of collusion in herding treatments, which could cause bids to fall below even those of the baseline treatment. Rather than hypothesise this as an expected outcome of the design, it is noted that this is a possibility but is not expected and will be discussed further in light of the results.

Hypothesis 5 – Interaction effects

The results for treatment four which incorporates both the feedback and information provision of the regret and herding treatments, HerdReg will depend upon the existence of any interaction effects. If the temptation to herd is somehow magnified by the opportunity to experience regret, perhaps because we would feel more responsible for any regret if we went against the crowd. The direction of causality could be also be reversed and it could be that the potential regret one could experience if one tried and failed to buy an X might be made more salient when one can see the behaviour of other participants. The fact that others may out-bid you and how you may feel if they do perhaps becomes more obvious if one can observe their actions. If there is an interaction effect, whilst it may not be possible to do more than speculate as to its origins in this design, it seems important to ascertain if such an effect exists.

One would expect at least a higher market price and mean bids for Asset X than in the baseline treatment and, if a positive interaction effect is present, these variables would be higher than in either the regret treatment or the herding treatment.

6. Results and analysis

Before focusing on the hypotheses, one interesting finding should be mentioned. Without exception, mean and median offers for X assets were under fundamental value, though the market price regularly went above it. Participants showed good understanding of the fundamental and expected value of X in answering the pre-experiment questionnaire but seemed to focus only on the possible

buyout value of X, rather than its expected or fundamental value, when making offers. This was most prevalent in the baseline treatment as can be seen in *Fig.1*. Although this leads to a general support for the prediction that fewer or no bubbles would be seen in this treatment it is surprising as most participants demonstrated that they understood that by buying an asset X, they would obviate the need to purchase any more asset Y. They were asked to calculate earnings based upon the purchase of an asset X in a particular round at a particular price assuming a particular final buyout value for X. In their answers, the majority of subjects understood that they would buy Y only if they did not own an X and that the fundamental value of X was its expected buyout value, plus Y multiplied by the number of rounds remaining. Despite this, when it came to bidding for an asset X, many subjects behaved as if they were bidding on the expected value of X rather than its fundamental value.

Generally, participants chose to invest in the X asset of uncertain value even though the expected payoff from doing so had deliberately been made equal to that of buying the asset of a certain cost in each round. Experimenter demand effects were minimised by the design so this can be taken to be motivated by a true desire to own the asset.

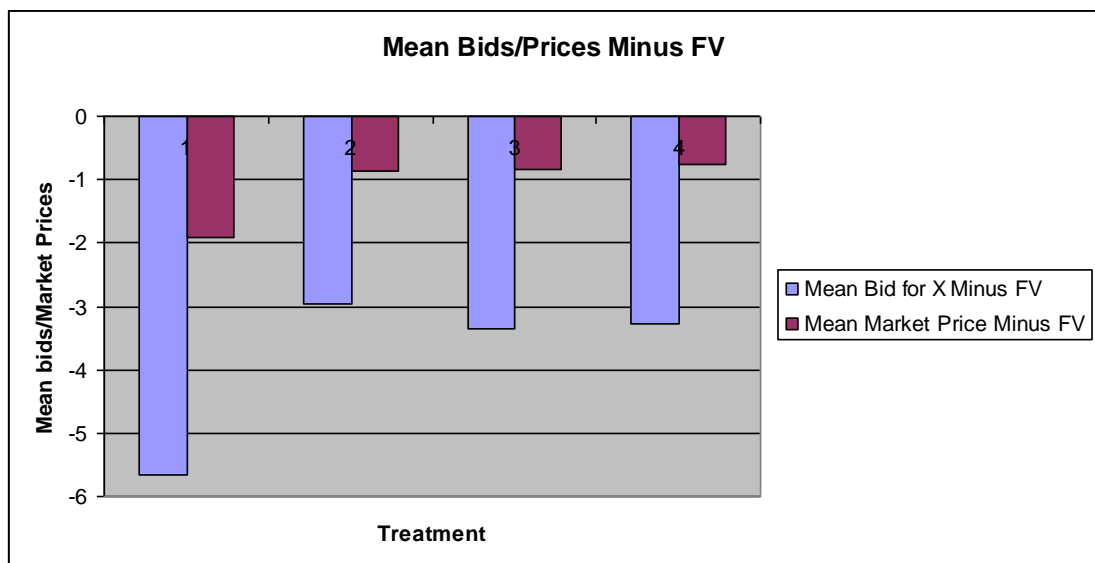


Fig.1. Mean Bids/Prices Minus FV

Hypothesis 1- Learning

There was a progressive decrease in mean and median bids and market prices for Asset X as subjects repeated the task for the second and third times. Figure two presents mean and median bids and market prices for each stage with data from each treatment pooled together.

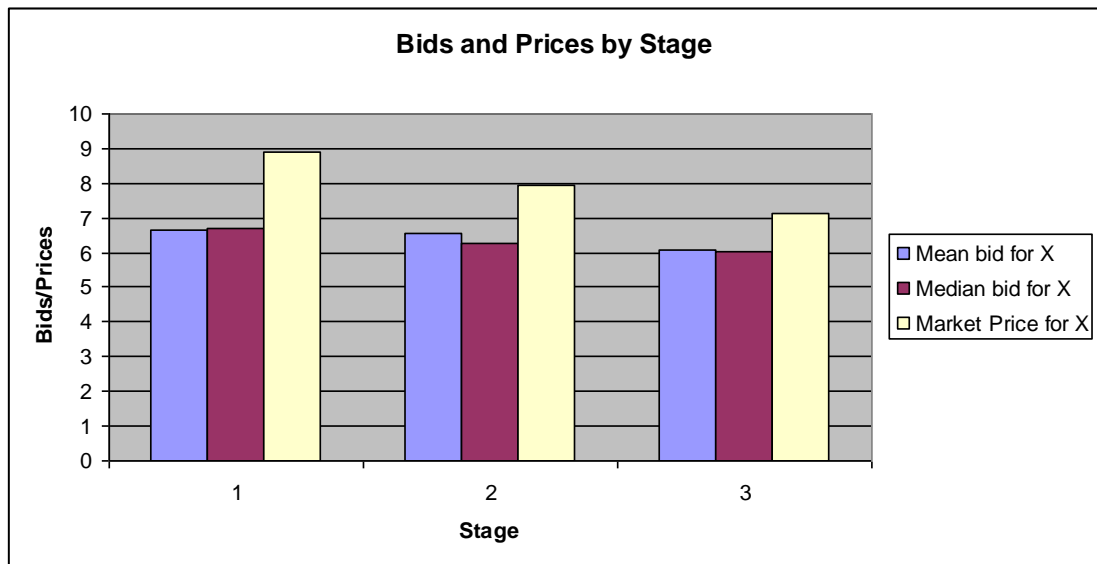


Fig.2. Bids and prices by stage across treatments

I conducted a Wilcoxon test to see whether the differences in market prices and in mean bids were significant between the three stages and then conducted separate tests for each treatment. The null hypothesis is that no learning takes place and that there are no significant differences in bids or market prices between the three stages. The alternative hypothesis, consistent with previous experimental findings, is that subjects lower their bids with learning and therefore they become progressively lower throughout the stages.

The test was therefore one tailed, as the prior belief in learning is well justified by experimental literature.

	p-value		p-value		p-value
MeanMktPrice Stage 1 and 2	.001**	Mean Bid X Stage 1 and 2	.314	Median Bid X Stage 1 and 2	.148
MeanMktPrice Stage 2 and 3	.002*	Mean Bid X Stage 2 and 3	0.014*	Median Bid X Stage 2 and 3	.2205
MeanMktPrice Stage 1 and 3	0.000***	Mean Bid X Stage 1 and 3	.024*	Median Bid X Stage 1 and 3	.0935

Table 1. Mean Market Prices and bids by stage

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

As can clearly be seen in *Table 1*, the difference in bids and in market prices between stages 1 and 2 were not significant. However, from Fig.2 it can be seen that stage 2 market prices and mean bids were lower as hypothesized.

Both bids and market prices were significantly lower in stage 3 than in stage 2. These differences were in both cases, statistically significant. It follows that stage three bids and prices were therefore also significantly lower than in stage 1.

Figures 3 – 8 show mean bids and market prices for asset X across rounds by treatment for each stage in turn.

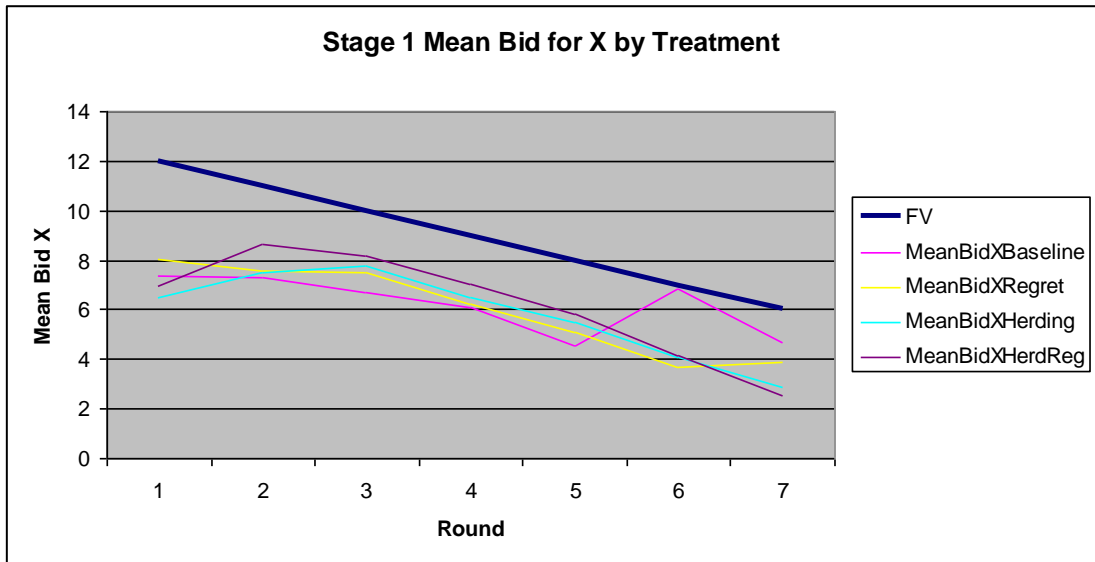


Fig.3. Stage 1 Mean Bid for X by treatment

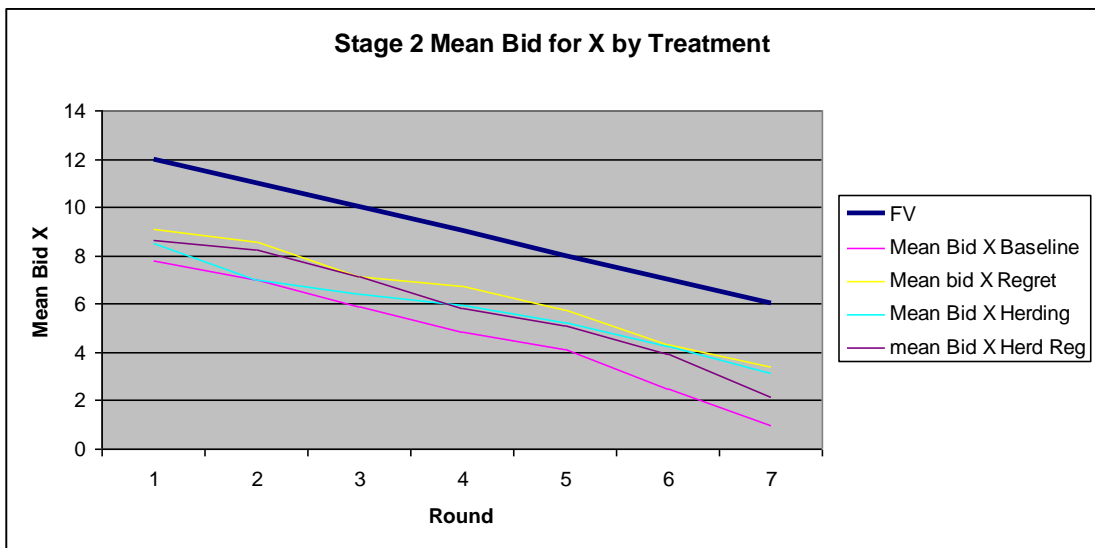


Fig.4. Stage 2 Mean Bid for X by treatment

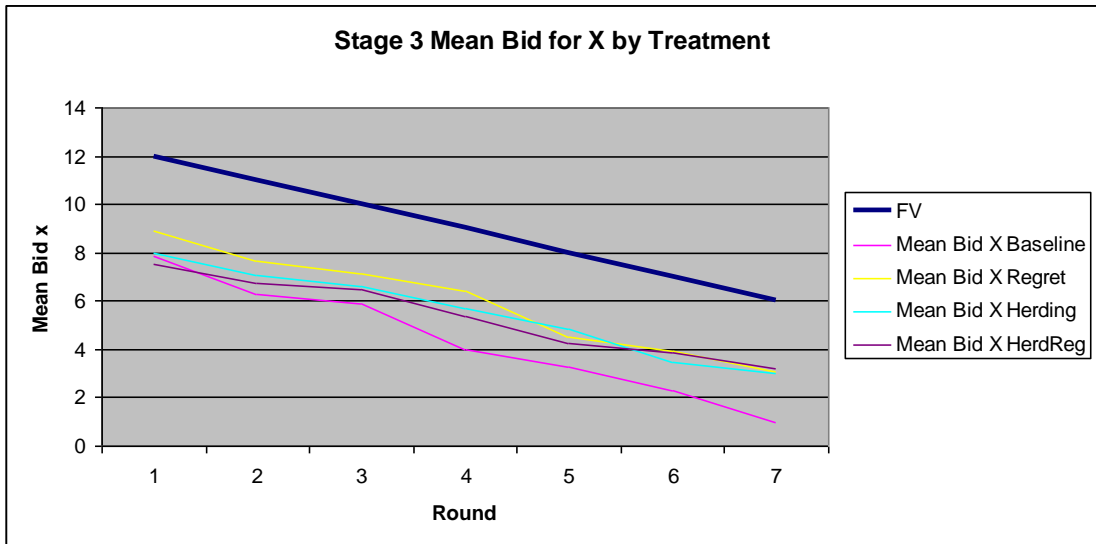


Fig.5. Stage 3 Mean Bid for X by treatment

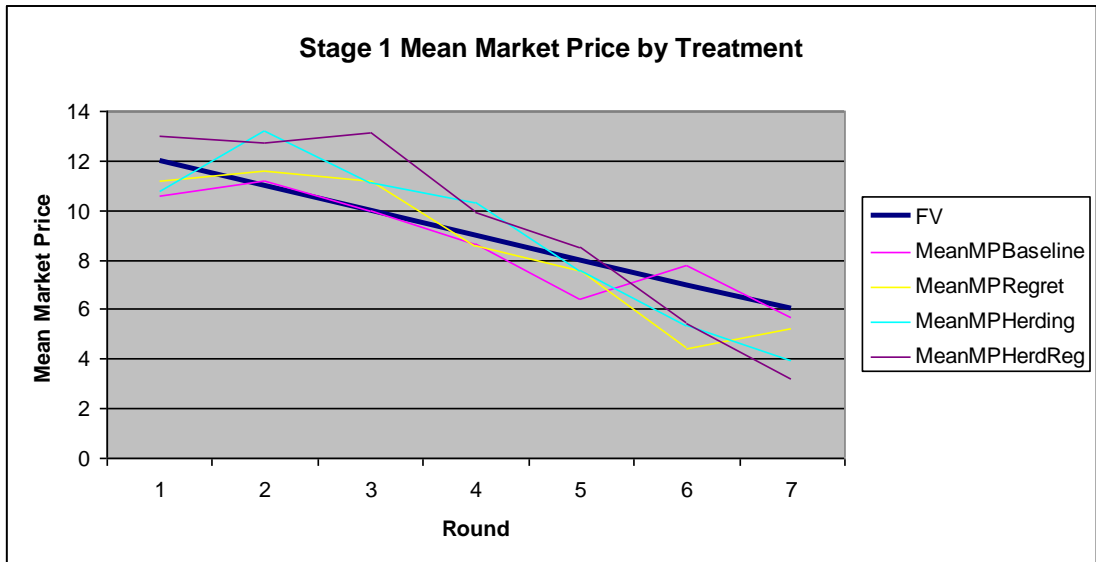


Fig.6. Stage 1 Mean Market Price by treatment

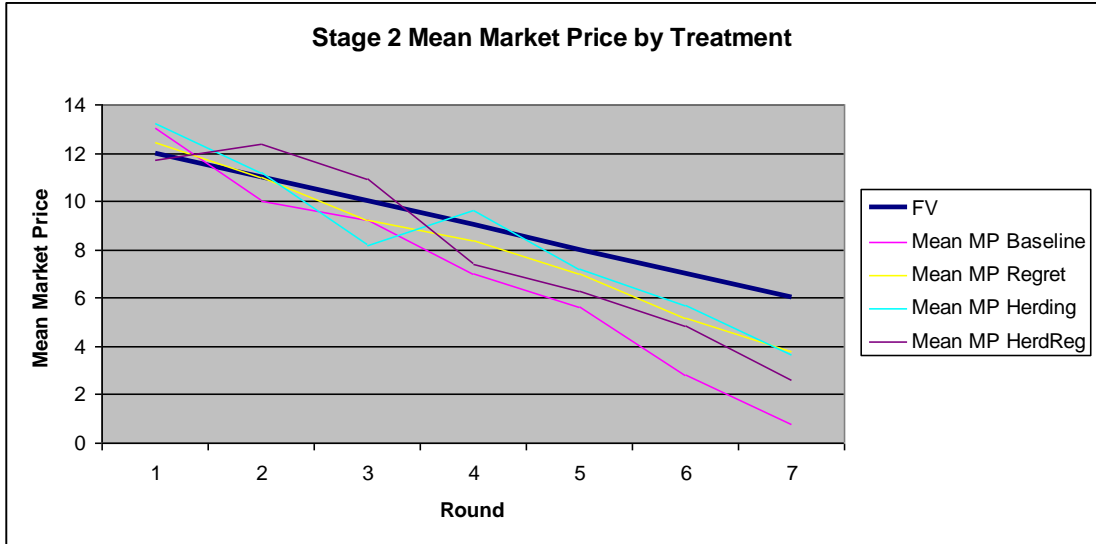


Fig.7. Stage 2 Mean Market Price by treatment

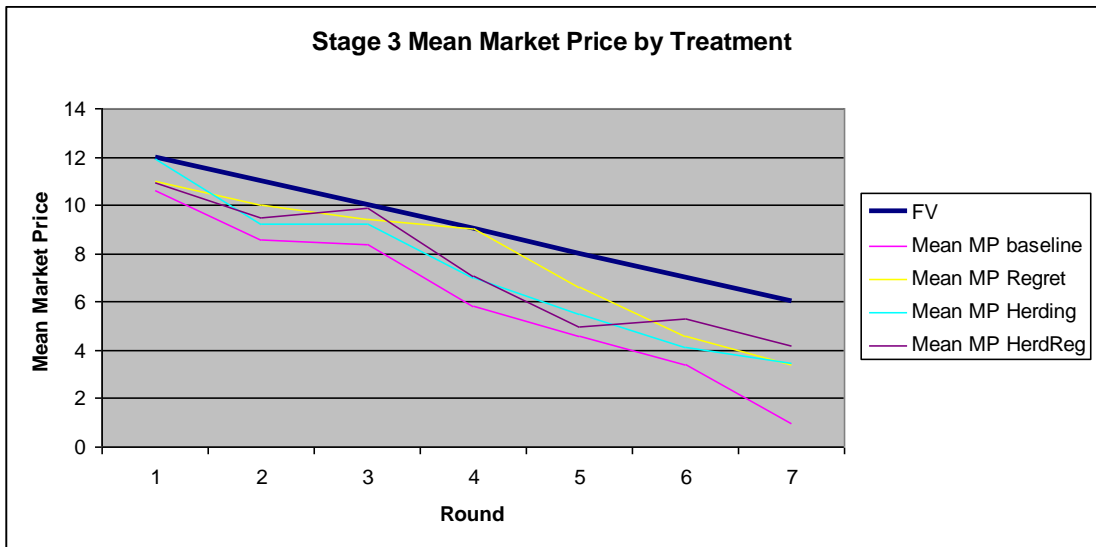


Fig.8. Stage 3 Mean Market Price by treatment

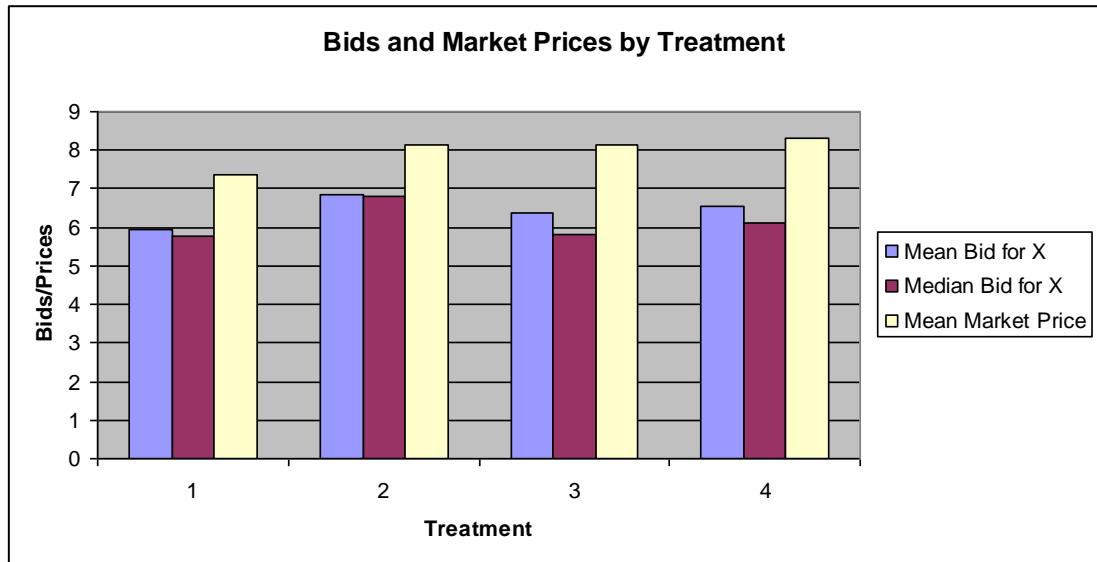


Fig. 9. Bids and Market Prices by Treatment

I conducted Wilcoxon tests for mean market price and mean bid broken down by treatment to see if there were differences in learning between the treatments. Again, if there were no learning the null hypothesis that there is no difference between stages across treatments would have to be accepted and the alternative hypothesis that bids and market prices decline with experience would be rejected. Remembering the prior belief is that the variables will become progressively lower; a one tail test was again used.

	MktPrice X	MktPrice X	MktPrice X	MeanBid X	MeanBid X	MeanBid X
Stage	1 to 2	2 to 3	1 to 3	1 to 2	2 to 3	1 to 3
Treatment						
1	.022*	.113	.022*	.0215*	.113	.04*
2	.501	.034*	.022*	.022*	.022*	.447
3	.173	.022*	.022*	.25	.343	.343

4	.04*	.25 ns	.022*	.447	.113	.113
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Table 2. Market Prices and Mean bids by Stage and treatment

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

In all treatments market prices were significantly lower in the third stage compared to the first. Mean bids were only significantly lower in the baseline treatment in a comparison between stage 3 and stage 1. This still provides evidence of learning, but indicates there may be some interference in the learning process from the conditions in the other treatments.

Hypothesis 2- Baseline treatment

In the baseline treatment, mean and median offers for X and market prices across all stages were below fundamental value. Hypothesis two is therefore generally confirmed by the absence of market prices in excess of fundamental value in this treatment across all three stages

Taking the results stage by stage (remember bubbles in asset market experiments are usually much reduced by stage two and entirely dissipated by stage three). Figs. 3 and 6 show stage 1 results. It can be seen from figure 3 that after beginning under fundamental value (as is a common finding in many asset market experiments) market prices almost track fundamental value for a significant number of rounds before sinking below it towards the final round. There is a 'blip' towards the end (perhaps suggesting last minute panic bidding on behalf of some subjects). Prices and bids decline through the next two stages in this treatment as was the trend across all treatments. This more detailed breakdown of prices and bids by stage also loosely supports hypothesis 2 that one would not expect to see prices and bids above fundamental value in this treatment.

Hypothesis 3- Feedback Conditional Regret

The null hypothesis is that mean bids and market prices will not differ significantly between treatments 1 and 2 i.e. that feedback conditional regret does

not impact upon the amount offered or the market price. The alternative hypothesis is that the knowledge that one will discover the value of X regardless of whether one has purchased the asset or not, will drive bids and market prices higher. One tailed tests were conducted due to this prior belief that the potential to regret would have an upward impact on bids and prices.

It is apparent from fig.1 that mean market prices and bids were higher in the regret treatment (2) than in the baseline treatment (1). The results of Mann Whitney Tests are presented in table 3.

Mean and median bids were significantly higher at the 10% level in treatment 2 than treatment 1 when stages were pooled together and mean bids were higher at the 5% level in stage 3. Although market prices across all three stages in treatment two were not significantly higher than those in the baseline, they are close to statistical significance in stage 2 and by stage three they are significant. This would be consistent with feedback effects coming into play at the end of stage 1 and being reinforced at the end of stage 2.

Treatments	1 and 2	1 and 3	1 and 4	2 and 3	2 and 4	3 and 4
Mean Market Price	.301	.377	.1255	.232	.1735	.301
Mean Bid X	.0875	.377	.1255	.058	.458	.301
Median Bid X	.082	.4575	.301	.081	.299	.2315
Mean Market Price Stage 1	.301	.458	.301	.337	.058	.232
Mean Bid X Stage 1	.301	.301	.377	.6301	.232	.173
Median Bid X Stage 1	.297	.297	.375	.123	.416	.121
Market Price Stage 2	.125	.301	.125	.299	.301	.232
Mean Bid X Stage 2	.038*	.377	.125	.058	.458	.377
Median Bid X Stage 2	.0165*	.335	.173	.068	.298	.3375
Market Price Stage 3	.006**	.173	.038*	.201	.458	.377
Mean Bid X Stage 3	.038*	.087	.232	.232	.377	.458
Median Bid X Stage 3	.069	.231	.170	.228	.229	.458

Table 3. Bids and Prices by Stage and Treatment

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

Hypothesis 4- Herding

The null hypothesis regarding herding is that there is no impact on bids or prices from being able to observe the actions of fellow participants. The alternative is that bids will be driven upwards as bids adjust towards those that have succeeded in securing an X asset. Remember that the opportunity for collusion was noted as a possibility and this would drive bids in the opposite direction. Nevertheless, a one tailed test was conducted.

Although the herding treatment (3) produced data that would be broadly consistent with the alternative hypothesis; mean and median bids were higher than in the baseline treatment and lower than in regret as predicted, the differences were not statistically significant (except for mean bids in stage three at the 10% level). There appeared to be a little more volatility in bidding, just from looking at the raw data but with the limited number of observations, it would be difficult to assert this with any confidence.

Hypothesis 5- Interaction effects

The HerdReg treatment (4) again elicited higher mean bids and market prices for the X asset than the baseline but again these were not generally statistically significant (with the exception of market prices in stage 3). With so few observations and with p-values so close to significant levels, I do suspect that further experimental sessions may have produced statistically significant differences between treatments one and four. This treatment produced the highest market price, indicating that at least for some subjects, the combination of being able to observe the bids of others and knowing that the value of X would be revealed if you did not manage to buy one made them willing to pay more than either of those factors in isolation. However, it would appear that this interaction effect did not affect participants in general as mean bids and market prices were lower than in regret.

The results above indicate the possibility of a regret effect. Regret is found to significantly alter bids and market prices in treatment 2 and in the other treatment

containing the potential for regret, treatment 4, market prices were significantly higher than in the baseline treatment in stage 3. To test whether the possibility to regret a decision makes prices and bids higher in these two treatments than in those with less opportunity to regret decisions a further test was conducted.

A Mann Whitney test compared bids and market prices in the two treatments with the regret element to those without (Baseline and Herd with Reg and HerdReg). For completeness, treatments with herding were compared to treatments without.

The null hypothesis is that there is no regret effect and that bids and prices in treatments with the regret condition are equal to or lower than those without the opportunity to experience regret. The alternative hypothesis is that the impact of FCR is to push bids and prices higher in these treatments.

Treatment type	Median Bid X	Mean Bid X	Market Price
With regret/without (2 & 4 against 1 & 4)	.0524	.048*	.145
With herding/without (3 & 4 against 1 & 2)	.647	.940	.545

Table 4. Bids and Prices by treatments

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

It can be seen from table 4 that mean bids are significantly higher in the regret treatments and market price is also higher (though not significantly so). Herding treatments where participants were informed about the actions of others were not significantly different to the two treatments where this information was not given.

7. Discussion and conclusion

Consistent with much previous research, there was evidence of learning in the experiment and bids followed the predicted downward path as stages progressed. Looking at variables across treatments is not entirely informative as evidence shows that bubbles, even where they occur in experiments, tend to dissipate over time. The results broken down into stages were a little more supportive of hypotheses. Camerer and Loewenstein (2003) draw attention to the greater power of the early stages of many experiments, pointing out that ‘many important aspects of economic life are like the first few periods of an experiment rather than the last’ and citing the example of ‘the purchase of large durables like houses’. One can assume there may be differences in how learning may operate in the various treatments, though with the limited observations available here it would be hard to find any discernible patterns of this nature.

All three non-baseline treatments had a higher mean and median offer for X than in the baseline treatment (though this was not significant in the herding or HerdReg treatments). Mean and median bids for X were significantly lower in the baseline treatment than in Regret treatments.

It was found that when faced with the decision of whether to invest in an asset of uncertain value, subjects were prepared to pay more for the asset in order to secure it if they were going to discover its value, regardless of whether they owned one at the end of the experiment. This supported the existence of a regret effect and the willingness to pay a ‘regret’ premium. As well as being willing to pay a premium not to have to experience regret, a participant in the regret treatment who bids and does not receive an X in one round may imagine that the others are bidding at a level much higher than they in fact are and may raise their own bid above the level necessary to secure the X. It would seem to be the absence of this fear of being made to regret their decision that removes this pressure on bids in the baseline treatment. A regret effect was further statistically supported by testing regret against non-regret treatments.

In the Herding treatment (and HerdReg), participants received a better indication of the general level of bidding and perhaps overshot less. Also, in herding treatments the information about what others were doing may have tempered bids as people co-ordinated. It was also found that the opportunity to observe the bids of others did not cause a statistically significant increase in bid amounts or market prices for the asset though it did appear to exert some upward pressure on both variables. Smith, Suchanek and Williams (1988) displayed only the highest bids and asks on participants' screens. If an element of herding is present in such experiments, and with the anchors around which herding might centre being the highest prices, it would appear to follow that overshooting fundamental value might be more common as a result. Observing the bids of all other participants, rather than just the highest bids and asks, may not therefore have created bubbles in herding treatments.

The fact that market prices were on average higher in HerdReg could indicate that some subjects were affected by the interaction of regret and herding, even if on average participants were not. As in auctions and both financial and housing markets, it is the price that the person with the highest estimate of value is willing to pay that dictates the market price. Perhaps some subjects in HerdReg were willing to pay a higher regret premium because they anticipated they would regret losing out on ownership of an X more knowing that others had just pipped them to the purchase. It may be simply that it evoked greater competitive feelings to purchase an X and not to possibly be the one subject made to experience regret.

The experimental design produced no bubble although possibly produced some evidence of feedback conditional regret at work in the creation of bubbles. This may have been because the design controlled for several of the suspected causes of experimental asset bubbles. Frequent dividend payments (Noussair, Robin and Ruffieux 2001), highly skewed pay-offs (Ackert et al 2002) and resale markets (Lei, Noussair and Plott 2001) have all been blamed for the phenomenon. All of these factors were deliberately removed from the design in order to more cleanly test for the effects of herding and regret. It may be that at least one of these is an essential ingredient in bubbles. It is possible herding or regret effects do partially cause bubbles, but perhaps they are not the catalyst.

Two of the strongest contenders for asset market bubble creation, at least in the laboratory are the use of declining fundamental values and the opportunities for speculation. Technically the asset X had a declining fundamental value as more experimental currency was saved the sooner it was bought, but the single asset design differed from the usual multi-unit one so this may not have created the necessary confusion about fundamental value needed to create a bubble. Speculation opportunities were non-existent. In many multi-asset designs, subjects act as buyers and sellers and may be motivated to buy above fundamental value if they believe they can sell at a higher price. This would appear to be the design feature from the laboratory market that may be the most important in bubble creation in real markets. From the Dutch tulip mania, to the dot com bubble to housing market booms, the ability to re-sell assets at a higher price would appear to be an essential bubble ingredient. It is these two design aspects that are explored in the next chapter.

Whilst not creating any bubbles, the Assets 2 experiment has shown how a simple manipulation can alter the amount people are willing to pay for an asset. There is no change in the expected value, nor fundamental value of the asset offered for sale between treatments and yet, the possibility to regret your decision and, to a lesser extent, simply the ability to observe the actions of others has a discernible effect on prices.

In real asset markets, including ones containing decisions about the purchase of a single large asset such as housing markets, there is certainly the possibility for buyers to experience regret. This may be a contributing factor to the detachment of prices from fundamental value, though the evidence presented in this chapter would indicate that there are more significant factors and therefore much room for further research.

References for Chapter 1

Ackert, Lucy F., Charupat, N., Church B. K. and Deaves R. 2002, "Bubbles in Experimental Asset Markets: Irrational Exuberance No More". *Working Paper 2002-24, Federal Reserve Bank of Atlanta*.

Allsopp, L. and Hey, J. D., 2000, "Two Experiments to Test a Model of Herd Behaviour", *Experimental Economics*, 3 :pp 121-136

Andrade, Eduardo, Lin, Shengle and Odean, Terrance 2012, "Bubbling with excitement: An Experiment". *Working Paper. Available at SSRN:*
<http://ssrn.com/abstract=2024549> or <http://dx.doi.org/10.2139/ssrn.2024549>

Anderson, L. R. and Holt, C. A., 1997, "Information Cascades in the Laboratory," *American Economic Review*, 87(5), 847—862.

Baddeley, M., 2005 "Behavioural Complexity in British Housing Markets: An Analysis of Neighbourhood Statistics for England and Wales", *CCEPP Working Paper No.09-05, Cambridge Centre for Economic and Public Policy, Cambridge, UK*.

Banerjee, A., "A Simple Model of Herd Behavior", 1992. *The Quarterly Journal of Economics*, Vol. 107, No. 3, pp. 797-817.

Barberis, Nicholas, Shleifer, Andrei and Vishny, Robert W., 1997 "A Model of Investor Sentiment". *NBER Working Paper No. W5926*.

Barberis, Nicholas & Thaler, Richard, 2003. "A survey of behavioral finance," *Handbook of the Economics of Finance*, in: G.M. Constantinides & M. Harris & R. M. Stulz (ed.), *Handbook of the Economics of Finance*, edition 1, volume 1, chapter 18, pages 1053-1128 Elsevier.

Bell, D. E., 1982. "Regret in decision making under uncertainty", *Operations Research*, 30, 961-981

Bell, D. E., "Risk Premium in Decision Regret" 1983, *Management Science*, 1983, Vol. 29(10), 1156-1166.

Bikhchandani, S., Hirshleifer, D., Welch, I., 1992, "A theory of fads, fashion, custom, and cultural change as informational cascades", *Journal of Political Economy* 100 (5), pp. 992–1026.

Black, A., Fraser, P., Hoesli, M. 2006. "House Prices, Fundamentals and Bubbles," *Journal of Business Finance & Accounting*, Blackwell Publishing, vol. 33(9-10), pages 1535-1555

Braga, Jacinto, Humphrey, Steven J, Starmer, Chris, 2009, "Market experience eliminates some anomalies—and creates new ones" *European Economic Review*, Vol.53(4), p.401(16)

Camerer, Colin and Weigelt, Keith, 1991. "Information Mirages in Experimental Asset Markets," *Journal of Business*, *University of Chicago Press*, vol. 64(4), pages 463-93, October

Camerer, C., G. Loewenstein, 2003 "Behavioral Economics: Past, Present, Future", in Camerer, C., G. Loewenstein, and M.Rabin, *Advances in Behavioral*

Economics, Princeton University Press.

Case, K. and Shiller, R. 2004 "Is there a bubble in the housing market? An analysis", *Brookings Papers on Economic Activity* 1, pp. 299–362.

Chamley, C. and Gale, D. 1994 "Information revelation and strategic delay in a model of investment", *Econometrica* 62 (5), pp. 1065–1085

Cox, James C., B. Roberson, and Vernon L. Smith 1982, "Theory and Behavior of Single Price Auctions," in V. L. Smith, ed., *Research in Experimental Economics, Vol. 2*, Greenwich, Conn.: JAI Press, 1-43.

Cox, James C., Samuel H. Dinkin, and James T. Swarthout. 2001 "Endogenous Entry and Exit in Common Value Auctions," *Experimental Economics*, vol. 4, no.2, pp. 163-181

Farlow, A., 2004 "Part Two, The UK Housing Market : Bubbles and Buyers"

Credit Suisse First Boston, January 2004

Fischbacher, Urs, 1999 "z-Tree. Toolbox for Readymade Economic Experiments", *IEW Working paper 21*, University of Zurich.

Genesove, D. and Mayer, C.J., 2001 'Nominal loss aversion and seller behavior: Evidence from the housing market'. *Quarterly Journal of Economics* 116, pp. 1233–1260

Gibler, K. M. and S. L. Nelson, 2003 "Consumer Behavior Applications to Real Estate Education", *Journal of Real Estate Practice and Education*, 6:1, 63–83.

Goeree, J.K. and Offerman, T. 2002, "Efficiency in auctions with private and common values: an experimental study", *American Economic Review*, 92(3), pp. 625-643

Guiso, Sapienza, and Zingales, 2011, "Time Varying Risk Aversion", *working paper*, University of Chicago.

Hey DH, Morone A. 2004, "Do markets drive out lemmings—or vice versa?" *Economica* 71(284)

Hirshleifer, D., 2001. "Investor Psychology and Asset Pricing," *Journal of Finance*, American Finance Association, vol. 56(4), pages 1533-1597, 08.

Hogarth, Robin M., MarionaPortell, Anna Cuxart, Gueorgui I. Kolev, 2011, 'Emotion and reason in everyday risk perception', *Journal of Behavioral Decision Making*, 24, 2, 202-222.

Humphrey, S. 2004. "Feedback-Conditional Regret Theory and Testing Regret Aversion in Risky Choice", *Journal of Economic Psychology*, 25, 839-857

Humphrey, S., Mann, P. and Starmer, C. 2005. "Testing for Feedback Conditional Regret Effects Using a Natural Lottery", *CeDEx Discussion Paper No. 2005-07*

IMF 2003, "An analysis of house prices in the United Kingdom", United Kingdom: *Selected Issues*, IMF Country Report No. 03/47

Kagel, J. and Levin, D. 1986, "The winner's curse and public information in common value auctions", *American Economic Review*, 76, pp. 894-920

Kagel, John H., 1989 'First-Price Common Value Auctions: Bidder Behavior and the "Winner's Curse"', *Economic Inquiry*, 27:2 (1989:Apr.) p.241

Kahneman, D., and A. Tversky 1974, "Judgment under uncertainty: heuristics and biases", *Science* 185:1124–1131.

Kahneman, D., and A. Tversky. 1979, "Prospect theory: an analysis of decision under risk", *Econometrica* 47:263–291.

Lahav, Yaron, and Shireen Meer, 2012, 'The Effect of Induced Mood on Prices in Experimental Asset Markets', *Working Paper*. Available at SSRN: <http://ssrn.com/abstract=2050299>

Larrick, R and Boles, T. 1995. 'Avoiding Regret in Decisions with Feedback: A Negotiation Example', *Organizational Behavior and Human Decision Processes* Vol.63, No.1, 87-97

Lei, Vivian, Charles N. Noussair, and Charles R. Plott, 2001 "Nonspeculative Bubbles in Experimental Asset Markets: Lack of Common Knowledge of Rationality vs. Actual Irrationality," *Econometrica*, July 2001, 69(4), 831-859.

Lind, B. and Plott, C. 1991, "The winner's curse: experiments with buyers and with sellers," *American Economic Review*, 81, pp. 335-346

Loomes, G. and Sugden, R. 1982. "Regret Theory: An Alternative Theory of Rational Choice under Uncertainty". *The Economic Journal*, 92, 805-824.

Loewenstein, G., & Lerner J. S. 2003. "The role of affect in decision making".

In R. Davidson, H. Goldsmith, & K. Scherer (Eds.), *Handbook of Affective Science* (pp. 619-642). Oxford: Oxford University Press.

Loewenstein, G. 2000 "Emotions in Economic Theory and Economic Behavior," *The American Economic Review*, Vol. 90, No. 2, Papers and Proceedings of the One Hundred Twelfth Annual Meeting of the American Economic Association (May, 2000), pp. 426-432

Meen, G. 1996 "Ten propositions in UK housing macroeconometrics: an overview of the 1980s and 1990s." *Urban Studies*, 33:425-444

Muellbauer, J. and Murphy, A., 1997, "Booms and Busts in the UK Housing Market" *The Economic Journal*, 107:1701-1727

Northcraft G.B. and Neale M.A. 1987. 'Experts, Amateurs, and Real Estate: An Anchoring-And-Adjustment Perspective on Property Pricing Decisions', *Organisational Behavior and Human Decision Processes*, 39.

Noussair, C., S. Robin and B. Ruffieux, 2001. 'Price Bubbles in Laboratory Asset Markets with Constant Fundamental Values', *Experimental Economics*, 4(1), 87-105

Porter, David P & Smith, Vernon L, 1995. "Futures Contracting and Dividend Uncertainty in Experimental Asset Markets," *Journal of Business*, University of Chicago Press, vol. 68(4), pages 509-41, October

SgROI, D. 2003 "The Right Choice at the Right Time: A Herding Experiment in Endogenous Time", *Experimental Economics*, Volume 6, Issue 2: 159-180, 2003

Shiller, Robert J., 1984, Stock prices and social dynamics, *Brookings Papers* 15, no. 2, 457-498.

Shiller, Robert J. 2000 *Irrational Exuberance*, Princeton University Press, pp. 149-153.

Smith, N., 2011 "Herding and Speculation in Experimental Asset Markets *Working Paper, September 12, 2011, University of Michigan.*

Smith, Vernon L., Gerry L. Suchanek, and Arlington W. Williams, 1988. "Bubbles, Crashes and Endogenous Expectations in Experimental Spot Asset Markets," *Econometrica*, 56, September 1988, 1119-1151.

Smith, Vernon L.; van Boening, Mark and Wellford, Charissa P. 2000,

"Dividend timing and behavior in laboratory asset markets", *Economic Theory*, 16, 567-583.

Statman, Meir 1995 "Behavioral Finance versus Standard Finance." In *Behavioral Finance and Decision Theory in Investment Management*. Edited by Arnold S. Wood. Charlottesville, VA:AIMR

Sunder, S., 1992. "Experimental Asset Markets: A Survey," *GSIA Working Papers 1992-19, Carnegie Mellon University, Tepper School of Business*

Thaler, Richard H, 1988. "Anomalies: The Winner's Curse," *Journal of Economic Perspectives*, American Economic Association, vol. 2(1), pages 191-202, Winter.

Van Boening, Mark V. & Williams, Arlington W. & LaMaster, Shawn, 1993. "Price bubbles and crashes in experimental call markets," *Economics Letters, Elsevier*, vol. 41(2), pages 179-185

Weeken, Olaf, "Asset Pricing and the Housing Market". *Bank of England Quarterly Bulletin, Spring 2004*

Zeelenberg, M., Beattie, J., van der Pligt, J. And De Vries, N. 1996. "Consequences of Regret Aversion: Effects of Expected Feedback on Risky Decision Making", *Organizational Behavior and Human Decision Processes*, Vol.65, No.2, 148-158

Appendices for chapter 1

Appendix 1 – Pre-experiment questionnaire

Session number.....

Date.....

Subject number.....

Questionnaire

Please answer the following questions;

1) In each round, unless I already own an X, I will buy either an Asset X or as Asset Y.

True

False

2) If I own an Asset X, I can buy an Asset Y in the next round.

True

False

3) If I make the highest unique offer of the round, I will definitely get the Asset X available in that round.

True

False

4) If I buy an X in stage 1, I cannot buy another in stage 2 or 3.

True

False

5) Imagine you were to buy an asset X in round 3 of stage 2 for 10 units of currency and the asset X was determined to be worth 7 units at the end of the experiment. If stage 2 was the stage selected to count for real; what would your final earnings be in £s?

When you have completed this, please raise your hand until somebody comes to see you.

ANSWER SHEET

1) Answer: True

2) Answer: False

Once you own an Asset X, you can no longer make an offer for another Asset X in that stage, nor do you need to buy any Asset Y

3) Answer: True

4) Answer: False

You cannot own more than one Asset X in any one stage, but each stage is separate.

5) 15 units = £15

Appendix 2(a) Experimental Instructions – Baseline Treatment 1

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

The Assets

You are given 20 units of currency at the beginning of each new stage.

There are two assets available for you to buy: **Asset X and Asset Y**.

Asset X is an asset which will be worth one of four amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **9, 7, 3 or 1** unit(s) of currency. There is an equal (one in four) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

Asset Y expires in each round. That means that it has no value from one round to the next or at the end of the experiment. It costs 1 unit *per round* and only one asset Y can be purchased by each participant in each round.

Task

In each round, you need to choose whether you wish to make an offer to buy an asset X or whether you wish to buy an asset Y. This applies unless you become an owner of an asset X.

One asset X is available in each round and in each round only one can be sold, making a total of 7 available during each stage. You may only own one asset X in each stage and if you have bought one, you need not buy any more Y, nor can you make any further offers for an X for the remainder of that stage.

In each round, unless you have already bought an X during that stage, you will first be asked to decide whether you wish to buy an asset Y or make an offer for an asset X.

If you choose to buy an asset Y, 1 unit of currency will be deducted from your currency holdings. If you choose to make an offer for an asset X, you will then be asked to state how much you are willing to pay for the asset X in that round.

You can offer as much or as little of your currency holdings as you like. The highest offer for X will be the one that is accepted. In the event of a tie in any round (that is, if two or more participants make identical, highest offers for asset X), then the participant who receives it will be randomly chosen by computer. If you make an offer for asset X that is not accepted, you will automatically buy an asset Y in that round.

Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Asset X value

Only participants who own an X for the chosen stage will be informed of the end of stage value of X. That is to say, if you did not buy an X during the stage that is selected to count, you will not be informed of its value and therefore will not know what you would have earned had you bought an X during the chosen stage.

Conversion Rate

At the end of the experiment, your currency holdings for the stage that is chosen for payment will be converted to cash on a 1 for 1 basis, i.e. each unit you hold is worth £1, so if you hold 10 units you will earn £10 etc.

Examples

1) If you buy a Y in each round throughout the stage that is chosen to count for real and do not own an X at the end of the stage, then your final cash holdings will be $20 - 7 = 13$.

This is your initial endowment less the cost of one Y in each round.

2) If you own an Asset X your final payment will be as follows;

20 minus any asset Y bought prior to owning an asset X minus the price paid for the asset X plus the value of asset X for the stage chosen (determined at the end of the experiment).

Table of example earnings

Action	Initial endowment of currency units		Minus No of units of Asset Y bought		Minus price paid for asset X		Plus value of asset X		= total earnings
Buy a Y in every round	20	-	7	-	N/A		N/A	=	13
Buy an asset X in round 1 for 12 units with value of X determined to be worth 9 units of currency	20	-	0	-	12	+	9	=	17
Buy an asset X in round 7 for £5 with value of X determined to be 1 unit of currency	20	-	6	-	5	+	1	=	10

Note that an asset X with a value of 7 bought in round 1 for 10 units would earn you a total of 17 units as no asset Y would be purchased. The same X bought for 10 units in round 6 would earn you 12 units, as 5 units of Y would have been bought in previous rounds.

If you choose to buy an X, when choosing what to you wish to offer for it, you might wish to take into account how many currency units you would save by not being required to buy more units of Y for the rest of the stage as well as the potential end of stage value of asset X.

Please now complete the short questionnaire to help us confirm that you have understood these instructions.

Appendix 2(b) Experimental Instructions – Regret Treatment 2

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

The Assets

You are given 20 units of currency at the beginning of each new stage.

There are two assets available for you to buy: **Asset X and Asset Y**.

Asset X is an asset which will be worth one of four amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **9, 7, 3 or 1** unit(s) of currency. There is an equal (one in four) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

Asset Y expires in each round. That means that it has no value from one round to the next or at the end of the experiment. It costs 1 unit *per round* and only one asset Y can be purchased by each participant in each round.

Task

In each round, you need to choose whether you wish to make an offer to buy an asset X or whether you wish to buy an asset Y. This applies unless you become an owner of an asset X.

One asset X is available in each round and in each round only one can be sold, making a total of 7 available during each stage. You may only own one asset X in each stage and if you have bought one, you need not buy any more Y, nor can you make any further offers for an X for the remainder of that stage.

In each round, unless you have already bought an X during that stage, you will first be asked to decide whether you wish to buy an asset Y or make an offer for an asset X.

If you choose to buy an asset Y, 1 unit of currency will be deducted from your currency holdings. If you choose to make an offer for an asset X, you will then be asked to state how much you are willing to pay for the asset X in that round.

You can offer as much or as little of your currency holdings as you like. The highest offer for X will be the one that is accepted. In the event of a tie in any round (that is, if two or more participants make identical, highest offers for asset X), then the participant who receives it will be randomly chosen by computer. If you make an offer for asset X that is not accepted, you will automatically buy an asset Y in that round.

Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Asset X value

All participants will be informed of the end of stage value of X for the chosen stage, regardless of whether or not they own one. That is to say, if you did not buy an X during the stage that is selected to count, you will still be informed of its value and therefore will know what you would have earned had you bought an X during the chosen stage.

Conversion Rate

At the end of the experiment, your currency holdings for the stage that is chosen for payment will be converted to cash on a 1 for 1 basis, i.e. each unit you hold is worth £1, so if you hold 10 units you will earn £10 etc.

Examples

1) If you buy a Y in each round throughout the stage that is chosen to count for real and do not own an X at the end of the stage, then your final cash holdings will be $20 - 7 = 13$.

This is your initial endowment less the cost of one Y in each round.

2) If you own an Asset X your final payment will be as follows;

20 minus any asset Y bought prior to owning an asset X minus the price paid for the asset X plus the value of asset X for the stage chosen (determined at the end of the experiment).

Table of example earnings

Action	Initial endowment of currency units		Minus No of units of Asset Y bought		Minus price paid for asset X		Plus value of asset X		= total earnings
Buy a Y in every round	20	-	7	-	N/A		N/A	=	13

Buy an asset X in round 1 for 12 units with value of X determined to be worth 9 units of currency	20	-	0	-	12	+	9	=	17
<i>Buy an asset X in round 7 for £5 with value of X determined to be 1 unit of currency</i>	20	-	6	-	5	+	1	=	10

Note that an asset X with a value of 7 bought in round 1 for 10 units would earn you a total of 17 units as no asset Y would be purchased. The same X bought for 10 units in round 6 would earn you 12 units, as 5 units of Y would have been bought in previous rounds.

If you choose to buy an X, when choosing what to you wish to offer for it, you might wish to take into account how many currency units you would save by not being required to buy more units of Y for the rest of the stage as well as the potential end of stage value of asset X.

Please now complete the short questionnaire to help us confirm that you have understood these instructions.

Appendix 2(c) Experimental Instructions – Herding Treatment 3

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

The Assets

You are given 20 units of currency at the beginning of each new stage.

There are two assets available for you to buy: **Asset X and Asset Y.**

Asset X is an asset which will be worth one of four amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **9, 7, 3 or 1** unit(s) of currency. There is an equal (one in four) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

Asset Y expires in each round. That means that it has no value from one round to the next or at the end of the experiment. It costs 1 unit *per round* and only one asset Y can be purchased by each participant in each round.

Task

In each round, you need to choose whether you wish to make an offer to buy an asset X or whether you wish to buy an asset Y. This applies unless you become an owner of an asset X.

One asset X is available in each round and in each round only one can be sold, making a total of 7 available during each stage. You may only own one asset X in each stage and if you have bought one, you need not buy any more Y, nor can you make any further offers for an X for the remainder of that stage.

In each round, unless you have already bought an X during that stage, you will first be asked to decide whether you wish to buy an asset Y or make an offer for an asset X.

If you choose to buy an asset Y, 1 unit of currency will be deducted from your currency holdings. If you choose to make an offer for an asset X, you will then be asked to state how much you are willing to pay for the asset X in that round.

You can offer as much or as little of your currency holdings as you like. The highest offer for X will be the one that is accepted. In the event of a tie in any round (that is, if two or more participants make identical, highest offers for asset X), then the participant who

receives it will be randomly chosen by computer. If you make an offer for asset X that is not accepted, you will automatically buy an asset Y in that round.

You will be informed whether or not an X has sold in each round. In each round, you will also be informed of the amount the asset X sold for and also of all offers made by your fellow participants.

Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Asset X value

Only participants who own an X for the chosen stage will be informed of the end of stage value of X. That is to say, if you did not buy an X during the stage that is selected to count, you will not be informed of its value and therefore will not know what you would have earned had you bought an X during the chosen stage.

Conversion Rate

At the end of the experiment, your currency holdings for the stage that is chosen for payment will be converted to cash on a 1 for 1 basis, i.e. each unit you hold is worth £1, so if you hold 10 units you will earn £10 etc.

Examples

1) If you buy a Y in each round throughout the stage that is chosen to count for real and do not own an X at the end of the stage, then your final cash holdings will be $20 - 7 = 13$.

This is your initial endowment less the cost of one Y in each round.

2) If you own an Asset X your final payment will be as follows;

20 *minus* any asset Y bought prior to owning an asset X *minus* the price paid for the asset X *plus* the value of asset X for the stage chosen (determined at the end of the experiment).

Table of example earnings

Action	Initial endowment of currency units		Minus No of units of Asset Y bought		Minus price paid for asset X		Plus value of asset X		= <i>total earnings</i>
Buy a Y in every round	20	-	7	-	N/A		N/A	=	13
Buy an asset X in round 1 for 12 units with value of X determined to be worth 9 units of currency	20	-	0	-	12	+	9	=	17
<i>Buy an asset X in round 7 for £5 with value of X determined to be 1 unit of currency</i>	20	-	6	-	5	+	1	=	10

Note that an asset X with a value of 7 bought in round 1 for 10 units would earn you a total of 17 units as no asset Y would be purchased. The same X bought for 10 units in round 6 would earn you 12 units, as 5 units of Y would have been bought in previous rounds.

If you choose to buy an X, when choosing what to you wish to offer for it, you might wish to take into account how many currency units you would save by not being required to buy more units of Y for the rest of the stage as well as the potential end of stage value of asset X.

Please now complete the short questionnaire to help us confirm that you have understood these instructions.

Appendix 2(d) Experimental Instructions – HerdReg Treatment 4

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

The Assets

You are given 20 units of currency at the beginning of each new stage.

There are two assets available for you to buy: **Asset X and Asset Y.**

Asset X is an asset which will be worth one of four amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **9, 7, 3 or 1** unit(s) of currency. There is an equal (one in four) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

Asset Y expires in each round. That means that it has no value from one round to the next or at the end of the experiment. It costs 1 unit *per round* and only one asset Y can be purchased by each participant in each round.

Task

In each round, you need to choose whether you wish to make an offer to buy an asset X or whether you wish to buy an asset Y. This applies unless you become an owner of an asset X.

One asset X is available in each round and in each round only one can be sold, making a total of 7 available during each stage. You may only own one asset X in each stage and if you have bought one, you need not buy any more Y, nor can you make any further offers for an X for the remainder of that stage.

In each round, unless you have already bought an X during that stage, you will first be asked to decide whether you wish to buy an asset Y or make an offer for an asset X.

If you choose to buy an asset Y, 1 unit of currency will be deducted from your currency holdings. If you choose to make an offer for an asset X, you will then be asked to state how much you are willing to pay for the asset X in that round.

You can offer as much or as little of your currency holdings as you like. The highest offer for X will be the one that is accepted. In the event of a tie in any round (that is, if two or more participants make identical, highest offers for asset X), then the participant who receives it will be randomly chosen by computer. If you make an offer for asset X that is not accepted, you will automatically buy an asset Y in that round.

You will be informed whether or not an X has sold in each round. In each round, you will also be informed of the amount the asset X sold for and also of all offers made by your fellow participants.

Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Asset X value

All participants will be informed of the end of stage value of X for the chosen stage, regardless of whether or not they own one. That is to say, if you did not buy an X during the stage that is selected to count, you will still be informed of its value and therefore will know what you would have earned had you bought an X during the chosen stage.

Conversion Rate

At the end of the experiment, your currency holdings for the stage that is chosen for payment will be converted to cash on a 1 for 1 basis, i.e. each unit you hold is worth £1, so if you hold 10 units you will earn £10 etc.

Examples

1) If you buy a Y in each round throughout the stage that is chosen to count for real and do not own an X at the end of the stage, then your final cash holdings will be $20 - 7 = 13$.

This is your initial endowment less the cost of one Y in each round.

2) If you own an Asset X your final payment will be as follows;

20 minus any asset Y bought prior to owning an asset X minus the price paid for the asset X plus the value of asset X for the stage chosen (determined at the end of the experiment).

Table of example earnings

Action	Initial endowment of currency units		Minus No of units of Asset Y bought		Minus price paid for asset X		Plus value of asset X		= total earnings
Buy a Y in every round	20	-	7	-	N/A		N/A	=	13

Buy an asset X in round 1 for 12 units with value of X determined to be worth 9 units of currency	20	-	0	-	12	+	9	=	17
<i>Buy an asset X in round 7 for £5 with value of X determined to be 1 unit of currency</i>	20	-	6	-	5	+	1	=	10

Note that an asset X with a value of 7 bought in round 1 for 10 units would earn you a total of 17 units as no asset Y would be purchased. The same X bought for 10 units in round 6 would earn you 12 units, as 5 units of Y would have been bought in previous rounds.

If you choose to buy an X, when choosing what to you wish to offer for it, you might wish to take into account how many currency units you would save by not being required to buy more units of Y for the rest of the stage as well as the potential end of stage value of asset X.

Please now complete the short questionnaire to help us confirm that you have understood these instructions.

Chapter 2

Assets 3 Experiment

1. Introduction

The experiment reported here intends to extend the research described in the previous chapter by considering the impact of speculation on bubbles. Given that the experiment in the previous chapter was partially motivated by housing market bubbles where opportunities for speculation could potentially play an important role in bubble formation, a natural extension to the research would seem to be the impact of speculation in an experimental market. The impact of speculation has been previously examined in asset market experiments where the existence of a resale market has been found to greatly exacerbate bubbles in the laboratory. The Assets 3 experiment will attempt to assess the role of speculation in bubbles, maintaining the use of a single, lumpy asset as in Assets 2 and with participants acting as both buyers and sellers.

The experiment will investigate whether speculation or fundamentals (or both) may be the driving force behind price bubbles in the housing market. This will be achieved by comparing market prices in a treatment where there is no opportunity for re-sale with one in which there is. It will also investigate the impact of rising fundamental values against constant ones and the effect of rising fundamental values on speculation and market prices.

Although traditionally, fundamental values in asset market experiments decline throughout rounds, this is perhaps a less good approximation of the housing market than increasing values. The supply of housing, which is already struggling to meet demand, could be expected to become even less adequate in the future as the impact of a rising population and changing demographics (e.g. more single occupiers) puts increasing pressure on a limited and relatively inelastic supply. For this reason, it seems more realistic to model fundamental values as rising rather than

falling over time. Whether the increases in fundamental values are contributing to bubbles will be examined by comparing market prices in treatments with rising fundamental values with treatments in which they are constant. Using constant rather than decreasing fundamental values in two treatments will provide a cleaner way of isolating the effect of increasing fundamental values.

In his *General Theory*, Keynes (1936, pp. 154–5) asserts that fundamentals are not the determining factor in asset prices, but that investors are instead “concerned, not with what an investment is really worth to a man who buys it ‘for keeps’, but with what the market will value it at, under the influence of mass psychology, three months or a year hence.” Rational expectations would predict that subjects in an experiment where an asset has a calculable or known fundamental value should only be prepared to buy the asset at this value. Even with the presence of a resale market, RE would predict that subjects would expect other participants to only value the asset at its fundamental worth and therefore would not pay more than this for it in the expectation that someone would pay a yet greater amount for it in a subsequent experimental round. These two somewhat conflicting views are considered in the experiment’s design where a resale market exists in two of the four treatments, allowing participants to sell on an asset at whatever price they can achieve, regardless of whether this is above or below its fundamental value.

2. Literature review

2.1 Fundamental value

The seminal paper by Smith, Suchanek and Williams (1988) (described in the previous chapter) and the majority who followed in a similar vein used a design where the asset or assets traded had a declining fundamental value. The usual finding of declining fundamental value designs has been that bubbles tend to be created in the laboratory setting, though are dissipated by experience. This had led some to claim that the observed laboratory bubbles were created as a result of subjects ‘overshooting’ the declining value. This assertion has motivated some

research where experimenters used an asset with a constant fundamental value and, more rarely, an increasing one.

Ball and Holt (1998) devised a classroom game where participants buy and sell dividend-paying paper assets that have a known chance of expiry in each round (assets are destroyed if a number 1 is rolled with a die) and a final buyout value. Participants are also endowed with a cash balance and the magnitude of this, the dividend, the risk of asset expiry and the final buyout value render the asset's fundamental value constant throughout rounds. These games are reported to produce bubbles of the type observed in laboratory experiments. Noussair et al (2001) used a design where fundamental values were constant rather than declining and also managed to generate bubbles in a laboratory setting. Their experimental design included varying the cash to asset ratio as well as comparing declining and constant fundamental values. They found declining values to be a cause of bubbles in experimental markets, largely because subjects did not understand the declining nature of assets' fundamental value and believed them to be constant. They also found that the frequency with which dividends were paid had a positive effect on bubbles. Bostian et al (2005) also examined the impact of using an asset with a constant fundamental value and, like Noussair et al (2001), concluded that frequent dividend payments were a cause of bubbles. In addition, they found that the length of trading period was significant, more bubbles were created during longer periods during which wealth could be accumulated. Bubbles were also more prevalent, the more cash participants were endowed with.

Davies (2006) replicated previous findings of laboratory bubbles using an asset with a declining fundamental value and then introduced an asset with an increasing fundamental value. The increasing value was achieved by the use of an asset that either paid a dividend or required a maintenance payment at the end of rounds, with the expected outcome being a small maintenance charge being paid rather than a dividend being received. The holding value of the asset, therefore, increases with each round that passes. He hypothesised that as, in his opinion, bubbles were caused by an overshooting of fundamental value, then an increasing value would produce undershooting and generate prices below fundamental value. This is indeed what he found occurred in the experiment.

Noussair and Powell (2010) used a design which allowed for fundamental values to increase and decline by means of varying taxes, dividends and buyout value. This created 'peaks and valleys' of fundamental value in rounds which they argue, given the cyclical nature of economic variables, is a more accurate reflection of the behaviour of assets in real markets. They found that average prices generally overshot fundamentals but there were key differences between valley and peak treatments. Peak treatments, where fundamental value increased and then decreased, produced results in keeping with previous research. Prices were above fundamentals but tracked them accurately in terms of direction, especially with experience. Valley treatments, where values decreased and then increased, produced less consistency, even with experience. Subjects did not successfully track fundamental value either in direction or magnitude even with opportunities for learning. However, Kose (2011) found that the critical factor in bubble creation was the existence (or not) of a final buy-out value for the asset rather than the direction of fundamental value. In treatments where the experiment was of an indefinite duration without an end value, transaction prices were significantly lower than in treatments of known duration with a buy back value. His experiment included increasing and decreasing fundamental value treatments and the finding held across both.

At least some evidence appears to suggest that laboratory bubbles may be the product of experimental design, in particular the use of an asset with a declining fundamental value could be a contender for explaining the phenomenon. If subjects are merely failing to accurately calculate the fundamental value or failing to update their information each round when the value is declining, this may suggest that ensuring the fundamental value is known, or leaving it constant may produce less deviation from an experimental asset's true value. Of course, there is sometimes justification for the declining fundamental design on the grounds of external validity, depending on the nature of the asset and/or circumstances one is trying to experimentally represent. Part of the motivation for the research reported here are the bubbles observed in housing markets and therefore there is certainly a justification for the use of non-declining fundamental values if one is trying to approximate the real world market in the laboratory.

2.2 Resale markets

Implicit in the conclusions of Smith, Suchanek and Williams, is that bubbles may occur even when all subjects are supplied with identical information about an asset's fundamental value due to subjects' beliefs that other participants may act irrationally and hence, may purchase an asset for a price above its fundamental value. This lack of common knowledge of rationality would clearly constitute a violation of rational expectations.

Tirole (1982) constructs a model using a rational expectations equilibrium (REE) which demonstrates stronger theoretical evidence against the possibility of speculation under rational expectations than merely the assertion that subjects oughtn't to doubt the rationality of others under RE. However, there appears to be experimental evidence of precisely this violation of RE. Lei, Noussair and Plott (2001) sought to explain the phenomenon of laboratory bubbles by attributing them to speculation. More specifically, they were interested in exploring speculation based upon doubts of the rationality of other traders in the experiment and the hope of exploiting this by selling an asset at a price above its true value. Naturally if one holds a belief that one can sell an asset for a price in excess of its fundamental value, one will be willing to pay a price in excess of this value (even if the value is known) so long as the participant believes it may be sold for an even higher price in a subsequent trading round. Their 'nospec' treatments, where there was no opportunity for resale of the asset still gave rise to bubbles and led them to conclude that speculation was not therefore a necessary condition for the existence of laboratory bubbles. Given this result, it follows that the lack of common knowledge of rationality could not have been the cause of bubbles observed in treatments where speculation was not possible.

Smith (2011) found evidence of both herding and speculation in an experimental asset market. Speculation was identified in participants who were asked to make a prediction about future asset prices and demonstrated that they understood fundamental value but then deliberately bought into a bubble by paying a price higher than this value. Perhaps importantly here, he observes that even well-informed traders do not predict that prices will converge to fundamentals in the long

run, with the implication that they must have some doubt about the rationality of co-participants.

The role of the lack of common knowledge of rationality in bubble creation via speculation is also at the heart of a working paper by Akiyama, Hanaki and Ishikawa (2012). They explore the idea that bubbles are the result of both individual rationality and the lack of common knowledge of rationality by replacing participants in one treatment with computers. By leaving only a single human subject, they eliminate the possibility of uncertainty about the rationality of the other traders affecting his decision making. This means that any deviation from fundamentals can be attributed to individual irrationality. The other treatment is run with all human participants and deviations in that treatment, it is argued, must be a result of both individual rationality and lack of common knowledge of rationality. They also ask participants for forecasts of trading prices and find that the participants in computer treatments quickly adjust their predictions to fundamental values unlike participants in the all-human treatments. Hence, it seems that the uncertainty about the rationality of others is driving the persistent deviation from fundamentals.

2.3 Learning and confusion

Almost as robust as the finding of asset market bubbles in the laboratory is the finding that they tend to disappear with experience. Generally subjects learn fairly rapidly that values have lost track of fundamentals and prices tend to converge within a few rounds. Haruvy, Lahav and Noussair (2007) used subjects price predictions to measure the degree of learning that takes place. They found expectations to be adaptive and hence bubbles diminish as information is updated with each market that subjects participate in.

It has also been shown that the presence of a relatively small number of experienced or well-informed traders can inhibit bubble formation and there is evidence that inexperienced or irrational traders in experimental markets can skew results in a way that would not occur if all participants were economists. Dufwenberg, Lindqvist and Moore (2005) examined the impact of mixing

experienced and inexperienced traders and reported that even including just a proportion of experienced traders can dissipate bubbles. Hargreaves and Zizzo (2011) found that traders with an economics background outperformed those without. It may be that there are not enough well-informed or experienced traders in real markets to prevent trading above fundamentals. Xie and Zhang (2012) found that introducing a steady stream of new traders in an experiment created so much noise that learning was obstructed and deviation from fundamentals continued. Learning did not necessarily dissipate bubbles in the valley treatments of Noussiar and Powell. It appeared that subjects became confused about the fundamental value of assets during this phase of the experiment. Kirchler, Huber and Stockl (2011) found that the declining nature of assets in experiments were a potential cause of bubbles. Subjects expected fundamental values to be constant and therefore overshot the true value. Perhaps real world traders make the same error, at least to an extent. House prices seem to rise far more readily than they fall for the most part (even during the recent lengthy recession, they have perhaps not reverted quite to fundamental values if estimates of a 30% overvaluation are to be believed).

Some studies have attempted to unravel the learning process observed in the laboratory asset markets; Hussam, Porter and Smith (2008) found that changing the parameters of the experiment can lead experienced subjects to rekindle bubbles e.g. injecting by more cash and more uncertainty. Perhaps this may be more representative of real markets as they are dynamic and variables are constantly changing. If more credit is suddenly available, this may well have an impact upon the markets for houses and other assets and if future asset values seem more uncertain, then perhaps there is greater opportunity for speculation.

It would appear then that subject confusion could be a cause of some experimental results. There is perhaps less literature on the subject than there ought to be, but the possibility is considered in a reasonable proportion of the literature and some have more specifically tried to address the issue. Lei and Vesely (2009) aimed to show that learning is not necessary for bubble dissipation; rather that adequate instruction on the nature of the asset and the dividend structure will prevent their formation. By allowing participants to observe a market before participation, they eliminated bubbles from the 'live' market as subjects were apparently well-informed from the outset of trading as to what fundamental values were. Huber and Kirchler

(2012) examined the way in which fundamental values were presented to subjects and found that giving them the values as a graph instead of in a table led to a reduction in price deviations from fundamentals. In addition, subjects were asked what the fundamental value of an asset would be in the subsequent round as they participated and this also reduced deviations.

3. Experimental design

The experiment is of a 2x2 factorial design. An asset ‘X’ is traded in an experimental market consisting of ‘buyers’ (participants endowed with experimental currency) and ‘sellers’ (participants endowed with a lesser amount of currency than buyers plus a single asset X). The experiment is divided into three identical stages of 7 rounds so there is opportunity for learning.

	Constant FV	Increasing FV
No Resale	Treatment 1	Treatment 2
Resale	Treatment 3	Treatment 4

In keeping with the majority of asset market experiments, in the Assets 2 experiment reported in the previous chapter there was a declining fundamental value which was achieved by the inclusion of a ‘rental’ market for a second asset ‘Y’. In Assets 3, as fundamental values are required to be increasing, there will be no rental market. An increasing fundamental value will be achieved by the introduction of a per-round maintenance charge attached to X in the two treatments that require it. In the constant fundamental treatments, this charge will simply be omitted.

Whoever owns an asset X in any round is required to pay the maintenance charge for that round. Whoever holds an X at the end of the final round receives the buyout value which is randomly determined, though takes one of 3 known possible values of 5, 10 or 15 units.

Increasing fundamental value (IFV) treatments

Buyers are allocated 20 units of experimental currency and sellers are allocated 17 units of experimental currency, plus one asset X with an expected final buyout value of 10.

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7
EVX	10	10	10	10	10	10	10
Charge	1	1	1	1	1	1	1
Cumulative charge	7	6	5	4	3	2	1
FVX	3	4	5	6	7	8	9

Any participant who does nothing would expect to earn 20 units of currency. Some examples are given below.

Buyers

Action: Buy X in R1 for 3 units

Payoff: $20 - 3$ (endowment minus cost of X) = 17 minus the charge of 7 for holding an X for seven rounds = 10. Expected value of X is 10, so the payoff would be 20.

Action: Buy in R4 for 6 units

Payoff: $20 - 6 - 4 + 10 = 20$

Sellers

Action: Sell in R1 for 3 units

Payoff: $17 + 3 = 20$ (Endowment of 17 plus price of X received)

Action: Sell in R4 for 6 units

$17 - 3 + 6 = 20$ (Endowment minus charge for holding X for three rounds plus selling price of X)

$20 - 6 = 14 + 6 = 20$

Constant fundamental value (CFV) treatments

The expected value of X is 10 throughout and the fundamental value of X is equal to this. Buyers are allocated 20 units of experimental currency and sellers are given 10 plus the X asset.

Resale/No Resale treatments

In No resale treatments, only one transaction per stage (of seven rounds) per buyer or seller is permitted. In Resale treatments, assets can be traded as many times as participants wish during each stage (though limited to one transaction per round, per participant due to the design of the computer programme).

In all treatments, the fundamental value of X is given on the screen at the beginning of each round. Participants are able to see offers and asks made by others.

Hypotheses

Three hypotheses are tested in the Assets 3 experiment relating to fundamental value, Speculation and opportunities for learning and their effects on experimental asset market bubbles,

Hypothesis 1- Fundamental value

If constant fundamental values reduce the tendency to deviate from fundamental value, as found by Noussair et al (2001), then bids and offers in treatments with increasing fundamental values will deviate more from fundamental value than those in constant fundamental value treatments. Unlike Davies (2006),

there is no prediction being made that participants will necessarily undershoot in increasing fundamental value treatments, only evidence of a reduction or elimination of deviations in constant fundamental value treatments. A comparison of the deviation of bids from fundamental value in constant and increasing fundamental values will show whether there is evidence that the nature of the fundamental value employed in experimental designs is a possible cause of the frequently observed bubbles.

Hypothesis 2- Speculation

If the existence of a resale market and therefore an opportunity for speculation is a contributory factor in bubbles, then mean offers and trading prices will be higher in resale treatments than in non-resale treatments.

Additionally, it is expected that there will be a higher volume of trades in resale treatments than in no resale treatments.

Hypothesis 3- Learning

If, consistent with previous experimental research, subjects learn to track fundamental value more closely with repetition, bids and offers will converge towards FV over stages. Evidence of learning will be found if the deviation on bids and offers from fundamental value lessens through rounds.

3.1 Experimental procedure

192 participants were recruited (8 subjects per session) and 24 sessions were run on campus at the University of East Anglia during 2009 and 2010. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). Participants were allocated to computer terminals randomly upon arrival and their role as a buyer or seller was therefore also determined randomly. Participants were all students from a wide array of disciplines. After arrival and a chance to read through instructions, a short questionnaire was completed by subjects to ensure they had understood the experiment and particularly the calculation of fundamental value. Session lasted approximately 40-60 minutes depending on treatment and the average payment was £9.20.

4. Results

4.1 Summary Statistics

	T1	T2	T3	T4	Stage 1	Stage 2	Stage 3
Mean Offer	8.8	5.5	9.3	6.1	7.2	7.6	6.9
Median Offer	9.2	5.7	9.4	6	7.3	7.4	7
Mean ask	10.9	6	10.4	6.6	7.7	7.8	7.4
Median ask	10.4	5.8	10.2	6.5	7.6	7.7	7.3
Mean Difference from FV (asks, offers)	A: 0.7 O: -0.1	A: 0.4 O: 0.1	A: 0.4 O: -0.3	A: 0.2 O: 0	A: 0.5 O: -0.1	A: 0.4 O: -0.2	A: 0.6 O: 0.1
Mean Absolute Difference from FV (asks and offers)	A: 1.1 O: 0.6	A: 0.8 O: 0.5	A: 0.9 O: 0.5	A: 0.6 O: 0.7	A: 0.9 O: 0.5	A: 1.0 O: 0.7	A: 0.8 O: 0.6
Mean Number of trades per round	2.1	1.8	4.8	5.2	3.7	3.6	4
Mean trading price	10	5.8	10.1	5.9	7.9	7.9	7.7

Table 1. Summary Statistics

The deviation from fundamental value is presented in two ways. The difference between FV and offers and asks provides an indication of whether the fundamental value was generally exceeded or undershot. The absolute difference gives an indication of the magnitude of departure from fundamentals. From table 1 it is clear that there has been relatively little deviation from fundamental values on average.

4.2 Hypotheses 1-3

Hypothesis 1 - Fundamental value

Mann Whitney tests were conducted to see whether the increasing fundamental value treatments had an impact on offers and asks.

If the null hypothesis is to be accepted, there should be no significant difference between deviations from fundamental value in treatments with constant fundamental value and those with increasing fundamental value. The alternative hypothesis, that the deviation will be greater in treatments with increasing fundamental value, will be accepted if the deviations are significantly different. As there is a belief that deviations will be greater in the increasing fundamental value treatments, a one- tailed test was conducted.

Treatments 1 and 3 (CFV) are compared to treatments 2 and 4 (IFV) in table 2. Also reported in the table are comparisons between each individual treatment.

Asking Prices		Offer Prices	
Treatments	P value	Treatments	P Value
T1/T2	**0.001	T1/T2	**0.002
T1/T3	0.868	T1/T3	0.712
T1/T4	**0.003	T1/T4	*0.012
T2/T3	**0.004	T2/T3	**0.001
T3/T4	**0.001	T3/T4	*0.023
T2/T4	0.499	T2/T4	0.512
T1 and T2 against T3 and T4	0.196	T1 and T2 against T3 and T4	0.213

(NoResale/Resale)		(NoResale/Resale)	
T1 and T3 against T2 and T4 (Constant FV/ Increasing FV)	**0.001	T1 and T3 against T2 and T4 (Constant FV/ Increasing FV)	**0.002

Table 2. Ask and Offer Prices by Treatment

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

Difference from FV		Absolute Difference	
Treatments	P value	Treatments	P Value
T1/T2	0.788	T1/T2	0.323
T1/T3	0.654	T1/T3	0.461
T1/T4	0.688	T1/T4	0.676
T2/T3	0.866	T2/T3	0.339
T3/T4	0.499	T3/T4	0.611
T2/T4	0.614	T2/T4	0.488
T1 and T2 against T3 and T4 (NoResale/Resale)	0.368	T1 and T2 against T3 and T4 (NoResale/Resale)	0.276
T1 and T3 against T2 and T4 (Constant FV/ Increasing FV)	0.619	T1 and T3 against T2 and T4 (Constant FV/ Increasing FV)	0.281

Table 3. Difference from FV and Absolute difference from FV by treatment

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

There is, as expected, a significant difference in average offers and asks between the CFV and IFV treatments. Clearly, as the true average fundamental values were not the same (6 as compared to 10) and these values were displayed on computer screens, this is an unsurprising result. It does, however, show some understanding of fundamental values on behalf of subjects.

More important is to consider the deviation from fundamentals in table 3 and to notice that there was no significant difference in asks or offers or between treatments with constant or increasing fundamental values. Absolute difference from fundamentals is also insignificant between treatments and, though not shown here, this was unsurprisingly also true for trading prices between treatments.

This lack of divergence is somewhat contrary to what has been observed in the literature. Although clearly, the aim was to eliminate overshooting caused by declining fundamental values in the design, it was expected that data from treatments with increasing fundamental values would differ from those with constant values. This result is not entirely out of keeping with previous research; Noussair et al (2001) and Bostian et al (2005) eliminated bubbles with the use of constant fundamental values and Davies (2006) found increasing fundamental value caused prices to fall below fundamental value. The result that no bubbles were observed is therefore not entirely without precedent.

Hypothesis 2 - Speculation

If the opportunity to sell on an asset to another participant causes the ask and offer prices to increase, there should be significantly higher prices observed in the two resale treatments when compared to the baseline. Therefore, the null hypothesis is that there is no difference and the alternative is that prices in the resale treatments are higher.

Table 2 displays the results for tests for any significant differences in asks and offers between resale and no resale treatments. No significant differences exist and therefore the null hypothesis is accepted. Speculation has been shown to possibly be driven by a suspicion that other participants may not act rationally. Smith (2011) found that even well informed traders expected others to bid above fundamentals so the fact that fundamental values were made clear to participants should not necessarily have inhibited the formation of bubbles. It seems participants did not speculate that they could but the asset for its fundamental value or above it and sell it on to another participant for an even higher price.

Number of trades	
Treatments	P value
T1/T2	0.451
T1/T3	0.656
T1/T4	*0.012

T2/T3	*0.033
T3/T4	0.612
T2/T4	**0.004
T1 and T2 against T3 and T4 (NoResale/Resale)	* 0.007
T1 and T3 against T2 and T4 (Constant FV/ Increasing FV)	0.071

Table 4. Number of trades by treatment

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

As shown in table 4, the opportunity for resale did inevitably lead to a significantly higher volume of trade as in no resale treatments the number of transactions permitted were restricted to one per stage, but this was the only significant result for the resale hypothesis. No apparent speculation was taking place.

Hypothesis 3 - Learning and confusion

There is no indication that subjects were confused about fundamental value as suspected in previous experimental asset markets. On the contrary, there was little deviation from fundamentals and therefore little learning could take place. Table 5 below shows that there was no significant difference between offers and asks nor differences from FV and absolute differences from FV between stages.

	Mean Offers	Mean Asks	Difference from FV	Ab Diff from FV
St 1/St2	0.121	0.366	0.688	0.712
St1/St3	0.545	0.354	0.412	0.599
St2/St3	0.444	0.099	0.588	0.772

Table 5. Offers asks and differences from FV by Stage

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

5. Discussion and conclusion

The two results that would appear to merit discussion are the low level of speculative activity and the lack of divergence from fundamental values.

The limited speculative activity could potentially be explained by the shortness of the experiment or the small pay differentials between courses of action, or the belief that others would be aware of fundamental value and would not pay a price above it.

Lei Noussair and Plott (2001) ran additional experiments as an extension to their main research to test the active participation hypothesis. As the Assets 3 experiment was relatively quick, subjects may not have felt compelled to trade to stave off boredom. If this phenomenon could have occurred in the Assets 3 experiment, I think its effects would have been tempered by the short duration of the experiment, any possible subject confusion (it was safer to do nothing) and an element of herding behaviour as the bidding and asking behaviour of others was visible to participants.

Ackert et al (2002) found that an asset with lottery characteristics (i.e. a small chance of a large payout/large chance of a small/zero payout) will trade further above fundamental value than an asset with more standard characteristics (i.e. less skewed payoffs). The small pay differential between each course of action and the expectation of earning £10 for doing nothing at all may therefore have limited trade. The risk of paying higher than fundamental value and losing some of an expected £10 may have seemed too high when the potential financial gain was so modest.

The results show that there are circumstances when the potential profitability of speculation are overridden by some other considerations in a laboratory asset market. Identifying exactly which circumstances were contributory in this case, would take further research. It might be interesting to run the experiment with a larger budget so that, for example, reselling an asset could potentially earn one significantly more than doing nothing. This may have more external validity as during economic booms, potential gains from speculation in asset markets and housing markets are clearly great motivators.

The most surprising result overall is that subjects seemed to track fundamental value rather closely across treatments and through all stages. No bubbles were formed and the differing treatments had no significant effect on behaviour. The experiment was apparently well understood by almost all participants. Those who failed to answer the questionnaire correctly were very few

in number. Tracing the behaviour of those subjects who ‘failed’ the questionnaire, did not prove useful. Some went on not to trade, some traded in line with FV, some not quite in line with FV.

It may well be that a combination of factors contributed to the results, perhaps the most influential of which was the displaying of the fundamental value on the computer screen at the start of each round. Huber and Kirchler (2012) eliminated bubbles by presenting the fundamental value with more clarity, relating it to a depleting gold mine rather than a stock market. They attributed the absence of bubbles to a better understanding of fundamental value due to learning opportunities. If they eliminated bubbles by presenting the concept of fundamental value in a less abstract way and the repetition of the decision making task, then the design of Assets 3 which left participants in no doubt how much the asset was ‘worth’ in each round and consisted of three identical stages understandably might eliminate them too. Their mechanism for ensuring fundamental value was understood was similar to that of Assets 3 in that subjects were asked about the current fundamental value of assets at the start of each trading period. Although not quite as transparent as displaying the value on a screen, the effect on bubble formation may apparently have been the same. Noussair et al (2001) certainly blamed the overshooting of fundamental values on a misunderstanding of their calculation. Kirchler, Huber and Stockl (2011) found that subjects expected fundamental values to be constant so it was their declining nature that caused the overshooting.

Lei and Vesely (2009) stressed the importance of adequately informing participants of the nature of fundamental value and Lei, Noussair and Powell (2010) certainly recognised the importance of eliminating confusion to obtain a clean result;

“...because the experimental procedures followed in asset market experiments were so carefully developed and because the theory of the lack of common knowledge of rationality is so compelling, the issue of procedures in asset market experiments has not been closely scrutinized. The research reported here suggests that the phenomenon of bubbles and crashes could have origins in aspects of the methodology of the experiment. If this assessment is correct, then research is able to proceed along different theoretical lines in the attempt to

understand the general process of price discovery and the dynamics of market adjustments.” (p858-9)

Declining fundamental values and the subject confusion created by using this design, and also perhaps caused by the method of presentation of fundamental value, could be responsible for at least some of the observed price deviations in many asset market experiments. That is not to say that this is not precisely what occurs in real markets, where participants may not know the true value of an asset that they are buying or selling, but the advantage of experimental asset markets is that the fundamental value can be controlled. To be able to control it but then have subjects confused about what is actually is, would seem to negate the laboratory's usefulness in this respect and designs of experimental asset markets need to take this possible pitfall into account. In real markets, it would appear, that either participants have short memories or do not learn from their mistakes as they appear to do in a laboratory setting.

References for Chapter 2

Ackert, Lucy F., Charupat N., Church B. K. and Deaves R. (2002): Bubbles in Experimental Asset Markets: Irrational Exuberance No More. *Working Paper 2002-24, Federal Reserve Bank of Atlanta.*

Akiyama, E., Hanaki, N., Ishikawa, R., "Individual irrationality and lack of common knowledge of rationality in experimental asset markets" *Working paper, May 11, 2012, University of Tsukuba.*

Ball, S. B., and C. A. Holt, 1998 "Classroom Games: Bubbles in an Asset Market," *Journal of Economic Perspectives*, 12, 207-218.

Bostian, AJ., Goeree, J., and Holt, C. A., "Price Bubbles in Asset Market Experiments with a Flat Fundamental Value" *Prepared for the Experimental Finance Conference, Federal Reserve Bank of Atlanta. September 23, 2005*

Davies, T., "Irrational Gloominess in the Laboratory" *August 18, 2006, Working paper, University of Arizona*

Dufwenberg, M., Lindqvist, T. and Moore E., "Bubbles and Experience: An Experiment" *The American Economic Review*, Vol. 95, No. 5 (Dec., 2005), pp. 1731-1737

Fischbacher, Urs, 2007. "z-Tree: Zurich toolbox for ready-made economic experiments", *Experimental Economics*, 10(2), 171-178.

Hargreaves Heap, S. P. and Zizzo, D. J., 2011 "Emotions and chat in a financial markets experiment" *Working Paper series, University of East Anglia, Centre for Behavioural and Experimental Social Science (CBESS) 11-11, School of Economics, University of East Anglia, Norwich*

Haruvy, E., Lahav, Y., and Noussair, C. N., “Traders' Expectations in Asset Markets: Experimental Evidence” *The American Economic Review* , Vol. 97, No. 5 (Dec., 2007), pp. 1901-1920

Huber, J., Kirchler, M. (2012), “The impact of instructions and procedure on reducing confusion and bubbles in experimental asset markets”. *Experimental Economics* 15: 89-105.

Hussam, R. N., Porter, D., Smith, V.L.. 2008. “Thar she blows:Can bubbles be rekindled with experienced subjects?” *American Economic Review* 98(3) 924–937.

Keynes, John Maynard, 1936, “The General Theory of Employment, Interest and Money”. *Macmillan Cambridge University Press, for Royal Economic Society*.

Kirchler, M., Huber, J., Stöckl, T. 2012, “Thar she bursts – Reducing confusion reduces bubbles”. *American Economic Review* 102(2): 865-883.

Kose, T., “Price Convergence and Fundamentals in Asset Markets with Indefinite Duration: An Experiment” Working Paper, University of Pittsburgh, December 2011

Lei, Vivian and Vesely, Filip, 2009, “Market efficiency: Evidence from a No-Bubble Asset Market Experiment”. *Pacific Economic Review*, Vol. 14 No.2, pp 246-256

Noussair, C. N. and Powell, O., 2010, "Peaks and valleys: Price discovery in experimental asset markets with non-monotonic fundamentals", *Journal of Economic Studies*, Vol. 37 Iss: 2, pp.152 - 180

Noussair, C., S. Robin and B. Ruffieux , 2001, “Price Bubbles in Laboratory Asset Markets with Constant Fundamental Values”, *Experimental Economics*, 4(1), 87-105.

Smith, N., “Herding and Speculation in Experimental Asset Markets” *Working Paper, September 12, 2011, University of Michigan*.

Smith, N., "Individual Trader Behavior in Experimental Asset Markets".
Dissertation Paper, July 2, 2012, University of Michigan.

Xie, H. and Zhang, J., 2012. "Bubbles and Experience: An Experiment with a Steady Inflow of New Traders," *CIRANO Working Papers2012s-01, CIRANO*

Appendix for Chapter 2

Instructions for Treatments 1 Buyers and Treatment 4 Sellers. Treatments 2 and 3 contain appropriate variations from 1 and 4.

Questionnaire follows instructions.

Experimental Instructions – Assets 3 Treatment 4 Sellers Instructions (IFV/R/SELLER)

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

Asset X

The participants in this experiment are initially allocated the role of either a buyer or a seller. There are 4 buyers and 4 sellers. Buyers are given 20 points at the beginning of each new stage and no asset. Sellers are given 17 points and one asset X at the beginning of each new stage.

You are a seller and therefore have been allocated 17 points and one asset X.

Asset X is an asset which will be determined to be worth one of three amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **5, 10 or 15** points. There is an equal (one in three) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

This means that on average one could expect the X asset be worth 10 points. This is known as its *expected value*, calculated by adding all the possible values together and dividing by the number of possible outcomes. $5+10+15=30$ then $30/3=10$.

Task

In each round, you need to decide whether you wish to offer the asset X for sale. This applies until you sell the asset X, if you choose to do so. The number of assets on offer in each round will depend upon how many of the sellers wish to sell. The price(s) at which the assets are available will depend upon what price the sellers are willing to sell for. As there are 4 participants allocated the seller role, this means that there are potentially 4 asset X's being traded during each stage. **No participant can own more than one X at any one time.**

You will see a screen displaying any offers for asset X's made by buyers and also any asset X's offered for sale by sellers (including your own should you decide to sell it). If you wish to sell an asset X for one of the amounts offered, you will have the option to click on it and accept the offer. Similarly, buyers will have the option to accept any X's offered for sale by clicking on those. Any trades that take place will be displayed upon the screen.

Ownership of asset X has a cost. You can think of this cost as a maintenance charge of *one point per round*, payable at the *end* of each round in which you hold an X.

It is entirely up to you whether you choose to try to sell the asset X or not. If you sell an asset X, you are permitted to buy one in a subsequent round if you wish. You can sell and buy asset X's as many times as you wish during each stage, though you can only make one transaction per round.

Should you choose to offer an asset X for sale in any round, you may ask as many or as few points for it as you like. Remember that on average asset X is worth 10 but there is an equal likelihood that it is worth 5, 10, or 15 points. You also might wish to take the cost of ownership into account when deciding what you wish to ask for an asset X. As there is a cost per round of owning an X, it could be said that its 'fundamental value' is reduced by the the remaining maintenance charge payable upon it. This fundamental value of X (FVX

in the table) in each round can be calculated by taking the expected value of the asset (EVX =10) and subtracting the costs attached to owning it. The table below shows how this fundamental value increases throughout rounds as there are fewer rounds left in which a charge will be payable on the asset. The fundamental value of asset X will be displayed on your screen during each round of the experiment.

	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7
EVX	10	10	10	10	10	10	10
Charge	1	1	1	1	1	1	1
Cumulative charge	7	6	5	4	3	2	1
FVX	3	4	5	6	7	8	9

Your Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Your final payment will depend firstly on whether you owned an X or not at the end of the last round of the stage that is chosen to count. If you did own an asset X, your final points total will be made up of the value of that X (determined randomly by computer at the end of the experiment), plus the balance of your points from any purchases or sales made during the stage. If you did not own an X in the last round of the chosen stage, your payment will simply be the balance of your points converted into cash (see below).

Conversion Rate

At the end of the experiment, after the X asset value has been determined, your points for the stage that is chosen for payment will be converted to cash on a 2 for 1 basis i.e. each point you hold is worth 50 pence, so if you hold 20 points you will earn £10 etc.

Some Examples

1) If you did not make any sales or purchases during the chosen stage, you will end the experiment with 10 points plus whatever the X was determined to be worth as you will still be holding this. This means you would have a final point total of either 15, 20 or 25 points.

This is your original 17 points, minus one point per round charge for holding the X asset for seven rounds, plus the determined value of X of either 5, 10 or 15 points.

These final point totals convert to either £7.50, £10 or £12.50.

2) If you sold the asset X for 3 points in round 1 and did not buy an asset X in a subsequent round. You would end with 20 points.

This is your original 17 points plus the 3 points from the sale of the asset X.

$17 + 3 = 20$. This would convert to £10.

3) If you sold the asset X in round 3 for 5 points, then bought an asset X for 7 points in round 5, and X was determined to be worth 10 points you would end with 20 points.

This is your original 17 points minus a one point charge for each of rounds 1 and 2 for holding the asset X, plus the 5 points from the sale of X in round 3, minus 7 points for the purchase of X in round 5 minus one point for each of rounds 5,6 and 7 for holding the X, plus the points value of the X asset.

$17 - 2 + 5 - 7 - 3 + 10 = 20$. This would convert to £10

Please now complete the short questionnaire to help us confirm you have understood these instructions.

QUESTIONNAIRE T4 SELLER

1) I must offer the asset X that I hold for sale in each round until it has been sold.

True

False

2) If I sell the asset X, I can buy another in a later round.

True

False

3) What is the fundamental value of asset X in round 4?

4) Suppose you sold an asset X in round 4 for 6 points and bought it again in round 6 for 6 points during the stage that was chosen to count for real. At the end of the experiment it was determined to be worth 10 points, how many points would you have at the end of the experiment?

ANSWERS

1) False

2) True

3) 6 points

4) $17 - 3 + 6 - 6 - 2 = 10 = 22$

Experimental Instructions – Assets 3 Treatment 1 Buyers Instructions
(CFV/NR/BUYER)

You are taking part in an experiment about decision making in a market setting.

Please feel free to raise your hand at any time if there is anything that you do not understand. Please do not talk to your fellow participants.

Duration

There are three identical *stages*, each consisting of seven *rounds*. There are eight participants including you and all participants take part in all stages.

Asset X

The participants in this experiment are allocated the role of either a buyer or a seller. Buyers are given 20 points at the beginning of each new stage and no asset. Sellers are given 10 points and one asset X at the beginning of each new stage.

You are a buyer and therefore have been allocated 20 points.

Asset X is an asset which will be determined to be worth one of three amounts at the end of the experiment (i.e. at the end of the seventh round of the third stage). The possible values of Asset X are: **5, 10 or 15** points. There is an equal (one in three) chance of X being worth each one of these amounts as the value of X is chosen randomly by computer.

This means that on average one could expect the X asset be worth 10 points. This is known as its expected value, calculated by adding all the possible values together and dividing by the number of possible outcomes. $5+10+15=30$ then $30/3=10$. This could also be said to be the fundamental value of the asset although it could be worth more or less than this amount. The fundamental value of the asset is displayed on the screen during the experiment and remains the same throughout.

Task

In each round, you need to decide whether you wish to make an offer to buy an asset X. This applies unless you become an owner of an asset X. The number of assets on offer in each round will depend upon how many of the sellers wish to sell. The price(s) at which the assets are available will depend upon what price the sellers are willing to sell for. As there are 4 participants allocated the seller role, this means that there are potentially 4 asset X's being traded during each stage

You will see a screen displaying any asset X's offered for sale by sellers and the prices asked for them and also any offers made by buyers (including your own should you make one). If you wish to buy an asset X at one of the prices offered, you will have the option to click on it and buy it. Similarly, sellers will have the option to accept any offers made by buyers by clicking on those. Any trades that take place will be displayed upon the screen.

You may only own one asset X in each stage and if you have bought one, you cannot make any further offers for an X for the remainder of that stage. If you buy an asset X you cannot sell it again, it remains yours for the rest of that stage.

It is entirely up to you whether you choose to try to buy an asset X or not. You can offer as many or as few of your points as you like.

Your Payment

At the end of the experiment, the value of X will be determined and one of the three stages will be randomly chosen to count for real. That is to say, you will be paid according to your final currency holdings *for that stage only*.

Your payment will depend firstly on whether you owned an X or not at the end of the last round of the stage that is chosen to count.

If you did not buy an asset X in the chosen stage, your payment will simply be your 20 points converted into cash (see below). If you did own an X, your payment will be made up of the value of that X, plus your remaining points (after purchase of the X asset).

Conversion Rate

At the end of the experiment, after the X asset value has been determined, your points for the stage that is chosen for payment will be converted to cash on a 2 for 1 basis i.e. each point you hold is worth 50 pence, so if you hold 20 points you will earn £10 etc.

Some Examples

If you do not own an X at the end of the chosen stage, you will hold your original 20 points which converts to £10.

If you spent 10 points on an X and it was determined to be worth 15, you would hold 25 points (10 remaining points and 15 from the X) which would convert to £12.50.

If you spent 10 points on an X and it was worth 5, you would hold 15 point which would convert to £7.50.

Please now complete the short questionnaire to help us confirm that you have understood these instructions.

QUESTIONNAIRE TREATMENT 1 BUYER

1) I must make an offer for an X in each round if I don't already own one.

True

False

2) If I buy an asset X, I can offer it for sale in a later round.

True

False

3) What is the fundamental value of X throughout the experiment?

4) If you were to buy an asset X in round 4 for 8 points and it was determined to be worth 10 points at the end of the experiment how many points would you have at the end of the experiment?

ANSWERS

1) False

2) False

3) 10 points

4) $20 - 8 + 10 = 22$

Chapter 3

AN EXPERIMENTAL ATTEMPT TO SEPARATE THE EFFECTS OF ILLUSION OF CONTROL AND FEEDBACK CONDITIONAL REGRET IN DECISION MAKING UNDER UNCERTAINTY

1. Introduction

This chapter reports the findings of an experiment which separates the effects of feedback conditional regret (FCR) from those of the illusion of control (IOC) during a decision making task. Its novelty lies in the combining of the research into these two distinct, but possibly related areas, whilst extending and refining some previous work as necessary. In particular, it explores the possibility that these phenomena manifest themselves in an observed reluctance to exchange or to sell lottery tickets.

Experimental studies have identified a reluctance on behalf of participants to exchange a lottery ticket for a seemingly identical one. Frequently, experimental participants have shown themselves to be unwilling to part with a ticket in exchange for another, even with the offer of a small incentive (Bar Hillel and Neter 1996). Postulated explanations include loss aversion, feedback conditional regret (FCR) and illusion of control (IOC). The latter two explanations are explored in the experiment reported here whilst controlling for loss aversion in the experimental design.

FCR specifically compares the impact of regret felt when one learns of the outcome of forgone choices with that felt when one does not have the opportunity to learn what might have been (e.g. Zeelenberg et al 1996). Lottery tickets have been used (Humphrey et al 2005) in order to explore how the possibility of experiencing FCR will impact upon decision making.

The illusion of control has a large literature in the field of psychology and describes the belief that we hold some kind of power over outcomes or, by some

interpretations, that we falsely overrate our chances of success under some circumstances. In particular it has been shown that a subject may be more reluctant to sell a lottery ticket when they have played a role in its selection (Langer 1975).

Loss aversion could provide an alternative explanation for the phenomenon, if one assumes that participants in experiments view the displeasure at an outcome where they sell/exchange a ticket that goes on to win as greater than the pleasure they would experience if they exchanged and subsequently won with their new ticket.

The experiment reported here uses the lottery ticket format to test for both of these effects separately and identifies which may have the larger impact on decision making. There is also the opportunity to observe the impact on decisions when the conditions necessary for both IOC and FCR exist together. Loss aversion is controlled for in the experimental design.

The chapter begins by giving a summary of feedback-conditional regret theory's foundations before reviewing the relevant literature on the illusion of control which has its origins mostly in the field of psychology. Alternative and possibly relevant theoretical and experimental work is briefly summarised before three key, motivating papers are presented as a background to the design and execution of the experiment. The results from the experiment show strong evidence of behaviour consistent with the experience of feedback conditional regret amongst subjects. Weaker evidence for IOC is also found. Explanations for the results and feasible reasons for the absence of strong IOC effects are then discussed, together with considerations of the experimental results' implications for economic theory and the experiment's external validity.

Literature review

2. Feedback Conditional Regret

Expected utility theory in its basic form describes how decision makers choose between risky or uncertain prospects by weighting the utility of each outcome and multiplying the weights by probabilities of their occurrence. Von Neumann and Morgenstern (1944) defined the preference axioms of completeness, transitivity, continuity, reflexivity, independence and monotonicity to construct a utility function

over lotteries. A great deal of theoretical and experimental work has been devoted to investigating how people's decisions may deviate from those predicted by EUT.

Feedback conditional regret has been investigated, both theoretically and experimentally. The building blocks were laid in the Regret Theory of Loomes and Sugden (1982), who describe the regret one can experience when one learns, not only of the outcome of a chosen path, but also the outcome of choices forgone, the path or paths we did not choose

2.1 Regret Theory

Although Savage (1951) utilised the notion of regret in his work on the Minimax principle, where individuals make decisions in order to minimise the maximum amount of regret experienceable, it was Loomes and Sugden (1982) (also Bell 1982) who formalised regret theory. In contrast to purely prospect based theories the value of one choice is also dependent on what is rejected. As stated by its authors (Loomes and Sugden, 1982, p820)

“Regret theory rests on two fundamental assumptions: first, that many people experience the sensations we call regret and rejoicing; and second that in making decisions under uncertainty they try to anticipate and take account of those sensations”. Regret theory's novelty lay in the idea that people factored the potential emotion of regret (or rejoicing) into their decisions. The authors of regret theory considered it consistent with rational behaviour on the grounds that it is rational to wish that one had made a different choice if things turn out badly.

In contrast to EUT regret theory comprises a choiceless utility function in that the utility derived from the outcome is independent from the means of its occurrence.

This gives rise to a modified utility function 'M' which is a function of both the outcome chosen but also the outcome foregone. Regret occurs when a higher level of utility would have been reached had a different decision been made. The natural

counterpart of regret, rejoicing, is experienced when one discovers that one would have been worse off with a different decision.

The following outline of the original theory is a modified description of that given in Humphrey (2004, p841-2) (which in turn was taken from Loomes and Sugden [1982]) as I will be describing his extension to the theory in a moment. The Loomes and Sugden model implicitly assumes that the outcomes of options not chosen are revealed.

There are n possible states of the world S_1, \dots, S_n, S_j may occur with probability p_j (where $\sum p_j = 1$).

There is a set X of conceivable consequences. An action is a list of n consequences, one for each state of the world. So action $A_i = (x_{i1}, \dots, x_{in})$ yields consequence x_{ij} if state of the world S_j occurs. In choosing between two actions A_i and A_k , if A_i is chosen and state of the world S_j occurs, then x_{ij} is experienced and x_{ik} is forgone. The *modified utility* received is $M(x_{ij}, x_{kj})$. If $x_{kj} > x_{ij}$ then M will include the effects of regret. If $x_{ij} < x_{kj}$ then M will include the effects of rejoicing. So the decision is determined by:

$$\begin{array}{ccc}
 \phi & & > \\
 A_i \sim A_k & \Leftrightarrow & \sum_{j=1}^n p_j M(x_{ij}, x_{kj}) = \sum_{j=1}^n p_j M(x_{kj}, x_{ij}) \\
 \pi & & <
 \end{array}$$

Using an anticipated net advantage function $\varphi(x_i, x_j) \equiv M(x_i, x_j) - M(x_j, x_i)$ this can be rewritten as

$$\begin{array}{rcl}
\phi & & > \\
A_i \sim A_k & \Leftrightarrow & \sum_{j=1}^n p_j \varphi(x_{ij}, x_{kj}) = 0 \\
\pi & & <
\end{array}$$

This function is subject to three restrictions:

1) Skew-Symmetry:

For all x, y $\phi(x, y) = -\phi(y, x)$

Where x and y are consequences;

2) Increasingness:

For any x, y, z , $\phi(x, z) \geq \phi(y, z) \Leftrightarrow x \succ y$

The better x is and the worse y is the more rejoicing the experiencing of x will bring;

3) Regret-Aversion (convexity):

For any x, y, z where $x > y > z$, $\phi(x, z) > \phi(x, y) + \phi(y, z)$

A disproportionate aversion to large regrets.

Experimental investigations of original regret theory where feedback on forgone choices is given have had mixed success in their explanation of EUT violations.

Loomes, Starmer and Sugden (1991) produced experimental evidence of inconsistencies in decision making that violated the transitivity axiom and Loomes, Starmer and Sugden (1992) produced experimental violations of monotonicity. However, Starmer and Sugden (1993) explored event splitting effects as an alternative to juxtaposition effects (where choices are affected by their positioning in pay-off matrices) and found evidence that experimental violations of transitivity could be explained by the manner in which events were presented to subjects rather than regret aversion.

2.2 Other research incorporating regret

Less formal models than regret theory have been the basis for, or included in, a significant amount of theoretical and experimental work. Many of these have shown evidence that some form of regret influences decision making.

Akin to the notion of risk aversion is the idea that people experience differing levels of regret aversion. Larrick and Boles (1995) attempted to measure this experimentally by comparing the levels of risk aversion in an experiment where the outcome of the non-chosen option would be revealed with a treatment in which it would not. They stated the difference to be a measure of 'regret aversion' and found a 10% regret premium (as labelled by Bell 1983) to exist. They also point out that in a typical choice between a gamble and a certainty if one opts for the certainty one is protected from regret as the gamble will not be played out. However in playing the gamble, the option foregone (the certainty) is known; hence, to protect oneself from regret, one must opt for the sure thing.

. Uncertainty aversion is a recognised experimental phenomenon and Kraemer and Stone (2010) present it as being based in a fear of regret. The decision making process is distorted as agents display an aversion to alternatives that provide feedback irrespective of choices when compared to alternatives that provide feedback only of chosen paths.

2.3. Anticipated Regret

Anticipatory not retrospective regret is key to regret theory and causes both risk and regret aversion. Although regret is experienced *ex post* it affects decisions *ex ante*. Supposedly (reminiscent of rational expectations) any factors that one considers may affect ones feelings of regret after an outcome has occurred should be taken account of in ones' decisions. Clearly, as this is a subjective process we may over or under estimate the impact of these factors on the regret that we actually experience at the outcome. Also, because of its subjective nature it has been shown that inducing anticipated regret by pointing out the possibility of regretting a decision has been shown to be sufficient to alter decisions (e.g. Simonson 1992). Zeelenberg (1999) supports the aforementioned results of Larrick and Boles and also his own previous research that found both risk averse and risk-seeking behaviour could be motivated by the desire to regret minimise. Hayashi (2008) creates a model where decisions makers are faced with choices that may or may not have full outcome resolution in order to investigate the impact of anticipated regret. The model shows that choice may be affected by foregone alternatives, how discarded choices may impact upon remaining ones. Anticipated regret is given as the cause of the endowment effect and in turn WTP/WTA disparities in Zhang and Fishbach (2005). They explain disparities in WTP and WTA in terms of regret aversion where buyers want to minimise any regret from paying too much so may underestimate their true value and sellers wish to minimise regret from not asking enough and therefore may overshoot their true value. They conducted three studies which all led them to conclude that stated prices could be manipulated by varying the opportunities for experiencing negative emotions (i.e. regret).

Coricelli et al (2005) conducted a study using neuroimaging to measure brain activity in subjects faced with choices that could result in regret. They found effects to be cumulative, regret aversion increased with repetition and also that both regret and its anticipation appeared to use the same parts of the brain. This would indicate that people do imagine experiencing the emotion of regret during decision making.

2.4 The Role of Self Agency

Regret theory has motivated numerous studies into factors which are likely to intensify the experience of regret. One key finding has been that the emotion of regret appears to grow more intense the more responsibility an individual feels for the negative outcome. Sugden (1985, p78-9) clarifies regret as containing two distinct components; the wish that you had chosen differently and self-blame for the action chosen. However if the anticipation of self-recrimination is incorporated into decisions, Sugden no longer maintains that it is a theory of rational choice.

This idea of the intensity of regret being a function of the amount of responsibility felt has been explored quite extensively and appears very robust (e.g. Fridja et al 1989, Gilovich and Medvech, 1994). Although Connolly et al (1997) found this was not supported empirically Zeelenberg et al (1998b) disagreed with this research on the grounds that they had chosen to measure happiness at outcomes rather than regret and provides a convincing criticism and counter evidence to support a relationship between the two. This can be seen to be related to omission bias as people are reluctant to be the instrument of the negative outcome. Ritov and Baron (1995) found that a negative outcome is viewed as worse if it resulted from action rather than inaction. In their decision justification theory (DJT) Connolly and Zeelenberg (2002) posit that the important thing is to be able to justify the choice made ex post. This is again the idea of the opportunity for self-recrimination being a determinant of the intensity of regret that one experiences. DJT is not strictly anticipatory but if one is aware of how easy or difficult it will be to justify ones decision ex post and factor that in to the decision ex ante then DJT could help to explain behavioural violations of standard theory.

2.5. Regret and Disappointment

Marcatto and Ferrante (2008) created a regret and disappointment scale (RDS) with which to distinguish between the two emotions in an experimental setting. Their

experiment compared the subjective evaluations of participants of their own experiences of regret and/or disappointment using direct questions with a more indirect series of questions aimed at uncovering their true underlying emotions. It seemed participants were poor at evaluating which of the emotions they were experiencing. Kraemer and Stone (2010) conclude that regret and disappointment may interact with each other, if this is the case, it may be a difficult task to separate the two in an experimental setting.

The work by Connolly et al (1997) was thought by Zeelenberg et al (1998b) to have confounded the emotions of regret and disappointment and he argued further that measuring happiness alone told one nothing about either emotion.

It appears there are some difficulties in distinguishing between the superficially similar emotions of regret and disappointment. A neat definition of the two is given in Landman (1993 p47) “The child is *disappointed* when the tooth fairy forgets his third lost tooth. The child’s parents *regret* the lapse.”

Interestingly, Zeelenberg (1998a, p224) reports a study by Roseman et al 1994 which he summarises as concluding that “...the experience of regret involves a focus on the self as a cause of the event, and on possibilities for undoing the regret by changing the unfavourable outcome or by improving future performance.” And he qualifies disappointment as giving people “...the feeling that they are not always able to control their own destiny, and that they perceive a lack of control. Moreover, and in contrast to the experience of regret, one should feel less responsible for causing the event.” So according to Zeelenberg regret is caused by feelings of responsibility and disappointment by outcomes failing to live up to expectations. Hence, according to Zeelenberg self-recrimination defines more than merely characterizes regret and is absent from disappointment. Although regret relates to actions chosen and disappointment to states of the world both emotions are experienced through counterfactual thought; imagining what might have been (Zeelenberg et al 1998c). Fridja et al (1989) also find that self-blame is more likely to cause regret than disappointment.

2.6 Feedback-Conditional Regret (FCR)

The original regret theory did not specifically test for the impact of feedback either on decision- making or on the depth of regret. Rather, feedback was given on both choices selected and those forgone. Work exploring feedback conditional regret studies the influence that varying feedback conditions may have upon decision making.

Although it is arguable that feedback is something of a necessary condition for the experience of regret, imagined outcomes also can play a role (e.g. Sugden 1985, Kahneman and Miller 1986). It is certainly considered by Kahneman (1995 p392) who asks readers to imagine a decision-maker facing two gambles;

“Both gambles will be played out but the decision maker will know only the outcome of the gamble chosen. Will the effects of regret vanish completely? The answer to this question is not yet known, but I suspect that it will be negative....An intriguing possibility is that the evaluation of options is not constrained by what the decision maker expects to be knowable. Thus, options may be avoided because their outcomes are likely to be regrettable even if they are not in fact likely to be regretted.”

However this is typically assumed (e.g. by Zeelenberg 1996) to be a much less important factor in the decision process than real feedback. Larrick (1993 p446) makes the distinction;

“Feedback about what definitely would have occurred produces a greater potential for regret than pallid, abstract knowledge of what was statistically likely to occur”

Faced with a pairwise choice problem, subjects who choose one option may or may not discover whether they would have been better off had they chosen another option. A subject who chooses a certain £10 over a 10% chance of £100 who knows he will not discover what would have happened had he chosen the gamble would be protected against any regret. If he knows that the gamble will be played out whatever option he chooses, he must weigh up the potential regret of foregoing the certainty and losing the gamble against taking the certainty and discovering that he would have won the £100 in the gamble. Because of this asymmetry of feedback Zeelenberg et al (1996) looked at the impact of feedback on regret in risky choices where not only the certainty option was resolved but the risky option would be

played out too. They hypothesized that people are regret rather than risk averse and found that regret can affect risk behaviour, causing either apparently risk seeking or risk averse behaviour depending on the option that minimises potential regret. They manipulated feedback so that in some treatments feedback was given on the safe option and in others it was given on the risky option. They found that people tended to select the option on which there would be feedback.

Humphrey (2004, p845-6) extends original regret theory to more explicitly state the importance of foregone act resolution thus formalising Zeelenberg's view of its importance. The typical layout of a pairwise choice experiment using lottery tickets and an act/event matrix display might be something like that shown below.

A	1-30	31-80	81-100
	£20	£10	£0
	30%	50%	20%
B	1-45	46-70	71-100
	£20	£10	£0
	45%	25%	30%

In choice A if any of numbers 1-30 are drawn one would receive £20; £10 for numbers 31-80 and £0 for numbers 81-100. So if one chooses A and number 35 is drawn one can regret not choosing B and if 75 is drawn one can rejoice at not choosing B. It can be seen that this design resolves both the chosen and not chosen paths because the matrix provides full feedback. The subject finds out the number of his lottery ticket, and so knows which state has occurred.

By contrast, in Humphrey's Matrix Example (table 1) with the subject choosing between the \$ and the P bet, the subject finds out only his payoff and has to try to infer the state of the world from this.

Acts in a standard triple				
Act	Probability of state of the world			
	p1 (blue)	p2 (yellow)	p3 (green)	p4(red)
\$	a	a	d	d
P	b	e	b	e
C	c	c	c	c

Where $a > b > c > d \geq e$ and are money consequences

Source: Humphrey, S. (2004). 'Feedback-Conditional Regret Theory and Testing Regret Aversion in Risky Choice', *Journal of Economic Psychology*, 25, p843

If $p1 + p3 > 1/2 > p1 + p4$ then P becomes the P bet and \$ the \$ bet as defined in the preference reversal phenomenon⁶.

Here, the outcome of one's decision does not reveal which state of the world occurred and could leave a slightly ambiguous emotional reaction. For example with the choice of act \$ over P resulting in the occurrence of outcome **d**, does one regret at foregoing b under the green state of the world or rejoice at foregoing e in the red state of the world?

Because of the ambiguity, in his feedback conditional regret theory Humphrey adds the following restrictions to those of original regret theory. : In Humphrey's theory, there are two different modified utility functions, $m(x, y)$ and $\mu(x, y)$, where $m(x, y)$ is the modified anticipated utility of having x and foregoing y when outcome x fully reveals which state of the world occurred and $\mu(x, y)$ is the modified anticipated utility of having x and foregoing y when outcome x does not fully reveal which state of the world occurred.

⁶ This preference reversal phenomenon as described by Grether and Plott (1979) is clearly illustrated by the classic example of the P bet and \$bet. The P bet describes a gamble with a decent chance of winning a modest prize and the \$ bet a smaller chance of a more substantial prize. It has been shown that there is a tendency for subjects to choose the P bet over the \$ bet in a straight choice but to place a higher monetary value upon the \$ bet than the P bet.

4) For all x, y such that $x > y : m(x, y) > \mu(x, y)$

When outcome x fully reveals the state of the world then the rejoicing upon receiving x and not y will be greater than if x did not fully reveal the state of the world.

5) For all x, y such that $x > y : m(y, x) < \mu(y, x)$

Regret will be lessened when y is attained and y does not fully reveal the state of the world.

6) For all x, y such that $x > y : \mu(y, x) - m(y, x) > m(x, y) - \mu(x, y)$

The impact of foregone act resolution upon regret is greater than upon rejoicing.

This follows from the observations of e.g. Larrick and Boles (1995).

Implicit in this revision of regret theory is the assertion that previous research may have overstated the certainty effect. Regret aversion causes a bias towards the certainty in choices where the choosing of the safer option does not lead to the revealing of outcomes of riskier options. Thus a requirement for foregone act resolution in all choices would help to end the confounding of risk and regret aversion as identified in Zeelenberg (1999).

If FCR impacts upon decisions ex ante then it could well be expected to manifest itself in a reluctance to place oneself in a situation such as having swapped a lottery ticket for another, or to have sold a lottery ticket with a potentially high

pay-out for a small cash sum if the lottery is then to be played out with one's original ticket included in the draw. Thus, by not selling or swapping one's original ticket, one is protected from the experience of FCR as one would not have known which ticket one would have received in exchange, or could only regret the loss of a small sum of money in the case of passing up the opportunity to sell one's ticket.

3. Control and the Illusion of Control (IOC)

Perception of control is said to be important for psychological well-being. One's 'locus of control' is defined as internal if one feels that events are a result of one's own actions and external if one feels that events are in the control of some external force such as luck (Marsh & Weary, 1995). Marsh and Weary concluded that an internal locus of control increases a person's expectation of success following success and decreases them following failure and an external locus decreases one's expectation of success following success and increased expectations following failure. Seligman (1975) defines an event as controllable when a person's voluntary responses have an impact on the consequences of that event and uncontrollable when no voluntary response has an impact on the event. He concludes that a consequence of feeling out of control is inaction. Control is also the central theme of Bandura's (1977) self-efficacy theory which concerns how individuals' expectations impact upon the goals they set for themselves. If they believe they have control over events sufficient to allow them to achieve something they will strive to do so e.g. passing a test.

There can be a tendency for this perception of control to become illusory when the belief in one's abilities to control outcomes is unfounded. Ellen Langer (1975) ran a series of psychological experiments to highlight a behavioural phenomenon which she labelled the 'illusion of control' (IOC). Defined by Langer (1975 p311) as "an expectancy of a personal success probability inappropriately higher than the objective probability would warrant", this effect was clearly illustrated in one experiment where it was shown that people placed a significantly higher value on a lottery ticket which they had selected themselves than on one

which they were allocated (on average there was a four-fold difference). This involvement effect was also found by others (Wortman 1975, Benassi et al 1981). The behaviour was found to be amplified by skill cues such as this involvement but also familiarity, choice and competition.

There has been some debate in the psychological literature as to whether the Illusion of Control is the most appropriate label for the phenomenon. An extensive meta-analytic review of experiments investigating the illusion of control was carried out by Presson and Benassi (1996) and they concluded that across all 53 experiments included in their study there was a strong illusion of control effect but they question whether the illusion is of control or judgement. As posited by Koehler et al (1994) it may be that individuals overrate their chances of success without actually believing they control the outcome. They found that the illusion of control could be shattered by repetition when multi-shot experiments were reported to quash the IOC by Koehler et al and Bersabe and Arias (2000). Although Langer herself found that in a repeated coin toss game, IOC increased rather than diminished if subjects were doing well (Langer and Roth 1975). In psychological investigation it has been found that IOC can be adaptive; depressives are less likely to exhibit a tendency towards IOC, showing it to be a kind of (albeit unrealistic) positive thinking which can be a positive attribute (Taylor and Brown 1988). However IOC has been used to explain some behaviour seen in financial markets where it is shown to be maladaptive. Fenton-O'Creevey et al (2003) found that financial markets provided fertile ground for IOC and that trader performance was inversely related to their propensity for it. There has also been identified on trading floors a tendency towards overconfidence or, further, even 'magical thinking'. Magical thinking is a phenomenon where people believe they have power to influence an outcome when they do not, a behaviour that has even been observed amongst pigeons⁷. Quasi-magical thinking, as defined by Shafir and Tversky (1992), describes situations in which people act as if they believe that their actions can influence an outcome (as with magical thinking)

⁷ In a classic experiment Skinner (1948) fed hungry pigeons small quantities of food at regular intervals with no dependence whatsoever on the bird's behaviour. Even though the feeding was not related to their behaviour, the birds began to behave as if they had a "superstition" that something they were doing was causing the feeding. Each pigeon apparently conditioned itself to perform a certain action to get the food such as turning around or head-tossing.

but in which they in fact do not truly believe this. Quasi-magical thinking appears to manifest more strongly in predicting outcomes of future, rather than reflecting on past events. By Langer's definition, it would appear that what differentiates the IOC from magical thinking is that it specifically relates to a belief in an increased probability of success not only in a belief in the ability to control outcomes. Hence it appears that magical thinking is a broader term and the Illusion of control may perhaps be a particular form of it. More recently Koszegi (2006) modelled 'ego utility' where an individual derives satisfaction from believing he is good at a particular task or activity and may overrate his skills as a result.

Langer's IOC is of interest to those studying the behaviour of gamblers. It has been shown repeatedly that skill is falsely attributed to chance situations. A clear example given by Langer (1975) is in casinos where it has been observed that craps players throw the die harder in the hope of generating higher numbers. Sports locker rooms are known to be bursting with superstitious behaviour as players go through their pre-match rituals in an attempt to influence the outcome of a game. This is also repeated behaviour; in fact it probably increases over time if it appears to work (like the coin toss in Langer [1975]) where if one wins it will be attributed to the correct ritual being followed but if something goes wrong, it will be questioned whether it was because something was done differently this time. It is not that their actions do not affect the outcome (i.e. running faster) it is merely that there is no direct causality between say, putting one's left shoe on first and winning a race. Langer and Roth (1975) found that people place larger bets before a coin is tossed than after (where the outcome has been concealed), as if they think that they can influence the outcome of the toss. I would question whether if people are willing to bet more on an untossed coin than on one that has been tossed but the outcome not revealed this is truly indicative of IOC. Do people believe they have an increased chance or does the greater excitement offered by the untossed coin induce higher bets (especially if the toss were to be watched)?

Goodman and Irwin (2006) investigated preferences for certain numbers generated by familiar systems such as dates or names and found them to exist along with preferences for systems such as horoscopes that, whilst not necessarily being believed in, create enjoyment and are therefore preferred over systems without such positive associations. Interestingly they feel that anticipated regret can be modified

by this enjoyment or a belief in fate (lack of control) as if subject's enjoyment of participating in the task makes up for any potential loss

The illusion of control and/or magical thinking operate on decision making *ex ante* but it is worth noting that there is a kind of illusory behaviour often displayed *ex post*. A fairly robust psychological finding is that individuals strive to avoid cognitive dissonance (conflicting thoughts) and will therefore tend to justify present and past decisions even in the face of evidence that the decision was wrong. The well-known psychological state of 'denial' is a prime example of this cognitive dissonance.

Goetzmann and Peles (1993) have offered this as an explanation as to why investors in losing funds are unwilling to confront the evidence that they made a bad investment by selling their investments. Zeelenberg (1999) compares post decisional dissonance with anticipated regret and whilst the line between the two is not sharply defined, he identifies the difference as lying in regret pertaining to the comparison of what is and what might have been and post decisional dissonance being able to arise merely out of what is. The aforementioned model by Hayashi (2008) shows how a decision maker may choose differently between choices that remain once some have been discarded than they would have done when all the choices were still on the table. In a similar vein to cognitive dissonance and offering one explanation for status quo bias is self-perception theory (Samuelson and Zeckhauser, 1988) This is the notion that, having made a decision (and therefore revealed ones preference to oneself where preferences are uncertain) one is more likely to adhere to that choice in the future thereby maintaining the status quo.

As this work is built upon psychological rather than economic foundations, its relevance to economics may not be immediately apparent but there are clear implications for theories of rational choice in economics. For example if, as found by Langer, the value one places on something is dramatically increased by the fact that one has engaged in some cognitive process in order to select it, this presents a challenge to the traditional definition of rational economic behaviour.

If an individual's expectation as to the chance of winning in a lottery can be manipulated by altering the level of involvement he feels in the process that has led

to his endowment with a particular ticket, then this could help to explain the reluctance to exchange or sell a ticket. An overinflated belief in the ticket's chance of success could be brought about by allowing subjects in an experiment to select their own ticket or perhaps more so by engaging them in a task in order to determine which ticket they will receive. If Langer is correct, the more involved subjects feel in the ticket selection process, the less willing they ought to be to subsequently part with the ticket.

4. Loss Aversion, Endowment effects and WTA/WTP

Prospect theory (Kahneman and Tversky 1979) describes how individuals evaluate losses and gains starting from a reference point. The central assumption of the theory is that people are loss averse; more specifically, that losses are felt more keenly than gains. Prospect theory allows for people's expected utility to be dependent on the way in which they frame the choices they face in their minds. This is because prospect theory replaced the utility function of EUT with a value function that is concave for gains and convex for losses. This means that the value function in prospect theory differs from the utility function in expected utility theory in a very important respect; it has a kink in it at the "reference point", the location of which is determined subjectively by the individual. The important feature of prospect theory here is the inclusion of a probability weighting function that means individuals tend to over-weight outcomes with very low probabilities. Attitudes towards risk and (pertinently) activities such as the purchase of lottery tickets can be explained by this. The chances of winning something like a national lottery with a minute probability of winning, if framed by advertisers and by consumers themselves as merely improbable, will be overestimated according to the theory and would explain why people pay in excess of the lottery's expected value for a ticket.

The assumption of rationality in economic theory traditionally means that people hold a fixed and known value for all goods and this is inalterable by framing or other such psychological effects. Endowment effects have often been held responsible for violations of rationality in the choices people make. An endowment effect is said to exist if people are more unwilling to part with, or place a higher value upon, a good that forms part of their endowment than one that does not. According to prospect theory, this is said to be because they view the loss of a good

from an endowment as more painful than a foregone gain (which therefore attracts a lesser value). Extensive research has been devoted to the unravelling of this robust finding (e.g., Knetsch 1989, Kahneman, Knetsch and Thaler 1990) and explanations have included Status quo bias (e.g. Samuelson and ZeckHauser 1988), where people are simply reluctant to alter their current position, or the closely related omission bias (e.g. Ritov and Baron, 1992, 1995) where, because it is easier (less costly) not to act than to act, people are more likely to stick with what they have.

Related to endowment effects is the willingness to pay, willingness to accept (WTP/WTA) disparity that has attracted a lot of interest from experimental economists (e.g. Knetsch and Sinden 1984, Coursey, Hovis and Schulze 1987). This is the phenomenon that when asked to place a value on a good (in many cases a public good) there is a strong tendency for people to place a higher value on a good when asked what they would be willing to accept in order to forego it than when asked what they would be willing to pay for the same good. Endowment effects and status-quo bias are amongst explanations given for this violation of EUT theory.

The reluctance to part with lottery tickets could perhaps be attributed to a simple endowment effect; because they view a ticket they are given as 'theirs' people form some sort of attachment to it and view their ticket differently to even an apparently identical one.

It could be that when asked what they would be willing to accept in order to part with a lottery ticket for a sum of cash, that participants in experiments have a tendency to value the ticket more highly than if they were asked what they would be willing to pay for one. This is not so much a possible explanation of the reluctance to swap or sell a ticket as a

Loss aversion may underlie endowment effects and the WTA/WTP disparity. If the potential loss felt if one were to exchange or sell a winning ticket (the prize forgone) is viewed as greater in magnitude than the commensurate gain would be if one exchanged or sold an won, then loss aversion might explain the observed reluctance

5. Motivation for the Experiment – three papers

The experiment reported in this chapter has been partially motivated by three papers in particular, the relevant parts of which I will summarise as a background to its design.

‘The Illusion of Control’ – Ellen Langer 1975

Ellen Langer conducted several experiments in order to identify factors which may induce the illusion of control. The most germane here being her choice experiments where a purchased lottery ticket was either given to or chosen by office workers before they were given the option (on a pretext) of selling it back. The tickets took the form of football cards, one of which was selected by participants in the choice condition with an identical card then allocated to a participant in the no choice condition. The mean selling price in the choice condition was \$8.67 and \$1.96 in the no choice for a \$1 lottery ticket.

In the same paper Langer investigated the role of familiarity. She compared preferences between lottery tickets bearing letters with those bearing unfamiliar esoteric symbols. It was found that the reluctance to swap was significantly stronger in the treatment with familiar letters than with the unfamiliar symbols which Langer concluded was attributable to the illusion of control.

She found that passive involvement was a factor in increased illusion of control. The illusion of an increased probability of success in a chance task could be induced by increased time spent dwelling on it. Langer ran a field experiment at a racetrack where the entrance fee paid to attend a race evening entitled race-goers to entry in a lottery. During the course of the evening, at various points in time, race-goers were asked to rate their confidence in their chance of winning the lottery. This was found to increase significantly as the evening wore on. In a subsequent experiment, this result was retested using a lottery amongst office workers divided into high and low involvement conditions. Participants in both conditions were given a three digit number as their entry into the lottery. In the high involvement condition this number was given out one digit at a time over three days and in the low involvement condition it was given in one go. Reluctance to exchange their

entry in the original lottery for entry into one with better odds was significantly greater in the group that had been given their number over three days. She also found a sense of competition and also response familiarity increased IOC. The central finding was that a purely chance task that mimics a skill task will induce the same behaviours in participants as if they truly had some control over the outcome.

Fong and McCabe (1999) were critical of Langer's use of football cards and other lotteries which allowed subjects to choose numbered tickets. In such studies it is hard to separate those who place a higher value on their ticket because it represents their favourite football player or lucky number from those who value it more highly because of their involvement in its selection. In either case it is difficult to know whether this involvement really translates into a higher subjective probability of winning or not. Is there just an issue of attachment rather than control? A preference for certain players, familiar symbols over unfamiliar ones does not necessarily equate to inflated belief in chances of success. Only the racetrack experiment asked about confidence in winning and it is hard to believe that in this field study, other factors (such as alcohol consumption or the early departure of those who had lost the most, leaving only the more confident winners) as the evening wore on were being controlled for.

'Why Are People Reluctant to Exchange Lottery Tickets?' – Maya Bar-Hilell and Efrat Neter 1996

Bar-Hilell and Neter (1996) ran a series of experiments to investigate people's reluctance to part with lottery tickets. Building on previous research (e.g. Knetsch and Sinden 1984) which showed a reluctance to exchange tickets for a lottery for cash they aimed to compare attitudes towards exchanging lottery tickets for other tickets with those of exchanging pens for pens. They found that people were indeed reluctant to exchange their ticket for another (plus a small incentive) but displayed no such reluctance when endowed with a pen and offered the chance to exchange it for another pen plus the same small incentive. They conclude that loss aversion could explain this state of affairs. If one gives up a ticket for another and one's original ticket goes on to win this is viewed as a loss, more so than a ticket exchanged for a winning one would be viewed as a gain.

Illusion of control was investigated in their first experiment where lottery tickets were distributed and subjects wrote their names on them before answering a series of questions. Were they willing to exchange for another ticket plus a sweet? Did they feel the ticket they held had a higher, equal or lower chance of winning than any other? Why were they willing or unwilling to exchange? They found little evidence of the illusion of control, people did not appear to believe that their tickets had a greater chance of winning, though a variety of reasons (fate, lucky numbers) were put forward to explain the reluctance to swap tickets. The effect of regret on the willingness to exchange was tested in a further two experiments. Lotteries were conducted where, in different treatments, participants either discovered the consequences of exchanging their ticket or did not and this outcome resolution was either public or private. In non-resolution treatments, exchanged tickets were removed from the draw altogether and replaced with others so no resolution was possible but the probability of winning remained the same. To their surprise, the authors found that uncertainty resolution had little impact on exchange decisions and that having the outcome of participants' decisions made public actually increased the numbers who were willing to exchange. They concluded that the anticipated regret of not winning when one has exchanged a ticket that could have been the winning one is the most feasible motivation for exchange reluctance which is unaffected by uncertainty resolution and therefore the imagined outcome is as strong a force as the real one. They found no effects from framing or the writing of a subjects name on a ticket.

A central question arising from their findings is what it is about the nature of lottery tickets that makes them be viewed so differently from pens. Bar-Hilell and Neter believe it is the potential *ex post* differences between lottery tickets that distinguish them from pens. Although lottery tickets represent identical gambles they may represent very different states of the world (if you exchange a pen for a pen, you get a pen). It is this difference that allows the mechanism of anticipated regret to affect the decision to exchange. As in the aforementioned studies, regret at an action taken can be expected to be greater than that caused by inaction.

It is worth the additional mention here of an experiment run by Ven and Zeelenberg (2011) which extended the Bar-Hilell and Neter study to specifically test for the effect of anticipated regret. Lottery tickets offered to participants in some

treatments were in sealed envelopes and participants were shown to be significantly more willing to exchange these tickets than those not in envelopes. The tickets that they could never know the numbers were exchanged more readily as participants were protected from the regret of finding out they went on to win having been exchanged.

Testing for Feedback-Conditional Regret Effects Using a Natural Lottery - Steven J Humphrey, Paul Mann and Chris Starmer 2005

Humphrey et al conducted an experiment specifically to test for the effect of feedback conditional regret on the decision to exchange a lottery ticket for cash. They used national lottery scratch cards as the medium. In this simple, one shot experiment subjects were allocated a scratch card and then offered the opportunity to sell it back to the experimenter (for up to £1.50). In one treatment they were to find out the outcome if the card was sold and in another they were not. As expected, the opportunity for regret in former caused a greater reluctance to part with the ticket and elicited a higher price than in the latter treatment. The difference between the two treatments was strongly significant; at the top offer price of £1.50 41.4% of subjects in the regret treatment and 16% in the no regret treatment chose to keep the card. If this is a replicable result, it would appear that the regret premium measured by Larrick and Boles at 10% could be something of an underestimate.

6. The Experiment

6.1 Experimental Design

The experiment reported here uses lottery scratch cards in a similar manner to that of Humphrey et al, but with additional treatments designed to isolate IOC effects. It investigates the impact of feedback-conditional regret on decisions in a similar way to their scratch card experiment, but includes two treatments designed to consider the impact of the illusion of control on the same decision. There are two treatments with full resolution and two with resolution of the gamble, only if it is chosen.

I wished to extend the scope of the Humphrey et al experiment to include the opportunity to distinguish between the illusion of control and FCR as reasons for reluctance to exchange a lottery ticket for cash. Although I prefer the medium of a national lottery scratch card to do this, I also aim to reproduce the elicitation of the illusion of control and anticipated regret in the Bar-Hillel paper, albeit in a different fashion.

The illusion of control was induced by asking subjects to choose their own scratch card from one of four sealed coloured envelopes. The aim of this was to maintain the required feeling of involvement whilst avoiding the potential confusion of preferences for lucky numbers (as the in Bar-Hillel and Neter experiments) or objects that subjects may have strong feelings about (such as football cards in Langer) so subjects should feel similarly involved to each other in the choice. Whilst some of the intensity of the illusion of control displayed by say, a football fan in Langer's experiment may be lost, the use of coloured envelopes should equalise the strength of preferences across subjects. There is a little more time spent thinking about the task in these treatments which will only increase the feelings of involvement over the non-envelope treatments.

The opportunity to experience FCR was also required in two of the treatments. Subjects were divided in to two groups of 'buyers' and 'sellers' (though the more neutral terms of 'cashholders' and 'cardholders' were used during the experiment) where buyers were given an amount of cash with which to bid for a scratch card in one auction and sellers were given a card and asked to select a minimum cash amount that they would sell it for in a separate auction. The central purpose of this dual auction design was to make the potential feedback conditional regret in some treatments more salient as the seller of the card in the regret treatments (i.e. the person willing to accept the least cash for his card) would be asked to cross the room and physically give the winner his scratch card as well as witnessing the card being scratched. Any winnings would obviously belong to the buyer of the card.

The fact that scratch cards are a familiar commodity to most subjects (this was verified in the experiment) gives an opportunity for the experience of the illusion of control in the envelope choice treatments and perhaps their use renders

the experiment less of an artificial task than some and improves its external validity. For clarity, verbal instructions were also given.

The experiment takes the form of a between subject, 2 X 2 factorial design and the treatments are as follows;

Treatment 1 - Neither IOC nor FCR

Subjects in the sellers group were given a scratch card at random and offered the chance to sell it (for a price between 10p and £5). They were asked to complete a table of incremental amounts, ticking all of those that they would be willing to accept for their card. They were instructed that they needed to be consistent e.g they could not indicate that they would accept £1 and £2 but refuse an amount between the two. An auction was then conducted to determine the seller. The participant in the sellers' group asking for the lowest amount sold their card, receiving the second lowest asking price for it to ensure incentive compatibility.

Buyers bid in a separate auction for a different scratch card from a different bag. Subjects in the buyers' group were given £3 in cash and asked to state (by means of ticking boxes next to incremental amounts from 10p up to £3) how much of that £3 they would be willing to pay for a scratch card. Again, consistency was required so a subject who was willing to pay one amount for a card, also had to indicate that they would also pay amounts below their maximum bid. In the buyers auction, the person offering the highest amount received the card (for the second highest bid price). In the event of a tie, the tied sellers' or buyers' participant numbers were put into bag and the auction winner drawn at random.

The seller of the scratch card did not find out if it was a winning card, the sold card was returned to a bag of scratch cards and buyers who won their auction were not required to scratch the card publicly.

In this treatment sellers of scratch cards are protected from feedback conditional regret as there is no revelation of the outcome of the path forgone i.e. whether the scratch card they sold was a winning one or not will never be known to them.

The involvement felt in the process of card selection was kept to a minimum. The cards were given out quickly and randomly, so there was no reason to expect subjects in this treatment to feel that they may have had any particular control over the chance of winning from their scratch card. The design of this treatment shouldn't induce either IOC or FCR and is therefore the baseline.

Treatment 2 - IOC Only

This treatment was conducted in the same way as treatment 1 except for the procedure of allocating cards to sellers. Subjects in the sellers' group selected their own scratch card by choosing between four coloured envelopes, each containing a scratch card and were then offered the chance to sell it as in treatment 1.

Subjects were required to write down which colour envelope that had selected to make their choice as a means of adding more significance to their choice. This was to increase their feeling of involvement in the process of deciding which scratch card they would own. Participants in IOC treatments were not given their main instructions until after they had selected the card as there was the possibility of the first choice contaminating the second by some process such as the disjunction effect (e.g. Tversky and Shafir 1992)⁸. This treatment should invoke illusion of control yet give no opportunity to experience FCR.

Treatment 3 - FCR Only

⁸ The disjunction effect was described by Tversky and Shafir (1992) who asked subjects whether they would accept the following gamble: on the toss of a coin either a \$200 win or a \$100 loss. Those who accepted were asked whether they would play another round of the gamble, some were asked before the initial gamble was played out and some afterwards. They found that those who were asked after the first toss were more much likely to accept the second toss whether they had won or lost. If one's decision is the same regardless of the outcome of the first bet, then it would seem that one would make the same decision before knowing the outcome. Tversky and Shafir explained this by the winners of the first toss having nothing to lose, the losers wishing to recoup their losses and those who were asked before the first toss not having a clear enough reason to agree to a second gamble. In the experiment reported in this dissertation [chapter] the decision as to whether one would sell the card could be coloured by the fact that subjects were being asked to choose an envelope at the same time.

This treatment operated in the same way as treatment 1 except that when a seller sold his card, he was asked to cross the room to give it to the winner of the buyers' auction who then scratched it off publically. Rather than having a separate bag of cards for buyers and sellers, the winning buyer would actually receive the card belonging to a seller. This provided a clear opportunity for sellers to experience feedback conditional regret if the card he sold went on to win a prize.

Treatment 4 - IOC and FCR

This treatment combined the envelope selection process with the public revelation of the scratch card. This gives the opportunity to experience FCR as in treatment 3 and IOC as in treatment 2.

Unlike Humphrey et al, I opted to use the lottery scratch card with the highest top prize of £100,000 as opposed to the £1,000 in their experiment as it seemed this could only magnify any feelings of regret or control. The expected value of this type of scratch card is a little over 59 pence (see appendix 2 for calculations) although subjects were not informed of this or of the odds of winning each prize. They were merely given the overall odds of winning a prize as 1 in 4.9, rendering the choice more one of uncertainty than risk. They were also informed that the prizes ranged from £1 to £100,000 and the cards retail for £1.

The maximum amount offered to purchase the scratch cards was increased to £5.00 in this experiment rather than the £1.50 maximum offer in Humphrey et al. This was done with the aim of increasing the range of data. There were 8 sellers and 4 buyers in each session.

The experiment was run in a fairly open way; though decisions and outcomes were kept private, there was no specific requirement for silence. This allowed subjects' instinctive reactions to the choices to both increase the saliency of regret and not to stifle any competitive feelings which could enhance the illusion of control.

Hypotheses:

Hypothesis 1 – Illusion of Control

If Illusion of control is a factor in reluctance to part with lottery tickets, then treatment 2 will produce higher requested selling prices than treatment 1. If participants have a higher WTA in treatments where they are asked to select a scratch card from a coloured envelope than when the cards are randomly distributed without envelopes, this will be taken as evidence of illusion of control. If an effect exists, in treatment 2, it will be isolated from any FCR effects that may be present in treatments 3 and 4

Additionally comparing participants stated WTA values in with no IOC treatments (i.e. 1 and 3 with 2 and 4) will test for the influence of illusion of control.

Hypothesis 2 – Feedback Conditional Regret

In treatment 1 there is no feedback from the gamble (no foregone act resolution). If FCR plays a role in reluctance to sell, then treatment 3 should produce higher WTA values than treatment 1. If knowing that they will witness another participant scratching your card and keeping any winnings from it if you sell it makes participants more reluctant to sell, the WTA values in treatment 3 will be higher than in treatment 1. In treatment 3, this effect will be isolated from any IOC effects in treatments 2 and 4.

Comparing regret with no regret treatments (i.e. 1 and 2 with 3 and 4) will test for the presence of FCR effects.

Hypothesis 3 – Interaction Effects

There is a possibility that the combination of FCR and IOC produce a higher WTA than either effect in isolation. If regret and Illusion of control can work together or compound each other then there may be a stronger effect on WTA values than when IOC or FCR effects are produced in isolation. If this is the case, then treatment 4 will produce higher WTA values than both treatment 2 and treatment 3. The null hypothesis is therefore that there will not be a significant difference between stated

WTA values in treatment 4 when compared with both treatment 2 and treatment 3. The alternative hypothesis is that the interaction of FCR and IOC produces an effect that is greater than either IOC or FCR produces alone, causing significantly higher bids between treatment 4 and both treatments 2 and 3.

A comparison between sellers' WTAs in treatments 1 and 2 gives a measure of the size of the influence of IOC on reluctance to sell and a comparison between treatments 1 and 3, a measure of the influence of FCR. The respective strength of the influence of IOC and FCR can then be compared by analysing asking prices in treatments 2 and 3.

6.2 Experimental Procedure

288 subjects were recruited by email and by direct approach on campus. The subject pool was a mixture of UEA students from a wide range of disciplines (both undergraduates and postgraduates) and some members of staff. Participants were randomly assigned to treatments and 24 sessions were conducted in total (6 of each treatment).

Subjects were randomly assigned to numbered desks upon arrival and given written instructions according to the treatment and according to their role of buyer or seller (see appendix). Subjects in all treatments were asked to complete a consent form. There was no attempt to control for differing risk attitudes amongst subjects; participants are simply representative of the distribution of risk attitudes in the general population.

7. Results and Analysis

The raw data were transformed to generate, for each subject and each treatment, a stated valuation. Where applicable, this was the mean of the most favourable price (i.e. highest selling price or lowest buying price) that the subject had rejected and the least favourable price (i.e. lowest selling price or highest buying price) that the subject had accepted. For example, a subject who stated that they would pay £1 for a scratch card but not £1.10 would have their valuation recorded as £1.05. Similarly, a seller stating they would accept 50p for their card but not 40p would have their valuation recorded as 45p. The data on sellers' valuations are truncated because the highest selling price that subjects were asked to consider was £5 and the highest buying price that subjects were asked to consider was £3. For subjects who report that they would not sell at £5, stated valuation is defined as £5.05. For subjects who report that they would buy at £3, stated valuation is defined as £3.05. These definitions have only a small effect on mean stated valuations and no effect at all on medians, since no buyers and only a very small proportion of sellers fell into these categories.

In Table 1 below are the mean and median stated valuations of scratch cards by treatment. The buyers' WTP values are given, but they are somewhat redundant as there was no attempt to control conditions in the buyer's task so as to enable a meaningful WTA/WTP comparison to be made nor to enable the measurement of any effects via FCR or IOC.

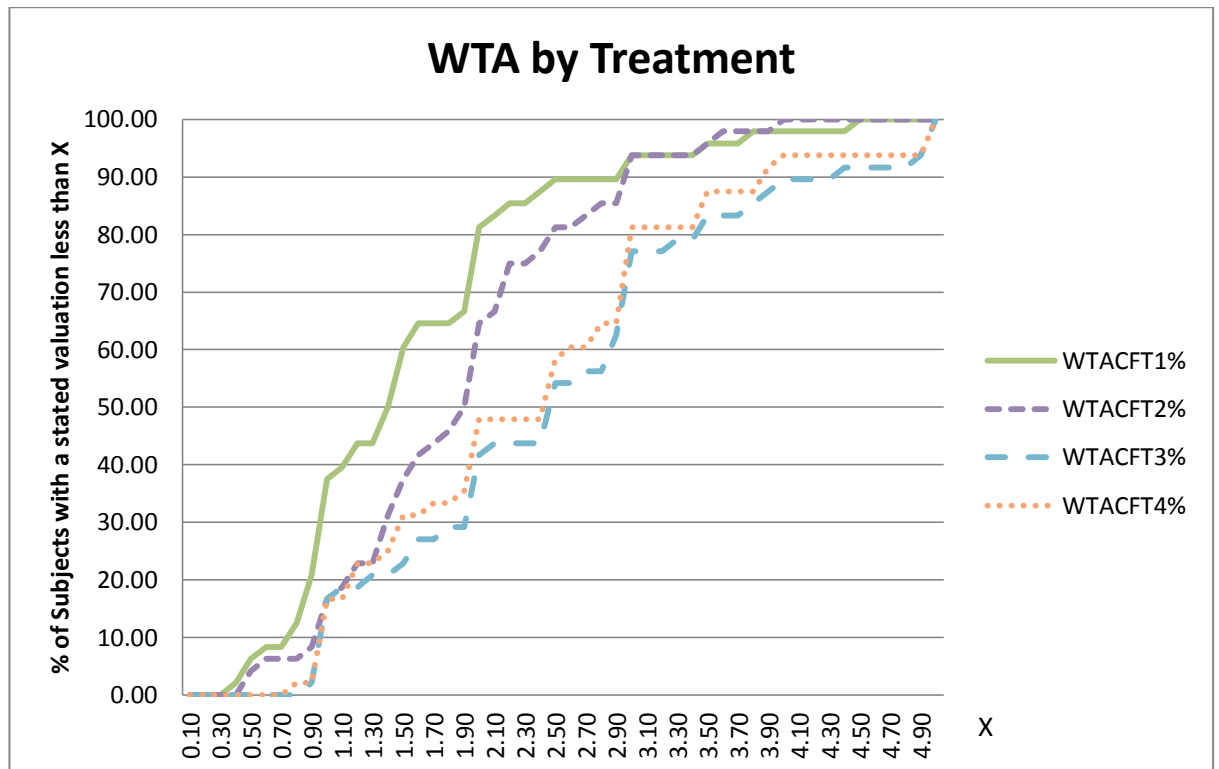
Treatment	Mean Sellers' SV	Mean Buyers' SV	Median Sellers' SV	Median Buyers' SV	Std Dev Sellers	Std Dv Buyers
1	1.54	1.49	1.4	1.55	.87	.60
2	1.86	1.41	1.9	1.15	.81	.71
3	2.49	1.38	2.45	1.05	1.18	.75
4	2.34	1.27	2.45	1.05	1.13	.63
All	2.06	1.39	1.95	1.05	1.07	0.67

Table 1: Mean and median stated valuation (SV) by treatment

Cumulative frequencies of reported valuation in each treatment are shown in Figure 1.

The bottom axis in each graph represents amounts up to £5 (fig.1) .For each amount of money, the graph shows the percentage of subjects whose reported valuation was less than that amount.

Fig.1 Cumulative frequency of reported valuation by treatment:WTA



Hypothesis 1 - Illusion of control

If the illusion of control was a factor in sellers' decisions, treatment 2 (IOC only) would be expected to have induced higher stated valuations from sellers than treatment 1 (the baseline treatment). The null hypothesis is that selecting a card from a choice of coloured envelopes makes no difference to what participants are willing to accept for the card and there is no difference between WTA in this treatment and the baseline treatment. The alternative hypothesis is that there is an illusion of control affect and WTA values are higher in treatment 3 than treatment .

Additionally an IOC effect will be shown if the two IOC treatments (2 and 4) give rise to higher WTA values than treatments (1 and 3) where no envelopes are used.

Table 1 shows some evidence of an IOC effect in that mean and median asking prices are higher in treatment 2 than in 1. Mean asking prices were 1.54 in treatment 1 and 1.86 in treatment 2; median prices were 1.4 and 1.9.

The same effect appears in the cumulative frequency data. In figure 1, sellers' stated valuations are higher in treatment 1 than 2. However, this effect does not appear to hold when treatments 3 and 4 are compared. Means are very close (2.49 in treatment 3 and 2.34 in treatment 4) and medians are identical at 2.45. This is confirmed by very similar cumulative frequency plots of the two treatments in Figure 1.

Table 2 shows results from one and two tailed Mann Whitney tests on asking prices (WTA) by treatment. Where there was no prior belief as to which treatment would produce the higher or lower WTAs, two tailed tests were used.

Asking Prices (WTA) for lottery scratch cards – Mann Whitney test results			
Treatment	Description	pvalue	Mean Ranks
T1 against T2	Noreg/No IOC against Noreg/IOC	.023*	T1 42.05
			T2 54.95
T1 against T3	Noreg/No IOC against Reg/No IOC	.000***	T1 36.59
			T3 60.41
T1 against T4	Noreg/No IOC against Reg/IOC	.000***	T1 38.01
			T4 58.99
T2 against T3†	Noreg/IOC against Reg/NoIOC	.009**	T2 41.07
			T3 55.93
T2 against T4†	Noreg/IOC against Reg/IOC	.047*	T2 42.88
			T4 54.13

T3 against T4†		.578	
	Reg/NoIOC against Reg/IOC		T3 50.07 T4 46.93
T1 and T2 against T3 and T4	No regret against regret	.000***	T12 78.78 T34 114.22
T1 and T3 against T2 and T4	No IOC against IOC	.321	T13 92.53 T24 100.47

Table 2: Mann Whitney tests on WTA

* significant at $p \leq 0.05$, ** significant at $p \leq 0.01$, significant at *** $p \leq 0.001$

† Denotes two tailed test

There was a significant difference between stated valuations in T1 and T2, but no significant difference between T3 and T4. Stated valuations in treatment 4 (Regret and IOC) are also significantly higher than those in the baseline treatment. However, a test of non-IOC against IOC treatments (i.e. 1 and 3 against 2 and 4) produced a p value of .321 so one has to conclude that although there is evidence of an IOC effect, it is not statistically significant in the experiment overall. The alternative hypothesis is only accepted on a pure test of treatment 2 against treatment 1.

Hypothesis 2 - Feedback Conditional Regret

There is more consistent evidence of a feedback conditional regret effect. In Table 1, comparing the baseline (treatment 1) with the FCR only treatment (treatment 3) produces mean valuations of 1.54 in the baseline and 2.49 in treatment 3; medians are 1.4 and 2.45 respectively.

The cumulative frequency graph also displays quite a marked difference between treatments 1 and 3. Treatments 2 and 4 (FCR only versus FCR and IOC) produced means of 1.86 and 2.34 and medians of 1.9 and 2.45.

The null hypothesis here is that there is no significant difference between WTA values in treatment 3 and treatment 1, indicating that the potential to regret selling one's card is not affecting the amount required to part with it. The alternative hypothesis is that the potential to regret is factored into decisions about how much compensation is required to part with it, producing higher WTA values in treatment 3 than treatment 1. Secondly if a FCR effect is present, there should be significant differences between treatments 1 and 2, where there should be no FCR, and treatments 3 and 4 which both contain the requirement to hand over sold cards to fellow participants for scratching.

Mann Whitney tests in Table 2 confirm a robust FCR effect with highly significant differences between treatment 1 and treatment 3 and significant difference in valuations between treatments 2 and 4. A test of non FCR against FCR treatments (treatments 1 and 2 versus 3 and 4) also produced a highly significant result. This indicates that there is a strong FCR effect that exists independently of any IOC effect.

There is strong evidence therefore that the prospect of another participant buying a seller's card and revealing if it was a winning one made the sellers' stated valuations markedly higher in regret treatments. The alternative hypothesis is accepted.

Hypothesis 3 – Interaction Effects

The data don't appear to support an interaction effect as stated valuations in treatment 4 are not higher than in both treatment 2 and treatment 3. Although there was a significant difference between treatment 4 and treatment 2, given that a regret affect appears to be present, this could be caused by the effect of FCR alone. The null hypothesis must be accepted, there is no evidence that IOC and FCR compound each other.

8. Discussion

The clearest result from the analysis of the experimental data is that there is a highly significant FCR effect. The results from Mann Whitney tests show significant differences between treatment 1 (the baseline) and treatment 3 (regret

only) and also a highly significant difference between the regret and no regret treatments. These results are consistent with the hypothesis that subjects will be more reluctant to part with a card if there is greater opportunity to experience regret.

Despite some apparent support for the existence of IOC in treatment 2 (i.e. in comparison between this treatment and treatment 1) the results do not rule out the possibility that some other phenomenon would better explain the greater reluctance to part with a card selected from a coloured envelope, especially as the result disappeared when the IOC treatments were pooled. Perhaps rather than a reflection of a belief that it has a greater chance of winning, the reluctance to sell is a reflection of the belief that subjects considered it to be more 'theirs' having gone through some kind of cognitive process to select it; a simple endowment effect. Perhaps this effect was then somehow eclipsed once regret was introduced into the decision.

Self-perception theory or the avoidance of cognitive dissonance may be applicable to the process of choosing a coloured envelope; subjects were required to make a second decision relating to the first in deciding whether to hold on to the card they had selected. It is possible therefore that the act of choosing induced, not IOC, but a need to then justify one's choice of envelope by playing out the scratch card option. That is, it is as if in choosing the card subjects had set out on a path that it was easier to continue on than get off (something like a sunk cost effect) or as if they say to themselves *I have chosen this envelope and this choice reflects on me, if I undo my choice I am saying I was wrong*. This phenomenon has been shown to persist even when decisions are imposed upon subjects and that choices viewed retrospectively may be somewhat personalised even if they were imposed or came about by a random rather than a deliberate process (e.g. Festinger and Carlsmith 1959). In this setting self-perception is hard to separate from cognitive dissonance. This could explain the higher asking prices in treatment 2, and perhaps the emotion of regret is simply stronger and overrules any fear of altering one's fate by selling a scratch card chosen so deliberately.

Considering that the objective probability of winning a prize is known it must be questioned whether there is really an irrational belief in a greater probability of winning. It might be interesting to ask subjects in each treatment to rate their confidence that they will win a prize. However, this highly subjective measure was

shown to be supportive of IOC in Langer and not supportive of IOC in Bar-Hilell and Neter so any results from such a question would have to be treated with great caution.

In treatment 4, I would perhaps have expected that the envelope choice would have amplified the regret affect via the feelings of responsibility for the selection of the card; an FCR effect in addition to the IOC effect demonstrated in treatment 2; but this was not the case. It may be the case that combining the potential for regret with IOC somehow causes IOC to lose its potency. Perhaps subjects cannot focus on the two together and so the larger effect masks the lesser one. There is evidence that there exists a counterfactual thought process that generates as much 'imaginary' regret as real (e.g. Roese 1997) as was found in the Bar-Hilell and Neter experiments where even outcomes that were unknowable had anticipated regret attached to them. This would imply that sellers in the IOC treatment (2) might in fact not be demonstrating IOC, but rather suffering from imaginary potential regret. It would be hard to identify this effect from the results here as this imagined regret could be mistaken for illusion of control, but perhaps the imagined regret disappears in treatment 4 (as it is replaced by anticipation of the real thing) and that is why the IOC result does not hold.

The debate as to what IOC consists of is not much advanced by the results reported here. This was not however the intention of the research and whether it is labelled as magical thinking or IOC is not perhaps of the greatest importance, but they may tell us something about the mechanism by which it operates as the effect was present in the treatment where regret was absent.

It is clear that there is some kind of feedback conditional regret effect present in the experiment. The experiment reported here followed on from that of Humphrey et al. though the design here aimed to make the anticipated regret even more salient. Humphrey had made it clear that is participants sold back tickets in regret treatments they would have to watch the card being scratched after the sale but the idea of crossing the room and handing over the card was to allow participants to imagine how they might feel if they sold their card and somebody else won a prize from it. Knowing that you will also be forced to witness the rejoicing of the person who benefited from your poor decision if the card turns out to be a winning one,

must make the anticipated regret stronger than if the card is merely returned to the experimenter to be scratched as it was in the previous experiments. This may be particularly strong motivation for asking for a higher price given the evidence from neuroimaging studies such as Coricelli's, supporting the theory that people imagine the regret they could feel when making decisions.

If FCR exists in real world settings outside the laboratory such as in financial markets, housing markets and in consumer behaviour then its importance is apparent. There is surely an implication for the accuracy of valuations of assets if the possibility of experiencing regret through feedback from decisions to sell increases the value we put on them. The exploitation of feedback-conditional regret is in evidence outside the laboratory such as in the Dutch postcode lottery⁹(described in Zeelenberg 1999), the UK National lottery dream number game¹⁰ and the popular television game show 'Deal or no Deal'¹¹ which are all preying on people's fear of regretting their decisions. It seems therefore that the emotional content of decisions can be accounted for and should not be ignored by economists simply because it is harder to quantify than other 'rational' elements of decision making.

⁹ This is a lottery run in Holland where postcodes are all entered in a draw for a large cash prize. Unless you pay and opt in to the draw you are not eligible to win but if your postcode is drawn you would find it impossible to hide from the information (the press or a 'helpful' neighbour would surely reveal your misfortune to you if you had not bought a ticket).

¹⁰ The game is played on the same ticket as the regular lottery. The numbers on your ticket are eligible for entry into a second game only if you pay extra and opt in to that game. It has been designed so that there is no avoiding feedback because in order to win you need to match the numbers already chosen in the first game with those drawn in the ordinary lottery draw in the same order that they appear on your ticket. Whilst checking to see if you have won in the ordinary draw you cannot help but learn if you would have won in the dream number game had you opted in to it.

¹¹ A group of twenty-two contestants play sequentially with one of the group chosen to play each week.

There are 22 sealed boxes (one for each of the group of contestants) with 22 amounts of money printed on the lid inside. Amounts range from £1 to £250,000.

The current week's contestant chooses a numbered box which they place in front of them for the duration of the game. One by one, the player eliminates amounts that his box may contain by asking for the other 21 boxes to be opened to reveal the amount of money they contain. Intermittently (say, every three boxes or so) the host of the show receives a telephone call from 'the banker' who offers to buy the players box for various sums depending on what amounts have already been eliminated from being within it (one imagines this is something like the expected value). For example if lots of high amounts of money boxes have been opened the offers will be lower than if many low amount boxes have been opened. The player clearly wishes to choose boxes containing low amounts of money therefore raising the probability that his own box contains one of the large amounts and so increasing the bankers offer. Eventually the contestant either 'deals' and sells his box or refuses to deal and opens his box to reveal the amount of money he will take home

References for Chapter 3

Allais, Maurice (1953). 'Le comportement de l'homme rationnel devant le risqué: critique des postulats et axiomes de l'école Américaine', *Econometrica* 21, 503-546.

Bandura, A (1977). 'Self-efficacy: Toward a Unifying Theory of Behavioral Change'. *Psychological Review*, 84(2), 191-215

Bar-Hillel, M. and Neter, E. (1996). 'Why are People Reluctant to Exchange Lottery Tickets?', *Journal of Personality and Social Psychology*, Vol.70, No.1, 17-27

Bell, D. E. (1982) 'Regret in decision making under uncertainty', *Operations Research*, 30, 961-981

Bell, D. E., 'Risk Premium in Decision Regret,' *Management Science*, 1983, Vol. 29(10), 1156-1166.

Benassi, V. and Presson, P. (1996). 'Illusion of Control: A Meta-Analytic Review' *Journal of Social and Economic Behaviour*, Vol.11, No.3, 493-510

Bernoulli, D. (1954). Exposition of a New Theory on the Measurement of Risk (L. Sommer, Trans.). *Econometrica*, 22, 22-36.

Bersabe, R. and Arias R. (2000), 'Superstition in Gambling' *Psychology in Spain*, Vol.4 No.1, 28-34

Chew S H, MacCrimmon, K(1979), 'Alpha-Nu Choice Theory: a Generalisation of Expected Utility Theory', *Working Paper 669, University of British Columbia*

Coricelli, G., Critchley, H., Joffily, M., O'Doherty, J P., Sirigi, A., Dolan, R J. (2005) 'Regret and its avoidance: a neuroimaging study of choice behaviour', *Nature Neuroscience*, Vol.8, No.9

Connolly, T., Ordonez, L. and Coughlan, R. (1997). 'Regret and Responsibility in the Evaluation of Decision Outcomes', *Organizational Behavior and Human Decision Processes*, Vol.70, No.1, 73-85

Connolly, T and Zeelenberg, M. (2002). 'Regret in Decision Making', *Current Directions in Psychological Science*, Vol.2, No. 6, 212-216

Coursey, D.L., Hovis, J.L. and Schulze, W.D. (1987). 'The Disparity Between Willingness to Accept and Willingness to Pay Measures of Value', *The Quarterly Journal of Economics*, Vol.102, No.3, 679-690

Dixon, M. (2000). 'Manipulating the Illusion of Control: Variations in Gambling as a Function of Perceived Control Over Chance Outcomes' *The Psychological Record*, 50, 705-719

Ellsberg, D. (1961). 'Risk, Ambiguity and the Savage Axioms', *Quarterly Journal of Economics*, 75, 643-669

Fenton-O'Creevy, M., Nicholson, N., Soane, E. and Willman, P.(2003). 'Trading on Illusions: Unrealistic Perceptions of Control and Trading Performance', *Journal of Occupational and Organisational Psychology* 76. 53-68

Festinger, L. and Carlsmith, J.M. (1959). 'Cognitive Consequences of Forced Compliance', *Journal of Abnormal and Social Psychology*, 58, 203-210.

Fong, C. and McCabe, K. (1999). 'Are Decisions Under Risk Malleable', *Economic Sciences*, Vol.96, p10927-10932

Frijda, N., Kuipers, P and ter Schure, E. (1989). 'Relations Among Emotion, Appraisal and Emotional Action Readiness', *Journal of Personality and Social Psychology*, 57, 212-228

Gilovich, T. and Medvech, V. (1994) 'The Temporal Pattern to the Experience of Regret', *Journal of Personality and Social Psychology*, 67, 357-365

Goetzmann, W. N. and N. Peles (1993). 'Cognitive dissonance and mutual fund investors,' Working paper, Yale School of Management.

Goodman, J. and Irwin, J. (2006). 'Special Random Numbers: Beyond the Illusion of Control', *Organisational Behaviour and Human Decision Processes* 99 161-174

Grether, D. M., and Plott, C. R. (1979). 'Economic theory of choice and the preference reversal phenomenon', *American Economic Review*, 69, 623-638.

Harless, D. (1992). 'Action Versus Prospects: The Effect of problem Representation on Regret', *The American Economic Review*, Vol.82, No.3,634-649

T Hayashi, 'Dynamic choice with anticipated regret', (2008) *Department of economics, University of Texas, Austin TX 78712, Unpublished manuscript.*

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

Humphrey, S., Mann, P. and Starmer, C. (2005). 'Testing for Feedback Conditional Regret Effects Using a Natural Lottery', *CeDEx Discussion Paper No. 2005-07*

Kahneman, D. (1995). 'Varieties of Counterfactual Thinking'. In N.J. Roese and J.M. Olson (Eds.), *What Might Have Been: The Social Psychology of Counterfactual Thinking* (pp.375-396). Hillsdale, NJ: Erlbaum

Kahneman, D., Knetsch, J.L., and Thaler, R.H (1990). 'Experimental Tests of the Endowment Effect and the Coase Theorem', *Journal of Political Economy*, Vol.98, No.6, 1325-48

Kahneman and Miller (1986) 'Norm Theory: Comparing reality to its Alternatives', *Psychological Review*, 80, 136-153

Kahneman, D and Tversky, A (1979). 'Prospect Theory: an analysis of decision under risk.' *Econometrica*, vol.47, pp. 263-91

Krahmer, D., Stone R., (May 2010) 'Anticipated Regret as an explanation of Uncertainty aversion', *Unpublished manuscript, Universität Bonn, Department of Economics and Hausdorff-Center for Mathematics, Adenauer Allee 24-42, 53113 Bonn, Germany*

Knetsch, J.L. (1989), 'The Endowment Effect and Evidence of Non-Reversible Indifference Curves', *The American Economic Review*, Vol.79, No.5, 1277-1284

Knetsch, J.L. and Sinden, J.A. (1984). 'Willingness to Pay and Compensation Demanded; Experimental Evidence of Unexpected Disparity in Measures of Value', *The Quarterly Journal of Economics*, Vol.99, No.3, 507-521

Koehler, J., Gibbs, B. and Hogarth, R. (1994). 'Shattering the Illusion of Control: Multi-Shot versus single-shot gambles', *Journal of Behavioral Decision Making*. 7, 183-191.

Köszegi, B (2006) 'Ego Utility, overconfidence, and task choice', *Journal of the European Economic Association*, Volume 4, Issue 4, pages 673–707.

Landman, J. (1993). 'Regret: The Persistence of the Possible', *New York: Oxford University Press*

Langer, Ellen (1975). 'The Illusion of Control', *Journal of Personality and Social Psychology*, 32, 311-28

Langer, Ellen and Roth, Jane (1975). 'Heads I Win, Tails It's chance: The Illusion of Control as a Function of the Sequence of Outcomes in a Purely Chance Task', *Journal of Personality and Social Psychology*, 32, 951-955

Larrick, R and Boles, T. (1995). 'Avoiding Regret in Decisions with Feedback: A Negotiation Example', *Organizational Behavior and Human Decision Processes* Vol.63, No.1, 87-97

Loomes, G. and Sugden, R. (1982). 'Regret Theory: An Alternative Theory of Rational Choice under Uncertainty'. *The Economic Journal*, 92, 805-824.

Loomes, G., Starmer, C and Sugden, R. (1991). 'Observing violations of transitivity by experimental methods', *Econometrica* 59, 425-439.

Loomes, G., Starmer, C and Sugden, R. (1992). 'Are preferences monotonic? A test of some implications of regret theory', *Economica* 59, 17-33.

Machina, M.J. (1982). 'Expected Utility without the Independence Axiom.', *Econometrica*, Vol. 50, 2, 277-324

Marcatto, F., & Ferrante, D. (2008). 'The regret and disappointment scale: An instrument for assessing regret and disappointment in decision making'. *Judgment and Decision Making*, 3, 87–99

Marsh, K. L., & Weary, G. (1995). 'Locus of Control'. In T. Manstead and M. Hewstone (Eds.), *The Blackwell Dictionary of Social Psychology* (p. 381). Oxford, UK: Blackwell.

Neumann, John Von and Morgenstern, Oskar (1944). 'Theory of Games and Economic Behaviour'. *Princeton, NJ. Princeton University Press*. 1944 sec.ed.

Quiggin, John (1993). 'Generalised Expected Utility Theory: The Rank-Dependent Expected Utility Model', *Dordrecht: Kluweir*

Ritov, I. and Baron, J. (1992). 'Status-Quo and Omission Biases', *Journal of Risk and Uncertainty*, 5, 49-61

Ritov, I. and Baron, J. (1995). 'Outcome Knowledge, Regret and Omission Bias', *Organizational Behaviour and Human Decision Processes*, Vol. 64, No.2, 119-127

Roese, N. J. (1997). 'Counterfactual thinking', *Psychological Bulletin*, 121, 133-148.

Roseman, I.J., Wiest, C., & Swartz, T.S. (1994). 'Phenomenology, behaviors, and goals differentiate discrete emotions', *Journal of Personality and Social Psychology*, 67, 206-211.

Samuelson, W. and Zeckhauser, R. (1988). 'Status Quo Bias in Decision Making', *Journal of Risk and Uncertainty*, 1, 7-59

Savage, L.J. (1951). 'The Theory of Statistical Decision', *Journal of the American Statistical Society*, 46, 55-67

Savage, L.J. (1954). 'The Foundations of Statistics', New York, Wiley.

Seligman, M. E. P. (1975). 'Helplessness: On Depression, Development, and Death'.
San Francisco: Freeman.

Shafir, E. and A. Tversky (1992). Thinking Through Uncertainty: Nonconsequential Reasoning and Choice, *Cognitive Psychology*, 24: 449–474.

Simonson, I. (1992). 'The Influence of Anticipating Regret and Responsibility on Purchase Decisions', *Journal of Consumer Research*, Vol.19, 105-118

Skinner B. F. (1948). "'Superstition" in the Pigeon', *Journal of Experimental Psychology*, Vol. 38, 168-272.

Sugden, R (1985), 'Regret, Recrimination and Rationality', *Theory and Decision*, 19, 77-99

Starmer, C. & Sugden, R. (1993). 'Testing for Juxtaposition and Event-Splitting Effects', *Journal of Risk and Uncertainty*, Vol. 6(3), pages 235-54.

Taylor, S.E., & Brown, J. D. (1988). 'Illusion and Well-Being – a Social Psychological Perspective on Mental-Health', *Psychological Bulletin*, 103(2), 193-210

Tversky, A. and E. Shafir (1992) 'The Disjunction Effect in Choice Under Uncertainty', *Psychological Science*, 3(5):305-309.

van de Ven N., Zeelenberg M. 2011 "**Regret aversion and the reluctance to exchange lottery tickets**", *Journal of Economic Psychology*, 32 (1) , pp. 194-200.

Wortman, C. B. (1975). 'Some Determinants of Perceived control', *Journal of Personality and Social Psychology*, 31, 282-294

Zeelenberg, M., Beattie, J., van der Pligt, J. And De Vries, N. (1996). 'Consequences of Regret Aversion: Effects of Expected Feedback on Risky Decision Making', *Organizational Behavior and Human Decision Processes*, Vol.65, No.2, 148-158

Zeelenberg, M., van Dijk, W., Manstead, A. and van der Pligt, J., (1998a) 'The Experience of Regret and Disappointment', *Cognition and Emotion*, 12 (2), 221-230

Zeelenberg, M., van Dijk, W. and Manstead, A. (1998b) . 'Reconsidering the Relationship Between Regret and Responsibility', *Organizational Behavior and Human Decision Processes*, Vol.74 No.3, 254-272

Zeelenberg, M., van Dijk, W., van der Pligt, J., Manstead, A., van Empelen, P and Reinderman D. (1998c). 'Emotional Reactions to the Outcomes of Decisions: The Role of Counterfactual Thought in the Experience of Regret and Disappointment', *Organizational Behavior and Human Decision Processes* Vol.75, No.2, 117-141

Zeelenberg, M. (1999). 'Anticipated Regret, Expected Feedback and Behavioural Decision Making', *Journal of Behavioral Decision Making*, 12, 93-106

Zhang, Y. and Fishbach, A. (2005). 'The Role of Anticipated Emotions in the Endowment Effect', *Journal of Consumer Psychology*, 15(4), 316-324

Appendix

Experimental instructions

Instructions are given below for treatments 1 and 4. Treatments 2 and 3 were variations of these including or excluding the relevant elements for regret or illusion of control.

Treatment 1 Seller Instructions– No Regret and No Illusion of Control

Date.....

Participant.....

Session.....

ST1 NR/ NIOC

INSTRUCTIONS

Welcome to the experiment. Please be assured that there are no tricks and no right or wrong decisions in this experiment, we are simply interested in how people behave.

You have been given a National Lottery scratchcard, which you will be asked to offer for sale in a moment. If you do not sell the card during the experiment, it is yours to keep.

Seven of your fellow participants have also been given a card; you are the 'cardholders'. An auction will be held shortly, during which you will have an opportunity to sell your card for one of the amounts listed in the table overleaf

.

Four of the participants in the experiment are 'cash-holders' and will hold a separate auction in which they will bid for a different scratchcard than the one sold in your auction.

Only *one* card will be sold during the cardholder auction. The person who is willing to accept the lowest price for their card will be the person who sells it, but they will receive the *second lowest* asking price. This means that whoever sells the card will always receive at least their minimum asking price.

At the end of the auction the sold card will be returned to the pot of cards without being scratched. Nobody will know if it was a winning card

Please now complete the table by ticking all of the amounts that you would be willing to sell your card for.

Because one card *must* be sold, the £5 box in the table is already filled in.

I would accept the following amounts for the scratch card

(please mark all that apply with a ✓)

£5.00	✓	£3.30		£1.60	
£4.90		£3.20		£1.50	
£4.80		£3.10		£1.40	
£4.70		£3.00		£1.30	
£4.60		£2.90		£1.20	
£4.50		£2.80		£1.10	
£4.40		£2.70		£1.00	
£4.30		£2.60		£0.90p	
£4.20		£2.50		£0.80p	
£4.10		£2.40		£0.70p	
£4.00		£2.30		£0.60p	
£3.90		£2.20		£0.50p	
£3.80		£2.10		£0.40p	
£3.70		£2.00		£0.30p	
£3.60		£1.90		£0.20p	
£3.50		£1.80		£0.10p	
£3.40		£1.70			

N.B. In the event of a tie i.e. two or more participants choosing the same minimum selling price, the seller will be chosen at random and receive the second lowest asking price.

Treatment 1 Buyer Instructions– No Regret and No Illusion of Control

Date.....

Participant.....

Session.....

BT1 NR/ NIOC

INSTRUCTIONS

Welcome to the experiment. Please be assured that there are no tricks and no right or wrong decisions in this experiment, we are simply interested in how people behave.

You have been given £3.00, which you will be asked to use to bid in an auction for a national lottery scratchcard in a moment. If you do not win the auction, the £3.00 is yours to keep. If you win the auction, you will receive the scratchcard in exchange for some or all of the £3.00 (depending on the auction price) and can keep any left over cash.

Three of your fellow participants have also been given £3.00 in cash; you are the ‘cash-holders’. An auction will be held shortly, during which you will have an opportunity to buy a scratchcard for one of the amounts listed in the table overleaf.

Eight of your fellow participants have been given a scratchcard; they are the ‘cardholders’ and will hold a completely separate auction in which they will offer to sell their cards. This is not connected to your auction.

Only *one* card will be bought during the cash-holder auction. The person who is willing to pay the highest price for a scratchcard will be the person who buys it, but they will pay the *second highest* offer price. This means that whoever buys the card will never pay more than their maximum offer price.

At the end of the auction the bought card will be given to the highest bidder.

Please now complete the table by ticking all of the amounts that you would be willing to pay for a scratchcard.

Because one card *must* be bought, the 10p box in the table is already filled in.

I would be willing to pay the following amounts for the scratchcard

(please mark all that apply with a ✓)					
£3.00		£1.90		£0.80p	
£2.90		£1.80		£0.70p	
£2.80		£1.70		£0.60p	
£2.70		£1.60		£0.50	
£2.60		£1.50		£0.40	
£2.50		£1.40		£0.30	
£2.40		£1.30		£0.20	
£2.30		£1.20		£0.10	✓
£2.20		£1.10			
£2.10		£1.00			
£2.00		£0.90p			

In the event of a tie i.e. two or more participants choosing the same maximum offer price, the buyer will be chosen at random and will pay the second lowest offer price.

Treatment 4 Seller Instructions – Regret and Illusion of Control

Date.....

Participant.....

INSTRUCTIONS

Welcome to the experiment. Please be assured that there are no tricks and no right or wrong decisions in this experiment, we are simply interested in how people behave.

You have selected a National Lottery scratchcard, which you will be asked to offer for sale in a moment. If you do not sell the card during the experiment, it is yours to keep.

Seven of your fellow participants have also chosen a card; you are the 'cardholders'. An auction will be held shortly, during which you will have an opportunity to sell your card for one of the amounts listed in the table overleaf

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Four of the participants in the experiment are 'cash-holders' and will hold a separate auction in which they will bid for the scratchcard that is sold in your auction.

Only *one* card will be sold during the cardholder auction. The person who is willing to accept the lowest price for their card will be the person who sells it, but they will receive the *second lowest* asking price. This means that whoever sells the card will always receive at least their minimum asking price.

At the end of the auction the cardholder who sells their card will be asked to cross the room and hand over the sold card to the winner of the cash-holder auction. They will then be asked, along with all other participants, to witness the card being scratched. The buyer of the card will receive any prize money from the card.

Please now complete the table by ticking all of the amounts that you would be willing to sell your card for.

Because one card *must* be sold, the £5 box in the table is already filled in.

I would accept the following amounts for the scratch card (please mark all that apply with a ✓)					
£5.00	✓	£3.30		£1.60	
£4.90		£3.20		£1.50	
£4.80		£3.10		£1.40	
£4.70		£3.00		£1.30	
£4.60		£2.90		£1.20	
£4.50		£2.80		£1.10	
£4.40		£2.70		£1.00	
£4.30		£2.60		£0.90p	
£4.20		£2.50		£0.80p	
£4.10		£2.40		£0.70p	
£4.00		£2.30		£0.60p	
£3.90		£2.20		£0.50p	
£3.80		£2.10		£0.40p	
£3.70		£2.00		£0.30p	
£3.60		£1.90		£0.20p	
£3.50		£1.80		£0.10p	
£3.40		£1.70			

N.B. In the event of a tie i.e. two or more participants choosing the same minimum selling price, the seller will be chosen at random and receive the second lowest asking price.

Date.....

Participant.....

Session.....

BT4 R/ IOC

INSTRUCTIONS

Welcome to the experiment. Please be assured that there are no tricks and no right or wrong decisions in this experiment, we are simply interested in how people behave.

You have been given £3.00, which you will be asked to use to bid in an auction for a national lottery scratchcard in a moment. If you do not win the auction, the £3.00 is yours to keep. If you win the auction, you will receive the scratchcard in exchange for some or all of the £3.00 (depending on the auction price) and can keep any left over cash.

Three of your fellow participants have also been given £3.00 in cash; you are the 'cash-holders'. An auction will be held shortly, during which you will have an opportunity to buy a scratchcard for one of the amounts listed in the table overleaf.

Eight of your fellow participants have been given a scratchcard; they are the 'cardholders' and will hold an auction in which they will offer to sell their cards.

Only *one* card will be bought during the cash-holder auction. The person who is willing to pay the highest price for a scratchcard will be the person who buys it, but they will pay the *second highest* offer price. This means that whoever buys the card will never pay more than their maximum offer price.

Although the auctions are conducted separately, the card that is sold in the cardholder auction will be the same one that is bought in the cash-holder auction.

At the end of the auctions the card that has been bought will be given to the highest bidder from your auction by the cardholder who has sold it in the other auction. The cash-holder who has bought it will be asked to scratch the card in front of the seller and all other participants.

Please now complete the table by ticking all of the amounts that you would be willing to pay for a scratchcard.

Because one card *must* be bought, the 10p box in the table is already filled in.

I would be willing to pay the following amounts for the scratchcard (please mark all that apply with a ✓)					
£3.00		£1.90		£0.80p	
£2.90		£1.80		£0.70p	
£2.80		£1.70		£0.60p	
£2.70		£1.60		£0.50	
£2.60		£1.50		£0.40	
£2.50		£1.40		£0.30	
£2.40		£1.30		£0.20	
£2.30		£1.20		£0.10	✓
£2.20		£1.10			
£2.10		£1.00			
£2.00		£0.90p			

N.B. In the event of a tie i.e. two or more participants choosing the same maximum offer price, the buyer will be chosen at random and will pay the second lowest offer price.